

A Work Project, presented as part of the requirements for the Award of a Masters Degree in Finance from the NOVA – School of Business and Economics

**IS THE BASEL III LEVERAGE RATIO COUNTERCYCLICAL? A STUDY  
FOR PORTUGUESE BANKS<sup>1</sup>**

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I dedicate this work, and my best, to my kids, Diogo and Sara.

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**Is the Basel III leverage ratio countercyclical? A study for Portuguese  
banks**

**Abstract**

This work analyses how the leverage ratio behaves through the cycle, vis-à-vis other capital ratios. For a sample of the largest Portuguese banks, the Basel III leverage ratio is indeed countercyclical. This result is relevant from a regulatory perspective, since the introduction of a limit on the leverage ratio will function as a restriction in the banks' balance sheet size, reducing the economic costs associated with the excessive growth of leverage in periods of economic expansion followed by aggressive deleveraging in the downturn. However, one cannot exclude that restrictions on banks' leverage incentivize its transference to less regulated intermediaries.

**JEL classification:** E52, C32, E44, G28

**Key words:** Banks; Leverage; Regulation; Pro-cyclicality

#### 1. Introduction

The basic concept underlying financial theory is that risk and expected return move together, which is to say, in an efficient market you can only expect more return if you take more risk.

Leverage, however, can mask the relationship between risk and return, in particular for banks, which typically hold only a relatively small portion of capital relative to assets. In fact, the banking sector has benefited from implicit public guarantees, not only regarding deposits but also against failure altogether, in particular banks that are regarded as “too big to fail”<sup>22</sup>. As a consequence of these implicit guarantees, banks have benefited from the upside of risk (return) while tax payers have borne the down side, leading to a classic moral hazard situation and an incentive for excessive risk taking (Adrian and Shin, 2008).

As a matter of fact, banks have historically operated with low levels of capital vis-à-vis assets (Admati et. al., 2013), despite being one of the most regulated industries. Furthermore, research conducted in ten European countries shows that **capital to asset ratios** have been on a long-term decline (Benink and Benston, 2005). Starting with around 30% capital in 1850-1880, the average ratio declined to about 15% in 1915-1933, 7.5% in 1945, 5-6% through 2001, and around 3% just before the financial crisis. This structural decline in capital levels has been attributed to factors such as looser

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<sup>22</sup> The term "too big to fail" is generally used in a broad sense. Clearly, being too big is a major part of the problem, but it is not all just about size. Excessive interconnectedness of financial institutions, reliance on a single or few firms for the provision of key financial infrastructure, and complexity of operations and cross-border activity are all part of what is referred to as "too big to fail". In combination, all these characteristics of a financial institution raise the impact of its failure on the financial system, and thereby give rise to the too-big-to-fail problem (Cecchetti, S., 2011).

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regulation, the increase in implicit guarantees from the government, higher cost of capital, the role played by large banks and increases in diversification<sup>3</sup>.

The financial crisis which started in 2007 and its enormous economic consequences have fuelled the discussion about the reliability of the pre-crisis regulatory framework, largely based on risk weighted capital requirements. Moreover, it should be noted that risk weights are dependent of general economic conditions and, as a consequence, are subject to cyclical fluctuations (Daníelsson 2001).

In this vein, among a large set of reforms, the Basel Committee of Banking Supervision (BCBS) is considering the introduction of a simple, risk-insensitive capital requirement, the leverage ratio (LR), which is regarded as a backstop measure to the risk weighted capital requirements and a guard against the build-up of excessive leverage, a key cause of the global financial crisis (BCBS, 2014).

Nevertheless, the leverage ratio also has its own drawbacks; most importantly, the leverage ratio is insensitive to assessments of the riskiness of different assets and used on its own can incentivize banks to arbitrage regulation by taking on riskier assets. It can also have unintended consequences in inducing a shift of activities with low measured risk to less regulated sectors (Acharya et al., 2012). Some research also suggests that bank portfolios could become more similar to one another and therefore more correlated, which could undermine financial stability, unless model risk is low or leverage requirements sufficiently high (Kiema and Jokivuolle, 2014).

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<sup>3</sup> Portfolio diversification implies a reduction of risk-weighted capital requirements, as the correlation between asset returns is usually less than one. However, it should be noted that during financial crises these correlations increase sharply and diversification gains are strongly reduced.

The present definition of the leverage ratio includes total assets; derivatives; securities financing transactions and off balance sheet items in the denominator and Tier1<sup>4</sup> capital as numerator.

The main purpose of this work is to assess whether, in the case of the Portuguese banking sector, the Basel III LR is a countercyclical capital requirement. It also assesses whether it is more countercyclical than the accounting leverage (Tier/Assets) and the risk weighted ratio (Tier1/Risk weighted assets), in the sense that it is a tighter constraint in booms and a looser constraint in recessions.

It should be noted that, for the purpose of this work, **pro-cyclicality refers to the mutually reinforcing mechanisms between the financial and real sectors of the economy which tend to amplify business cycle fluctuations and cause or exacerbate financial instability** (Financial Stability Forum, 2009). Hence, if the leverage ratio is a countercyclical capital requirement, the ratio is expected to decrease as the cycle variable increases and vice-versa.

The model detailed in section 4 compares the behaviour of different capital ratios along the business cycle. These ratios have the same numerator (Tier 1) and different denominators (risk weighted assets, total assets and the BCBS leverage exposure measure) and several cycle measures were also tested (nominal GDP, real GDP and the credit-to-GDP gap) in order to have a comparable conclusion.

Nonetheless, the extensive literature summarized in section 3 mainly focus on the relationship between banks assets and their leverage. Moreover, the leverage is usually measured as the ratio of assets over capital, excluding some components of the BCBS LR.

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<sup>4</sup> Tier 1 capital includes common equity, subordinated debt and hybrid debt, which can be converted into capital and absorb losses.

The remainder of the work is structured as follows: section 2 presents a brief overview of the regulatory framework; section 3 comprises the literature review; the model, the empirical specification and the results obtained for the larger Portuguese banks are presented in section 4. Section 5 concludes.

## 2. Regulatory framework

The objective of the regulatory capital framework is to ensure that there is sufficient capital for banks to absorb unexpected losses and continue lending in a stress (BCBS, 2010).

This framework has evolved from a simplified Basel I approach, with few risk buckets, to a Basel II, 2.5 and III, increasingly more complex and risk sensitive (Haldane and Madouros, 2012), largely based on banks' internal models<sup>5</sup>. Regardless of this increasing sophistication, banks have continued to fail and in the recent financial crisis, the amount of public support has been paramount, as well as the costs for the non-financial sectors, which have not yet fully recovered. According to Reinhart and Rogoff (2009), banking crises are associated with profound declines in output and employment<sup>6</sup>.

In the aftermath of the financial crisis that started in 2007, the regulatory reform has targeted the insufficiencies in regulation and supervision that were brought to light, since banks whose (risk weighted) capital ratios were well above minimum requirements collapsed, leading to public support or outright failure.

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<sup>5</sup> It should be noted that there was no effective international standard, since the degree of implementation of Basel II varied across jurisdictions and national supervisory authorities had a reasonable degree of discretion.

