Banks Leverage Ratio – the Portuguese case

Overview

This special feature presents the new regulatory Leverage Ratio, which has been introduced as a complementary requirement to the risk-based capital requirement. According to the recent literature, using a multi country sample, the Leverage Ratio appears to be more counter-cyclical than risk-based capital ratios. Hence, even a static leverage ratio goes some way towards addressing pro-cyclicality during an upturn by operating as an automatic stabilizer, which ensures that capital moves in proportion with total exposure.

If an institution is subject to both risk sensitive and risk insensitive capital requirements, then at a given moment, which one is more constraining will depend, among other things, on the requirements per se and on the balance sheet structure of the institution, in particular on the risk weights attributed to each asset. Moreover, there is a specific average risk weight at which both requirements impose the same minimum capital quantum, which has been defined as the Critical Average Risk Weight (CARW).

Banking groups operating in Portugal, more specifically the largest seven, present an average risk weight above the CARW and, as such, risk weighted ratios will most likely remain the binding capital requirement. In this vein, the results presented in this document show that, at the moment, the leverage ratio minimum requirement will suffice to address the risk of excessive leverage and that the introduction of the leverage ratio in the macroprudential toolkit is not necessary, either as countercyclical or as a structural instrument. In particular, empirical analysis shows that, in contrast to existing studies in a cross-country setting, the counter-cyclicality of the Leverage Ratio does not outperform the one evidenced by the Tier 1 capital ratio in the Portuguese case.

Notwithstanding, it must be noted that if banks operating in Portugal augment their holdings of assets with low risk weights or change the approach to compute risk weights, translating into a significant reduction of their average risk weight, the LR could be an effective constraint. The LR could also be binding if the calibration was done at a significantly higher level than what is currently envisaged in Basel III.

Leverage ratio as a new regulatory requirement

The inclusion of the Leverage Ratio in the regulatory framework was one of the responses to the problems that surfaced in the most recent financial crisis, when it became clear that the capital held by financial institutions was insufficient or of insufficient quality to absorb the unexpected losses that stroke the sector, despite the fulfilment of other regulatory capital requirements at the time. One of the causes for this inconsistency stems from the fact that risk weights ascribed to the various asset categories might not be able to capture the true risk of assets. Against this background, the Basel Committee on Banking Supervision (BCBS) introduced a new regulatory Leverage Ratio (herein after LR). This measure aims at mitigating risks of excessive leverage, complementing the existing risk-based capital adequacy requirements. It was also considered a simple and transparent measure.

Some credit institutions reached historically high leverage levels in the years preceding the financial crisis, causing a high level of financial fragility. Empirical evidence from ten European countries shows that capital to asset ratios has been on a long-term decline (Benink and Benston (2005)). Starting with a capital to asset ratio of around 30% 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 start of the financial crisis. This structural decline has been attributed to factors such as looser regulation, the increase in implicit government guarantees, the role played by large banks, and increased diversification.

In January 2014, the BCBS published the current definition of the LR. According to this definition the leverage ratio is computed as the ratio of bank´s Tier 1 over the exposure measure. Tier 1[1] encompasses the same components as used in the regulatory capital. The exposure measure comprises (i) on-balance sheet assets (excluding financial derivatives and securities financing transactions (SFT))[2]; (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 replacement cost and the potential future exposure and (iv) Securities Financial Transactions (SFT), comprising balance sheet exposure and the counterparty credit risk. Netting between assets and liabilities is not permitted and risk mitigants (like collateral) are disregarded.

As noted, the aforementioned ratio, which is referred to as "regulatory leverage ratio" is different from the ratio commonly named as "leverage ratio" in finance. Indeed, the LR is the inverse of the financial leverage ratio: when financial leverage increases, the LR decreases, and vice-versa.

On 11 January 2016, the BCBS issued a press release informing about the agreement reached by its oversight body, the Group of Governors and Heads of Supervision (GHOS), according to which a minimum level of 3% for the LR, based on Tier 1 capital, would be required. It is expected to be applied from 1 January 2018 onwards. Furthermore, the GHOS discussed additional requirements for institutions which are systemically important at the global level (G-SIBs) and the details of such additional requirements have been part of a public consultation by the BCBS, even though the Committee has not yet released guidelines on this regard.[3] The level of 3% was determined after years of careful monitoring of the LR following its introduction as part of Basel III in 2010.

At European level, the Capital Requirements Regulation and Capital Requirements Directive (CRR/ CRDIV) framework introduced the LR as a new prudential tool, together with related reporting and public disclosure obligations for institutions. In October 2014 the European Commission (EC) Delegated Act[4] legally implemented the main features of the January 2014 BCBS LR definition, while maintaining the link to other parts of the European regulatory framework and other specificities.