<sup>6</sup> The unemployment rate rises an average of 7 percentage points over the down phase of the cycle, which lasts on average over four years. Output falls an average of over 9 percent, although the duration of the downturn is considerably shorter than for unemployment.

Furthermore, this financial crisis also highlighted that assessing the solvability of individual institutions is not a sufficient condition to financial system stability, albeit it is an essential one. In fact, problems arising in one institution can easily spread to other institutions or to the whole system via interconnectedness or common exposures, alongside with liquidity drying in financial markets, which is the modern equivalent of a bank run (BCBS, 2010). The possibility of such occurrence is usually referred to as “systemic risk”<sup>7</sup>.

The “lessons from the crisis” include, among other very relevant conclusions, the statement that there is a strong relation between risk-weighted capital requirements and the business cycle. Since internal models reflect past realizations of default rates (PD) and losses (LGD), in “good times the estimated losses and, consequently, capital requirements tend to be low”, in particular after a period of reduced volatility (Adrian and Shin, 2010). Additionally, since severe financial crisis are relatively rare and the models incorporate only a limited number of observations past crises tend not to be reflected in estimates of future losses (short term bias)<sup>8</sup>. Moreover, there is a lag between the occurrence of facts that influence PD and LGD and the correspondent incorporation in those estimates.

The introduction of a simple, risk-insensitive capital requirement, the LR, which is not subject to the same cyclical fluctuations of risk weighted capital requirements, is regarded as a backstop measure to the latest and a guard against the build-up of excessive leverage, a key cause of the global financial crisis (BCBS, 2010).

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<sup>7</sup> Article 2- c) of Regulation (EU) 1092/2010 defines systemic risk as “*a risk of disruption in the financial system with the potential to have serious negative consequences for the internal market and the real economy*”.

<sup>8</sup> The recent reform addresses this issue by requiring through-the-cycle estimates. (Regulation EU 575/2013).

In particular, as risk weighting relies on knowable and quantifiable risks, there is a possibility that the assumptions underlying banks' risk models or the standardized approach are not satisfied in the real world. Uncertainty and the possibility of structural breaks mean that the distributions of PD and LGD might not be fully known for certain types of exposures. Dermine (2014) shows that the LR limits the risk of a bank run when there is imperfect information on the value of a bank's assets. Similarly, models are simplifications of the real world and the ways in which they are simplified may lead to mis-calibration (Danielsson 2001). In this sense, the LR can help to protect against 'unknown unknowns', the proverbial black swan in the tail of the probability distribution.

In January 2014, the BCBS published the present definition of the leverage ratio. According to this definition, the capital measure is Tier 1 and the exposure measure comprises (i) on-balance sheet assets (excluding financial derivatives and securities financing transactions (SFT)<sup>9</sup>); (ii) off-balance sheet items (OBS) weighted according to the respective probability of being converted into on-balance sheet assets; (iii) financial derivatives, including the potential future exposure and (iv) SFT, comprising the counterparty credit risk. Netting between assets and liabilities is not permitted and risk mitigants (like collateral) are disregarded.

Although this definition of the LR is not yet final<sup>10</sup> and the eventual requirement of a minimum LR will only be decided in 2017, with a view to an eventual migration to

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<sup>9</sup> SFT, usually referred to as repo-like transactions, include repos, reverse repos and securities lending.

<sup>10</sup> The Basel Committee of Banking Supervision (BCBS) published a framework for the leverage ratio in January 2014, which is deemed nearly final (BCBS, 2014). At European level, the EU Regulation 575/2013 requires a final report from the European Banking Supervision Authority (EBA) to support the European Commission final decision regarding calibration of the LR by 2016.



Pillar I requirement in 2018, the impact assessment exercise has started in 2010, with a minimum reference level of 3%.

### 3. Literature Review

Most empirical studies conclude that bank leverage is pro-cyclical regarding banks' assets, in particular for determined business models [investment banks (Adrian and Shin, 2008 and Baglioni et al., 2011) or banks especially involved in securitizations (Becalli et. al., 2014)] or large banks (Kalemli-Ozcan et. al., 2012).

The papers by Adrian and Shin (2008, 2010, 2013) study the cyclical behaviour of American banks balance sheet leverage. Their work is considered seminal and has been commonly used as a benchmark. Adrian and Shin (2008) shows that leverage (defined as assets/capital) is countercyclical for households, a-cyclical for commercial banks and pro-cyclical for investment banks.

For these investment banks, who keep mainly marked to market balance sheets, the authors conclude that the main determinant of leverage is their borrowing conditions, namely the haircuts on repo transactions. Additionally, the authors find a link between financial intermediaries' balance sheet management and the markets' perception of aggregate risk, measured by volatility<sup>11</sup>. When market asset prices rise and aggregate perception of risk is low, financing conditions are favourable and banks expand their balance sheets, mostly with recourse to very short term debt. The rate of growth of the aggregate financial sector balance sheets can be understood as the supply of aggregate liquidity; hence, the individual balance sheet management of financial intermediaries translates into credit growth (as more borrowers get credit when the banks' balance sheet expands) and credit crunches (when financial intermediaries need do reduce their

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<sup>11</sup> For which the authors use as proxy the innovations of the VIX index for the main American stocks.

balance sheet size). As a consequence, there are negative externalities from this profit seeking individual behaviour.

In Adrian and Shin (2013), the link between the value-at-risk (VaR) per unit of capital disclosed by banks and their leverage fluctuations is explored. Since VAR is determined for a given probability of failure (usually 1%), a capital stock and the underlying characteristics of assets (volatility, correlations), leverage behaviour can be mimicked assuming that financial intermediaries try to maintain this probability constant, perhaps in order to keep external ratings and creditworthiness. Hence, when volatility is low, the VaR per unit of assets (“unit VAR”) decreases and banks have “space” to grow their balance sheets. They do so by increasing their short term financing (repos, hedge funds cash management) and applications (reverse repos). It should also be noticed that the “unit VAR” can be interpreted as the required capital for banks per unit of asset, which corresponds to the medium risk weight in solvency regulation.

The “unit VaR” and stock options implied volatility are both measures of firm risk, except that, while the unit VaR is the firms’ own assessment of risk, implied volatility is the market’s assessment of equity risk. The authors refer a time lag of about 6 months between the pike in implied volatility and the pike in unit VaR during the financial crisis, given the backward-looking nature of the VaR (and risk weights) estimates. Since the supply of credit increases, riskier projects get financing. This dynamic is further enhanced by the existence of moral hazard, which arises due to limited liability -

banks' shareholders get only the upside of increasing risk taking and thus have an incentive for this behaviour<sup>12</sup>.

Baglioni et al. (2011) build on Adrian and Shin (2008) analysis, while investigating a sample of 77 major European banks (the Stoxx600 banks index) from 2000 to 2009. In Europe, the predominant type of bank is “universal”; hence the authors have distinguished “investment banks” and “commercial banks” by using the median ratio between interest income and net revenues (56%). Banks were classified as “commercial banks” if their ratio was above median. The authors conclude that (mainly) “investment banks” respond to a change in their assets value by changing leverage in the same direction, that is, leverage is pro-cyclical, which confirms Adrian and Shin (2008) results.

Becalli et. al. (2014) focus on the influence of off balance sheet items (in particular securitization) on leverage, building a measure of “effective leverage” that includes off-balance sheet securitizations, which compares with “formal” leverage (on balance sheet assets). Among other findings, the authors conclude that formal leverage underestimates effective leverage, and that not only investment banks but also commercial banks which are more involved in securitization have procyclical leverage. It should be noted that this is an approach to the present BCBS of the leverage exposure measure, since off balance sheet commitments are included in this exposure.

Galo and Thomas (2013) use a general equilibrium model to explore the relationship between bank leverage, GDP and capital and conclude that the volatility and procyclicality of leverage can be understood as the result of the interplay between collateralized bank debt, moral hazard and changes in uncertainty. Since a significant

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<sup>12</sup> Merton (1973) derives the same conclusion by using option pricing to the value of an enterprise with an underlying price equal to its debt.

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share of banks' liabilities has limited liability, banks enjoy the upside risk in their assets, leaving the institutional investors to bear downside, which is a classic moral hazard problem that induces banks to increase their debt and invest in riskier assets. In order to induce each bank to invest efficiently, investors monitor banks' leverage ratios. If the uncertainty regarding banks' assets returns increases, banks have an incentive to invest in riskier projects and investors will require a lower target leverage in order to prevent them from doing so. This deleveraging forces banks to contract their balance sheets leading to a fall in intermediated credit.

Fostel and Geanakoplos (2013) summarize several researches on the leverage cycle developed using a general equilibrium model is based in the relationship between leverage and collateral, since leverage can be obtained as the inverse of the haircut on collateral (for repo-like transactions). Volatility is a proxy for the fear of default and haircuts applied to the collateral are dependant of this perception of risk. Hence, fluctuations in volatility (like in the VIX index) can trigger adjustments in leverage. As in Adrian and Shin (2008), the conditions of credit to financial intermediaries determine their leverage. Authors conclude that the demand for collateral can origin bubbles in asset prices, which reinforce the leverage cycle, which is up when volatility is low, hence, in determined conditions, leverage can be determined endogenously.

The paper by Brei and Gambacorta (2014) is the first empirical investigation on how the new LR behaves over the cycle. The paper establishes an empirical framework to compare the cyclical properties of different capital ratios. Given this empirical specification, the authors conclude that the Basel III LR is significantly more countercyclical than the RW capital ratio: it is a tighter constraint in booms and a looser constraint in recessions. In what concerns the components included in the exposure

measure definition which determine a different sensitivity to the cycle, it concludes that off-balance sheet items (OFS), like guarantees and other elements (credit lines, acceptances and items related to securitizations), are the items that give origin to the more procyclical behaviour of the Basel III exposure measure, which is in line with Becalli et. al. (2014) and their findings regarding the inclusion of securitizations in the “effective leverage”. The authors also conclude that results are different in “normal times” as compared with the crisis period, specifically; all capital ratios tend to be less countercyclical (more procyclical) during the crisis period. This might be explained by the reduced correlation of the denominator (which includes lending) with the cycle measures associated with the recognition of crisis-related losses or banks’ need to deleverage resulting from debt-overhang.

The cyclicity of capital, on the other hand, has been less studied and appears to be a-cyclical, at least during expansions, which means that banks do not accumulate capital in “good times” (Brei and Gambacorta, 2014).

The empirical specification used in this work adapts the model used in Brei and Gambacorta (2014) to the Portuguese banking sector and assesses whether the authors’ results hold.

#### **4. Empirical Specification**

Brei and Gambacorta (201) analyses how the Basel III LR (Tier I Capital/Exposure) behaves over the cycle and it proposes a setup to test for the cyclical properties of several bank capital ratios: i) The Basel III LR (Tier I Capital/Basel III Exposure); ii) The accounting leverage ratio (Tier I Capital/Total Assets); and iii) The capital-to-risk-weighted-assets ratio (Tier 1 Capital/Risk-weighted assets). Different cycle variables

were considered, namely, (a) the annual growth rate of nominal GDP (expressed in national currency); (b) The annual growth rate of real GDP; and (c) The credit-to-GDP gap (the difference between the credit-to-GDP ratio and its trend). The empirical specification follows Ayuso et al. (2004) and can be derived from a model in which a representative bank minimizes its intertemporal costs of capital.

The dynamic panel regression, broken down by bank, is designed to test how the different capital ratios correlate to the cycle:

$$L_{it} = \alpha_i + \theta C_t + (\beta + \beta * C_t)L_{it-1} + (\chi + \chi * C_t)Y_t + (\delta + \delta * C_t)X_{it-1} + \varepsilon_{it}$$

The dependent variable,  $L_{it}$  is the capital ratio in year  $t$ , of bank  $i$ . As mentioned above three capital ratios are tested: the Basel III Leverage; the accounting leverage ratio and the capital-to-risk-weighted-assets ratio (Tier 1/Risk-weighted assets);  $\alpha_i$  is a bank-specific constant which measures time invariant fixed effects;  $C_t$  is a dummy variable that accounts for the crisis period, as well as for the beginning of the adjustment towards the new regulatory standards – in Portugal, the dummy has been attributed a value of 1 from the last quarter of 2008 until the first quarter of 2014, since the crisis was prolonged by the sovereign debt crisis. The inclusion of  $L_{it-1}$  acknowledges the persistence in capital ratios, that is to say, the existence of short term adjustment costs.  $Y_t$  is the cycle explanatory variable.

As stated above, three cycle variables are being considered, namely, the annual growth rate of nominal GDP (expressed in national currency); the annual growth rate of real GDP; and the credit-to-GDP gap. The first two are business cycle measures, while the last one is a financial cycle proxy.

$X_{it-1}$  is a vector of bank-specific control variables, which are typically used in studies that explain banks' choice of target capital ratios: bank size ( $S_{it-1}$ ) is measured

by the log of total assets; bank's provisions over loans ( $P_{it-1}$ ) measure the relative riskiness of the bank and the return on assets ( $ROA_{it-1}$ ) measures the direct cost of remunerating capital.

Hence, if the leverage ratio is a countercyclical capital requirement the results will yield a negative value for  $\chi$ . As a consequence, when the nominal GDP has positive growth rates, the leverage ratio will decrease and may become binding, thus requiring the bank to decrease its leverage exposure or increase its capital.

Additionally, if it is the more countercyclical of the capital ratios being tested,  $\chi_{\text{Tier1/Leverage Exposure}} < \chi_{\text{Tier1/Total Assets}} < \chi_{\text{Tier1/RWA}}$ , which means that the leverage ratio is more sensible to the cycle, thus being the first capital requirements to signal the need for corrective action from the bank. In this sense, it would be the a tighter constraint in booms and a looser constraint in recessions

Finally, the effect of the crisis and innovation in banks' regulation is also tested (by testing the statistical significance of  $\chi^*0$ ).

One possible identification problem is endogeneity, originated either from misspecification of the model (omitted variables) or from simultaneity among variables, since the state of the banking sector could also affect the business cycle and the credit cycle.

To minor the first effect, the estimator that is used – the dynamic System Generalized Method of Moments (S-GMM), is intended to reduce endogeneity bias and takes into account the heterogeneity in the data caused by unobservable factors affecting individual banks. Hence, the estimator comprises a two-steps approach using the model in first-differences in step #1.

In order to address the second question, different lags of the endogenous variables are also used, since instrumental bank-specific characteristics are lagged by one year in order to mitigate the possible endogeneity problem.

#### 4.1. Data

For the estimation of the empirical model, quarterly supervisory bank level data for Tier 1 capital, total assets, risk weighted assets, financial derivatives, securities financing transactions; off balance sheet items (guarantees and commitments), profits, total credit and provisions were used. When quarterly data is not available, linear interpolation of annual or semi-annual data was used. Observations cover the period from 2000Q4 to 2014Q1. The cut-off dates correspond to the availability of consistent data in the beginning of the period and the choice of 2014Q1 precludes including the data break associated with the resolution measured applied to Banco Espírito Santo, SA in August 2014. The exact availability of data is disclosed in Annex II, as well as the methodology used to estimate the exposure measure of the LR.

Quarterly nominal and real GDP data are from the National Statistics Institute (INE) and the series used refer to ESA 1995 methodology. The credit-to-GDP gap was obtained from internal estimates of the Banco de Portugal<sup>13</sup>.

The sample includes the largest banking groups operating in Portugal, either regarding total assets or credit provisioning to the economy, namely, Caixa Geral de Depósitos (CGD); Banco BPI (BPI); Banco Comercial Português (BCP); Banco

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<sup>13</sup> The 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. The credit aggregate referred here is “credit to private non-financial sectors”. 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).



Espírito Santo (ES); Banco Santander Totta (BST) e Caixa Económica Montepio Geral (CEMG). Despite its relevance to the Portuguese banking sector, Banco Internacional do Funchal (BANIF) was excluded from the sample, due to extreme variations in capital ratios that could not be attributable to cyclical effects.

Table 1 presents a summary characterization of the main variables, namely, capital ratios and business cycle measures. It can be observed that nominal and real GDP growth rates during the crisis period were negative (-0.002;-0.003), while all the capital ratios present a higher average during this period. It should also be noted that the credit gap depicts a negative mean during the crisis, revealing the tightening of credit supply to the economy.

**Table 1 – Data summary**

Variable	Mean	Std. dev	Min	Max	Variable	Mean	Std. dev	Min	Max
<b>Capital Ratios</b>					<b>Cycle Variables</b>				
Tier 1/Leverage exposure	0.053	0.011	0.030	0.082	Nominal GDP growth	0.005	0.010	-0.022	0.026
Tier 1/Leverage exposure - Crisis	0,059	0,010	0,039	0,082	Nominal GDP growth – crisis	- 0,002	0,011	- 0,022	0,014
Tier1/ Total Assets	0.056	0.011	0.034	0.086	Real GDP growth	-0.000	0.008	-0.024	0.147
Tier1/ Total Assets – Crisis	0,064	0,010	0,044	0,086	Real GDP growth – crisis	- 0,003	0,009	- 0,024	0,011
Tier 1/Risk weighted assets	0.086	0.021	0.050	0.162	Credit Gap (in differences)	0,001	1,763	- 3,583	4,299
Tier 1/Risk weighted assets - Crisis	0,102	0,020	0,065	0,162	Credit Gap (in differences) - crisis	- 0.248	1,748	- 3,583	3,747

#### 4.2. The cyclicity of capital ratios

The **baseline results** were derived from equation 1 for the different capital ratios considered and the diverse economic cycle measures and the crisis dummy. Results for the baseline regression using the nominal GDP growth rate are presented in table 2, for

the other cycle measures outcomes are presented in annex I. Additionally, the t-test on the difference in the mean between Tier/Exposure measure and Tier1/Total assets indicates that the two capital measures are statistically different (the results for the t-test are also presented in annex 1).

**Table 2 – Baseline Results**

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure (LR)		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,8784***	0,0213	0,8664***	0,0223	0,9107***	0,0183
<b>L (t-1)*C</b>	+	0,8399***	0,0402	0,8330***	0,0408	0,9010***	0,0313
<b>Y (t) = Nominal GDP growth</b>	-	<b>-0,0322**</b>	0,0190	-0,0308	0,0205	<b>-0,0726***</b>	0,0308
<b>Y (t)*C</b>	-	-0,0484*	0,0296	-0,0489	0,0311	-0,0676	0,0527
<b>C</b>		0,0017***	0,0004	0,0020***	0,0005	0,0033***	0,0008
<b>Constant</b>		0,0061***	0,0010	0,0072***	0,0012	0,0075***	0,0014

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

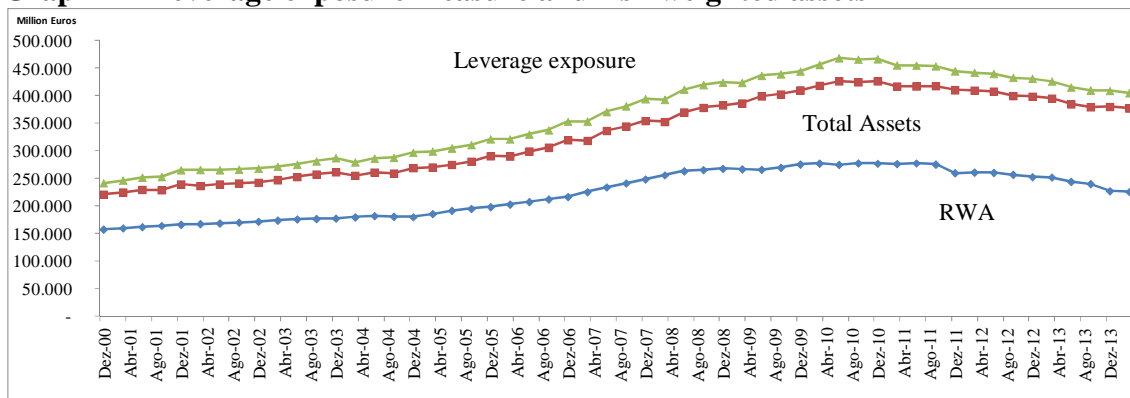
By the observation of the table above, one can conclude that:

- (i) **The LR varies in opposite relation with nominal GDP** ( $\chi_{\text{Tier1/Exp}} < 0$ ), while this is not the case when considering the ratio Tier 1/Total Assets.
- (ii) During the **crisis period**, only the leverage ratio coefficient is statistically different from zero and negative, indicating that the ratio is countercyclical ( $\chi_{\text{Tier1/Exp}} < 0$ ).
- (iii) Regarding the complete sample, the risk-weighted capital ratio is also countercyclical ( $\chi_{\text{Tier1/RWA}} < 0$ ). and the associated coefficient is statistically significant. Additionally, the absolute value of the coefficient for the cycle variable (GDP nominal growth) is higher for this capital ratio than for the LR (-0.07 versus -0.03), which is to say,  $\chi_{\text{Tier1/Leverage Exposure}} > \chi_{\text{Tier1/RWA}}$ .

This result can be explained by the fact that risk-weighted capital requirements are subject of regulatory constraints, which increased during the crisis (hence, TIER 1/RWA increased while nominal GDP presented negative growth rates) leading to a countercyclical behaviour. This is a classical case for the Lucas critique, since we are observing a variable which is subject to policy restrictions. By contrast, the LR was not subject to restrictions or close monitoring.

Additionally, Portuguese banks have changed their balance sheet composition, moving away from assets with non-zero risk weights towards sovereign debt (with an associated zero risk weight). Hence, leverage exposure growth has been more pronounced than risk weighted assets increase, as can be observed in graph 1. Once again, this was possible because leverage is not regulated and, furthermore, no bank in the sample would fail the 3% threshold which has been tested in Basel II quantitative impact assessment (as is depicted in table 1).

**Graph 1 – Leverage exposure measure and risk weighted assets**



(iv) All the capital ratios are time persistent. As a matter of fact, 0.87 of the LR in a given period can be explained by its value in the previous quarter. The coefficient for the risk weighted capital ratio is even higher (0.91).

(v) It should also be noticed that the coefficients for the crisis dummy are always statistically different from zero and positive. This can be explained by increased capital requirements during the post-2008 period, which translate in a 0.002 coefficient for the LR and a 0.004 coefficient for the RWA ratio.

(vi) Coefficients for the real GDP growth as cycle measure are not statistically different from zero for all the capital ratios and the coefficients for the credit gap are all very close to zero. These results are presented in annex I.

As can be observed in table 3, the inclusion of bank specific characteristics does not change the main conclusions presented above. This can be interpreted as a similitude between the business models of the several banks in the sample, which indeed are all universal banks, despite differences in the total share of the market and even in risk taking and balance sheet composition.

It should also be highlighted that the size coefficient is not statistically different from zero for the complete sample, hence one can assume that the “too big too fail” subsidy is independent of the bank size or that it is not relevant. On the other hand, in the crisis period this coefficient becomes statistically significant for all the business cycle measures, perhaps due to greater scrutiny and requirements by the supervisor concerning larger banks, which were also recapitalized, either with public (BCP, CGD and BPI) or private capital (ES). Additionally, it can be argued out that the implicit public subsidies are bigger during crises, when the likelihood of failure increases.

When using the real GDP growth as the cycle variable coefficients for the cycle measure are still not statistically significant but coefficients associated with bank specific characteristics are all statistically different from zero and positive.

**Table 3 – Controlling for bank specific characteristics**

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. Err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,8652***	0,0237	0,8479***	0,0248	0,8926***	0,0208
<b>L (t-1)*C</b>	+	0,7757***	0,0512	0,7394***	0,0551	0,8641***	0,0411
<b>Y (t) = Nominal GDP growth</b>	-	<b>-0,0327*</b>	0,0190	-0,0288	0,0205	<b>-0,0718**</b>	0,0309
<b>Y (t)*C</b>	-	-0,0427	0,0294	-0,0362	0,0309	-0,0577	0,0533
<b>C</b>		0,0015**	0,0005	0,0016***	0,0006	0,0036***	0,0009
<b>Size (t-1)</b>		0,0008	0,0005	0,0013	0,0006	-0,0007	0,0009
<b>Size (t-1)*C</b>		0,4668***	0,1915	0,1167***	0,0360	0,1036*	0,0605
<b>ROA(t-1)</b>		0,2673**	0,1208	0,2996	0,1303	-0,0074	0,1904
<b>ROA(t-1)*C</b>		0,0831***	0,0323	0,0012	0,0012	0,0017	0,0021
<b>%Prov. (t-1)</b>		0,0340**	0,0161	0,0439***	0,0177	0,0384	0,0269
<b>%Prov. (t-1)*C</b>		0,0049	0,0131	-0,0004	0,0137	-0,0069	0,0238
<b>Constant</b>		-0,0027	0,0059	-0,0070	0,0062	0,0150	0,0099

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

### 4.3. The cyclicity of the components of the capital ratios

A capital ratio can change by altering either the numerator or the denominator, hence it is relevant to analyse separately the cyclical behaviour of the numerator (Tier 1) and the denominators (leverage exposure, total assets and risk weighted assets). The specification of the model is the same as the one in section 4.1, with minor adaptations. Since the logarithmic transformation did not yield stationary variables, differences were used in order to avoid spurious regressions, corresponding to these variables growth rates.

Table 4 depicts the results for the baseline regression. It can be observed that Tier1 coefficients depict a negative sign, leading to the conclusion that capital is countercyclical, including in the crisis period, when more demanding regulatory requirements were imposed. However, it should be stressed that the ongoing regulatory

reform addresses this undesirable effect by imposing a countercyclical capital buffer, which is constituted in the upswing and can be depleted during downturns<sup>14</sup>.

Results for the leverage exposure and total assets are statistically significant for the crisis period, during which they show a countercyclical pattern, while when considering the complete sample period, the sign of the corresponding coefficients signal procyclical behaviour. Risk weighted assets are significantly procyclical when considering the entire sample period, but countercyclical during the crisis.

Table 4 – Cyclicity of the components of the capital ratios

Dependent variable L (t)	Tier 1 (growth)		Leverage Exposure (growth)		Total Assets (growth)		Risk Weighted Assets (growth)	
	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	0,9831***	0,0087	0,9895***	0,0055	0,9933***	0,0058	1,0071***	0,0038
L (t-1)*C	0,9834***	0,0178	0,0552***	0,0048	0,0480***	0,0040	0,0670***	0,0059
Y (t) = Nominal GDP growth	-0,9433***	0,3197	0,1439	0,1731	0,1628	0,1799	0,3832***	0,1234
Y (t)*C	-1,0157**	0,5187	-1,6865***	0,4602	-0,7553**	0,3718	-0,3004	0,5142
C	-0,0068	0,0086	0,1852	0,0511	-0,0084**	0,0042	-0,0245***	0,0027
Constant	0,1524**	0,0641	0,0000	0,0000	0,0849	0,0605	-0,0555	0,0383

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Using the credit gap as the cycle variable yields differentiated results, since all components are pro-cyclical and the coefficients are statistically significant.

#### 4.4. The cyclicity of the leverage exposure components

Since the leverage ratio exposure measure builds on total balance sheet assets, while including additional components that increase the risk of eventual excessive leverage, namely, the potential future exposure of derivative contracts, the counterparty credit risk of securities financing transactions (SFT) and the conversion of off-balance sheet items

<sup>14</sup> BCBS (2010)

(OBS), guarantees and commitments, into on balance sheet components it is relevant to consider each one specific contribution to the cyclicity of the exposure measure (and the leverage ratio). The results of an econometric specification analogous to the one presented in section 4.3 are presented in table 5.

It can be observed that the only component that exhibits a procyclical pattern is OBS, which is positive and statistically different from zero. This component also shows a countercyclical behaviour during the crisis, perhaps due to the conversion of banks' commitments and guarantees or to more risk aversion from the banks when entering into these operations.

The derivatives and SFT components do not present statistically significant coefficients.

Table 5 – Cyclicity of the components of the leverage exposure

Dependent variable L (t)	Derivatives (growth) $\llcorner$		SFT (growth)		OBS (growth)	
	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	0,9845***	0,0145	0,7489***	0,0685	0,9427***	0,0118
L (t-1)*C	1,0444***	0,0237	0,6572***	0,0737	0,3712***	0,0319
Y (t) = Nominal GDP growth	-2,6729	3,7162	8,9063	8,5639	1,2628*	0,7472
Y (t)*C	1,0387	5,5350	9,1697	7,9137	-0,9226	2,4175
C	-0,1979**	0,0858	-0,3446	0,6191	5,0400**	0,2488
Constant	0,1776**	0,0842	1,3905**	0,7153	0,0000***	0,0000

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Since this work follows the study conducted in Brei and Gambacorta (2014), results can be compared with this benchmark. Several aspects can be pointed out:

- (i) In both studies, capital ratios present a high degree of time persistency, which can be explained by adjustment costs, in particular when issuing additional capital.
- (ii) In both studies, the Basel II leverage ratio is countercyclical, as well as the accounting leverage ratio and the risk weighted assets ratio. Nonetheless, in the

Portuguese case the LR is not more countercyclical than the risk weighted assets ratio. This result may be explained by the particular adjustment process that the Portuguese banking system undertook in recent years, as well as by historically low risk weighted capital ratios and relatively high average risk weights.

(iii) In both studies, the leverage exposure and total assets are counter-cyclical during the crisis period. On the other hand, Tier 1 is pro-cyclical in Grei and Gambacort (2014), while countercyclical for the Portuguese banking sector. This result can be explained by the capitalisation effort that has been undertaken in recent years, during which product growth was sluggish (in Portugal).

(iv) In both studies, off balance sheet items are the most pro-cyclical component of the Basel III leverage ratio exposure.

## **5. Conclusions**

In an increasingly complex model of regulation, the leverage ratio is on the way of being introduced as a backstop measure to risk weighted capital ratios. At the present, some jurisdictions like Canada, United States Switzerland and the UK have already introduced a leverage restriction or recommendation via national legislation.

At international level, the BCBS is currently assessing the impact of introducing a 3% minimum requirement, while at EU level the European Commission is expected to deliver a report on the calibration of a possible binding Pillar I requirement by 2018.

Hence, the subject merits being studied, as it will condition the future behaviour of bank managers.

The major part of the literature deals with cyclicity of bank leverage rather than the leverage ratio. The key aspect in this regard is that, by the findings in the literature,



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bank leverage appears to behave cyclically because banks' assets and liabilities management decisions are mainly driven risk-adjusted regulatory capital adequacy requirements. When banks try to maintain a constant volume of risk-weighted assets through the cycle, bank leverage will vary with the cycle. In this context, a regulatory leverage ratio requirement may limit cyclicity of bank leverage.

Brei and Gambacorta (2014), is the first empirical experiment that assesses the behaviour of the leverage ratio over the economic cycle. Portugal is not included in the authors' sample; nevertheless, if the requirement is imposed by European regulation, Portuguese banks will also be subject to it.

This work, in line with Brei and Gambacorta (2014), concludes that the leverage ratio is countercyclical. On the other hand, the results of this study do not convey that it is a tighter constraint in booms and a looser constraint in recessions than the risk weighted capital ratio.

This can be explained by the adjustment process undertaken by the Portuguese banks, by their characteristic of universal banks or by the fact that the banks considered in the sample were not subject to a leverage restriction, but were subject to a risk weighted assets requirement. In this regard the Lucas critique applies concerning the comparison of a risk weighted ratio and the leverage ratio when the first was subject to a restriction.

#### References

- Acharya, V., Mehran, H., Shuermann, T. and Thakor, A. (2012): Robust capital regulation, CEPR Discussion papers 8792.
- Admati, A. R., Demarzo, P. M., Hellwig, M. F., & Pfleiderer, P. (2011). Fallacies , Irrelevant Facts , and Myths in the Discussion of Capital Regulation : Why Bank Equity is Not Expensive. *Preprints of the Max Planck Institute for Research on Collective Goods Bonn 2010/42*.
- Adrian, T., & Shin, H. S. (2010). Liquidity and leverage. *Journal of Financial Intermediation*, 19(3), 418–437.
- Adrian, T., & Shin, H. S.. (2010), The Changing Nature of Financial Intermediation and the Financial Crisis of 2007-09. Federal Reserve Bank of New York Staff Reports (March).
- Adrian, T., & Shin, H. S. (2014). Procyclical leverage and value-at-risk. *Review of Financial Studies*, 27(2), 373–403.
- Aikman, D., Galesic, M., Gigerenzer, G., Kapadia, S., Katsikopoulos, K. V, Kothiyal, A., ... Neumann, T. (2014). Taking uncertainty seriously: simplicity versus complexity in financial regulation. *Bank of England Financial Stability Paper*, (28).
- Ayuso, J., Pérez, D., & Saurina, J. (2004). Are capital buffers pro-cyclical? Evidence from Spanish panel data. *Journal of Financial Intermediation*, 13(2), 249–264.
- Baglioni, a., Beccalli, E., Boitani, a., & Monticini, a. (2013). Is the leverage of European banks procyclical? *Empirical Economics*, 45(3), 1251–1266.
- Banca D'Italia, Financial sector pro-cyclicality (2009), *Occasional papers, Questioni di Economi e Finanza, number 44*.
- Beccalli, E., Boitani, A., & Di Giuliantonio, S. (2014). Leverage pro-cyclicality and securitization in US banking. *Journal of Financial Intermediation*.
- Brei, M., & Gambacorta, L. (2014). The leverage ratio over the cycle, (471). *BIS Working Papers*, No 471 (November).
- Cecchetti, S. (2011). How to cope with the too-big-to-fail problem? *10th Annual Conference of the International Association of Deposit Insurers, "Beyond the Crisis: The Need for a Strengthened Financial Stability Framework"*, Warsaw, Poland, 19 October 2011.
- Committee, B. (2014). Basel Committee on Banking Supervision, Basel III leverage ratio framework and, (January).

- Committee, B. (2010). Basel Committee on Banking Supervision, Basel III: A global regulatory framework for more resilient banks and banking systems
- Drehmann, M. (2013). Total credit as an early warning indicator for systemic banking crises, Basel Committee on Banking Supervision, *BIS Quarterly Review*, June 2013.
- Financial Stability Forum (2009). Report of the Financial Stability Forum on Addressing Procyclicality in the Financial System.
- Fostel, A., & Geanakoplos, J. D. (2013). Reviewing the Leverage Cycle. *Annual Review of Economics*.
- Galo, N.&Thomas, C. (2013). Bank Leverage Cycles, *Banco de Espana*, Working Paper No. 1222.
- Haldane, A. G., & Madouros, V. (2012). The dog and the frisbee. *Federal Reserve Bank of Kansas City's 36th Economic Policy Symposium*, 1–36.
- Harald Benink and George Benston, “The Future of Banking Regulation in Developed Countries: Lessons from and for Europe,” *Financial Markets, Institutions and Instruments* 14, no. 5 (2005): 289–327.
- Kalemli-Ozcan, S., Sorensen, B., & Yesiltas, S. (2012). Leverage across firms, banks, and countries. *Journal of International Economics*, 88(2), 284–298.
- Kierma, I. and Jokivuole, E. (2014). Does a leverage ratio requirement increase bank stability?. *Journal of Banking and Finance* 02/2014, 39, pages 240-254.
- Merton, R., Theory of Rational Option Pricing. *The Bell Journal of Economics and Management Science*, Vol. 4, No. 1 (Spring, 1973), pp. 141-183.
- Regulation (EU) 1092/2010 of the European Parliament and of the Council (24 November 2010), on European Union macro-prudential oversight of the financial system and establishing a European Systemic Risk Board.
- Regulation (Eu) No 575/2013 of The European Parliament and of The Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012.
- Reinhart, C. M., & Rogoff, K. S. (2009). The Aftermath Of Financial Crises. *National Bureau of Economic Research (NBER)*, Working paper series, No. 14656.

**ANNEX I: Results for alternative measures of the cycle variable**

Table 1a) Baseline regression/Cycle variable = Real GDP growth

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,8744***	0,0212	0,8627***	0,0222	0,9062***	0,0183
<b>L (t-1)*C</b>	+	0,8308***	0,0401	0,8238***	0,0407	0,8963***	0,0314
<b>Y (t) = Real GDP growth</b>	-	-0,0085	0,0203	-0,0107	0,0220	-0,0335	0,0332
<b>Y (t)*C</b>	-	-0,0229	0,0357	-0,0239	0,0374	0,0188	0,7654
<b>C</b>		0,0020***	0,0004	0,0023	0,0004	0,0040***	0,0007
<b>Constant</b>		0,0060***	0,0010	0,0071	0,0012	0,0072***	0,0014

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 1b) Baseline regression/Cycle variable = Credit Gap

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,8753***	0,0212	0,8643***	0,0222	0,9065***	0,0183
<b>L (t-1)*C</b>	+	0,8128***	0,0460	0,7964***	0,0483	0,8483***	0,0412
<b>Y (t) = Credit Gap</b>	-	0,0000	0,0000	0,0000*	0,0000	0,0000	0,0000
<b>Y (t)*C</b>	-	-0,0001	0,0001	-0,0001	0,0001	-0,0003*	0,0002
<b>C</b>		0,0012**	0,0007	0,0014**	0,0007	0,0032***	0,0011
<b>Constant</b>		0,0020	0,0027	0,0026	0,0029	0,0026	0,0043

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 2a) Controlling for bank specific characteristics/Cycle variable = Real GDP growth

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	+	0,8609***	0,0236	0,8441***	0,0247	0,8878***	0,0209
L (t-1)*C	+	0,7250***	0,0542	0,2343***	0,0192	0,8549***	0,0408
Y (t) = Real GDP growth	-	-0,0109	0,0204	-0,0123	0,0220	-0,0292	0,0332
Y (t)*C	-	-0,0080	0,0368	0,0215	0,0225	0,0339	0,0631
C		0,0018***	0,0005	0,0019***	0,0005	0,0042***	0,0009
Size (t-1)		0,0008	0,0005	0,0013**	0,0006	-0,0006	0,0009
Size (t-1)*C		0,5751***	0,2009	0,0033***	0,0001	0,3625	0,3401
ROA(t-1)		0,2596**	0,1213	0,2939**	0,1309	-0,0227	0,1922
ROA(t-1)*C		0,1231***	0,0359	1,0537***	0,1300	0,1153*	0,0607
%Prov. (t-1)		0,0349**	0,0162	0,0449***	0,0177	0,0403	0,0272
%Prov. (t-1)*C		0,0012	0,0012	0,3438*	0,0211	0,0017***	0,0021
Constant		-0,0031	0,0059	-0,0076	0,0062	0,0131	0,0099

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 2b) Controlling for bank specific characteristics/Cycle variable = Credit Gap

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	+	0,8495***	0,0239	0,8349***	0,0249	0,8782***	0,0208
L (t-1)*C	+	0,7640***	0,0506	0,7279***	0,0539	0,8399***	0,0441
Y (t) = Credit Gap	-	0,0000**	0,0000	0,0000*	0,0000	0,0001***	0,0000
Y (t)*C	-	0,0001***	0,0001	0,0001	0,0001	-0,0002	0,0002
C		0,0007***	0,0007	0,0008	0,0008	0,0023**	0,0012

Dependent variable L (t)	Expected Sign	Tier 1/Leverage Exposure		Tier 1/Total Assets		Tier 1/RWA	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
Size (t-1)		0,0003	0,0006	0,0009	0,0006	-0,0014	0,0010
Size (t-1)*C		0,4675***	0,1922	0,5892***	0,2012	0,3614	0,3390
ROA(t-1)		0,2412**	0,1199	0,2775**	0,1295	-0,0535	0,1901
ROA(t-1)*C		0,1204***	0,0431	0,1618***	0,0467	0,0743	0,0727
%Prov. (t-1)		0,0481**	0,0172	0,0583***	0,0189	0,0640**	0,0284
%Prov. (t-1)*C		0,0006	0,0011	0,0012	0,0012	0,0014	0,0021
Constant		-0,0041	0,0059	-0,0086	0,0062	0,0108	0,0099

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 3a) Cyclicity of the components of the capital ratios /Cycle variable = Real GDP growth

Dependent variable L (t)	Tier 1 (growth)		Leverage Exposure (growth)		Total Assets (growth)		Risk Weighted Assets (growth)	
	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	0,9634***	0,0123	0,9794***	0,0079	0,9788***	0,0083	1,0006***	0,0059
L (t-1)*C	0,9795***	0,0180	0,0539***	0,0047	0,0467***	0,0039	0,0551***	0,0049
Y (t) = Real GDP growth	-0,3889	0,3510	0,0632	0,1830	0,0803	0,1903	0,3903***	0,1278
Y (t)*C	-0,5071	0,6375	-1,9132*	0,5359	-1,1488*	0,4381	-2,3243***	0,5379
C	0,0020	0,0081	-0,0099***	0,0037	-0,0095**	0,0039	-0,0261***	0,0025
Constant	0,1485**	0,0648	0,1292**	0,0575	0,0887	0,0604	-0,0466	0,0385

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 3b) Cyclicity of the components of the capital ratios /Cycle variable = Credit Gap

Dependent variable L (t)	Tier 1 (growth)		Leverage Exposure (growth)		Total Assets (growth)		Risk Weighted Assets (growth)	
	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
L (t-1)	0,9301***	0,0142	0,9581***	0,0099	0,9596***	0,0104	0,9816***	0,0077
L (t-1)*C	0,9863***	0,0184	0,1234**	0,0156	0,1268***	0,0150	0,1757***	0,0158
Y (t) = Credit Gap	0,0019***	0,0004	0,0009***	0,0003	0,0008***	0,0003	0,0007***	0,0002

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Dependent variable L (t)	Tier 1 (growth)		Leverage Exposure (growth)		Total Assets (growth)		Risk Weighted Assets (growth)	
	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>Y (t)*C</b>	0,0022***	0,0013	0,0639***	0,0010	0,0639***	0,0010	0,0637***	0,0011
<b>C</b>	-0,0238**	0,0106	-0,0262***	0,0055	-0,0253***	0,0057	-0,0430***	0,0039
<b>Constant</b>	0,0752	0,0671	0,1701***	0,0582	0,1309**	0,0612	-0,0159	0,0392

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 4a) Cyclicity of the components of the leverage exposure/Cycle variable = Real GDP growth

Dependent variable L (t)	Expected Sign	Derivatives (growth)		SFT (growth)		Off-Balance Sheet Items (growth)	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,9307***	0,0237	0,5738***	0,0808	0,9337***	0,0152
<b>L (t-1)*C</b>	+	1,0443***	0,0237	0,6211***	0,0720	0,3263***	0,0270
<b>Y (t) = Real GDP growth</b>	+	-0,5781	4,3938	-0,6044	10,1702	1,8183	0,8105
<b>Y (t)*C</b>	+	2,9027	6,9578	5,4852	11,3075	-0,6236	2,5268
<b>C</b>		-0,0147	0,1062	0,1414	0,5878	0,0197	0,0165
<b>Constant</b>		0,0876	0,2183	3,2089***	0,9444	0,5011***	0,1040

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

Table 4b) Cyclicity of the components of the leverage exposure/Cycle variable = Credit Gap

Dependent variable L (t)	Expected Sign	Derivatives (growth)		SFT (growth)		Off-Balance Sheet Items (growth)	
		Coeff.	Std. err	Coeff.	Std. err	Coeff.	Std. err
<b>L (t-1)</b>	+	0,9349***	0,0237	0,5447***	0,0799	0,9309***	0,0153
<b>L (t-1)*C</b>	+	1,0532***	0,0281	0,4649***	0,0895	0,3944***	0,0341
<b>Y (t) = Credit Gap</b>	+	0,0209***	0,0081	0,0466*	0,0257	0,0007	0,0009
<b>Y (t)*C</b>	+	0,0043	0,0028	0,0355***	0,0054	0,0381***	0,0018
<b>C</b>		-0,4394**	0,1953	-0,3794	0,6440	-0,0086	0,0296
<b>Constant</b>		-2,8549***	1,1509	-3,1288	3,6159	0,4001***	0,1487

All estimations are based on the Arellano and Bover (1995) system GMM estimator. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level. Bank fixed effects are not reported.

```
. ttest Tier1Ativos==lr1
```

Paired t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Tier1A~s	377	.0566529	.0005775	.0112126	.0555174	.0577884
lr1	377	.052537	.0005637	.0109447	.0514287	.0536454
diff	377	.0041159	.0000929	.0018032	.0039333	.0042985

```

mean(diff) = mean(Tier1Ativos - lr1)          t = 44.3188
Ho: mean(diff) = 0                            degrees of freedom = 376

Ha: mean(diff) < 0          Ha: mean(diff) != 0          Ha: mean(diff) > 0
Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000         Pr(T > t) = 0.0000

```



#### **ANNEX II: Data sample and the estimate of the Leverage Ratio exposure measure**

##### **A. Data availability and source**

Individual bank data from the supervisory reports to the Banco de Portugal was used in the empirical estimates; hence this data is confidential. In the most recent periods all the variables are available with quarterly frequency, nevertheless in the beginning of the period some of the variables are only available annually or semi-annually and quarterly data was obtained using linear interpolation. Table 5 depicts the availability of data on a bank basis.

It should also be stressed that the introduction of the IFRS did not cause a major time series break in what regards data used in this study, since the previous regime stipulated analogous rules regarding, inter alia, netting of exposures. Furthermore, Banco de Portugal has kept long time series of comparable data for the major banking groups, which are used in this work.

Nominal and real GDP are official statistics from the national statistics institute (INE), seasonally adjusted.

The credit gap regards one-sided (real-time) long-term trend deviations of total credit to non-financial private sectors vis-à-vis nominal GDP and was obtained from Banco de Portugal internal estimates, in line with the Basel III guidelines for the countercyclical capital buffer. 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).

Table 5 Data availability per banking group

	Source	CGD	BCP	BPI	BST	CCAM	CEMG	ES	SICAM
<b>TIER 1</b>	Supervisory reporting to Banco de Portugal	2000Q4-2008Q4: Semi-annual data							
<b>Risk Weighted Assets</b>		2009Q1-2014Q1: Quarterly data							
<b>Total Assets</b>		2000Q4-2014Q1: Quarterly data							
<b>Profits</b>									
<b>Credit</b>									
<b>Provisions</b>									
<b>Financial Derivatives</b>		2008Q2-2014Q1: Quarterly data							
<b>Securities Financing Transactions</b>		2005Q1-2014Q1: Quarterly data							2007Q1-2014Q1 Quarterly data
<b>Guarantees</b>		2000Q4-2014Q1: Quarterly data							
<b>Cancellable Commitments</b>									
<b>Uncancellable Commitments</b>									
<b>Nominal GDP</b>	INE	2000Q4-2014Q1: Quarterly data							
<b>Real GDP</b>									
<b>Credit Gap</b>	Banco de Portugal internal estimates	2000Q4-2014Q1: Quarterly data							

### B. Estimating the Leverage Ratio Exposure

The present definition of the leverage ratio exposure, which is tested in this work, was only introduced in January 2014, hence only 3 QIS exercises include comparable data (the description of the LR exposure is in the final of section 2 of the main text). The methodology used to extrapolate the leverage exposure was adopted from Gambacorta

(2014) and essentially estimates the relationship between the balance sheet exposure of derivatives and SFT with the add-ons for, respectively, potential future exposure (PFE) and counterparty credit risk and applies those coefficients to on-balance sheet exposure. Furthermore, in the case of derivatives, netting is not allowed, hence an additional coefficient for the relationship between balance sheet values and leverage exposure is also calculated.

The inclusion of off-balance sheet items (OBS) is one of the most striking features of the leverage ratio exposure, since recent history has proved that in moments of crisis off-balance exposure turns into on-balance. In the EU, OBS items will be included in the exposure of the leverage ratio via the use of the supervisory conversion factors in Annex I of the Capital Requirements Regulation (CRR), according to the likelihood that those items have of being converted into on-balance sheet items, ranging from 10% for cancellable commitments and 100% for full risk categories. The OBS considered are guarantees and commitments.

Table 6 Coefficients used to estimate the leverage exposure

Exposure item	Coefficient	Rationale	Expected Value	Estimate
<b>Derivatives</b>	$A = \frac{BCBS (2014) Derivatives Exposure}{Derivatives accounting balance sheet value} - 1$	Revert derivatives netting	$1 \leq A \leq 0^{15}$	-25%
	$B = \frac{BCBS (2014) Derivatives PFE}{Derivatives accounting balance sheet value}$	PFE	$B > 0$	22%
<b>Securities Financing transactions</b>	$C = \frac{BCBS (2014) Counterparty Credit Risk}{SFT accounting balance sheet value}$	Counterparty Credit Risk	-	9%
<b>Off-balance Sheet items</b>	$D = \frac{BCBS (2014) OBS Exposure}{OBS accounting value}$	OBS exposure	$D \leq 1$	37%

<sup>15</sup> The expected value is negative because Portuguese banks use IFRS and are not allowed to net accounting assets and liabilities, like in the US GAP.

## **Is the Basel III leverage ratio countercyclical?**

### **A study for Portuguese banks**