Furthermore, the EC was mandated to elaborate a legislative proposal in order to implement the LR as a regulatory requirement, if considered appropriate. In order to inform the EC regarding this legislative proposal, the EBA was also mandated[5] to elaborate a report, which should assess, inter alia, the effectiveness of the LR to contain the buildup of leverage in the financial system, the possible differentiation according to business models, expected effects on credit provisioning to the economy, risk taking by institutions and the cyclicality of the ratio and of its components.

The report was published by EBA[6] on 3 August 2016. Briefly, the EBA recommends the imposition of a flat 3% LR minimum requirement, independent of the banks' business model. Furthermore, only G-SIBs and very large banks show a higher risk of excessive leverage, which would justify an additional LR requirement to the aforementioned 3%, in line with the BCBS GHOS statement. In November 2016, the EC has published a legislative proposal to implement a minimum LR, alongside risk based capital requirements.[7]

The leverage ratio as a complementary capital requirement

While the risk-based capital ratios limit risk-taking incentives, the LR is a complementary requirement that sets a minimum capital to total exposure. Hence, it limits the overall balance sheet size for a given capital endowment. In order to achieve this, calibration needs to be determined ensuring that both approaches to capital regulation remain relevant.

In fact, risk-weighted capital requirements[8] oblige banks to assign risk weights to their assets at a granular level, with the capital requirements being commensurate to the measured riskiness of each asset. Therefore, the more risk a bank takes, the more capital it must have, with a view to ensuring that banks have adequate capital to absorb potential losses. A risk-weighted approach to setting

capital requirements can also help to mitigate risk shifting incentives, whereby banks take on riskier portfolios to boost return on equity. As such, when risks are adequately measurable, risk-weighted capital requirements are indeed the best way to achieve the aim of the capital framework[9].

However, as risk weighting relies on risks´ estimation, there is a possibility that the assumptions underlying banks' risk models or the standardised approach are not satisfied in the real world[10]. More generally, models are simplifications of the real world and the ways in which they are simplified may lead to miscalibration (Daníelsson (2002)). In this sense, the LR can help to protect against "unknown unknowns".

As such, complementing risk-weighted capital ratios with a LR requirement gives banks better protection against uncertainties and risks that are hard to model compared with a standalone risk-weighted requirement (Morris and Shin (2008)). Beyond model risk and uncertainty, the fact that leverage ratios also place an absolute restriction on the size to which individual bank balance sheets can grow, for a given level of equity, may mean they are better suited to containing aggregate risk in the financial system. This feature may give better protection against losses which are rare but highly correlated across the system given that risk weights do not take account of these correlations. In other words, it could be stated that the LR might be able to counterbalance the effects of the miscalibration of risk weights.

The literature also shows that in environments characterised by complexity, small samples and uncertainties, simple indicators or metrics, such as the LR, sometimes outperform more complex, risk-weighted ones in offering robust protection against default (Aikman et al. (2014)).

In this regard, Gambacorta and Karmakar (2017), consider the two regulatory requirements in the realm of a medium sized dynamic stochastic general equilibrium (DSGE) model and show that the introduction of the LR over and above the risk weighted requirements leads to a small loss in steady state levels of real variables but the benefits in terms of volatility reduction are quite substantial.

Leverage in a system wide perspective

While the LR requirement regards individual institutions, limiting the size of the balance sheet for a given capital endowment, it can additionally be considered in a system-wide perspective, as it also automatically reduces the build-up of leverage in the financial system in the upturn, creating a countercyclical automatic stabilizer that will reduce the economic costs associated with aggressive deleveraging in the downturn.

According to the literature, bank financial leverage also appears to behave cyclically. According to Adrian and Shin (2008), pro-cyclical financial leverage can be seen as a consequence of the active management of balance sheets by financial intermediaries who respond to changes in prices and measured risk. In essence, when market asset prices rise and aggregate perception of risk is low, financing conditions are favourable and banks may have strong incentives to expand their balance sheets, particularly with recourse to very short term debt. In some circumstances, the rate of growth of the aggregate financial sector balance sheets can be understood as the supply of aggregate liquidity to the economy[11]. Hence, the individual balance sheet management of financial intermediaries translates into credit growth (as more borrowers get credit when the banks' balance sheets expand) and credit crunches (when financial intermediaries need do reduce their balance sheet size).[12] Since the supply of credit increases, riskier projects might get financing. This dynamic is further enhanced by the existence of moral hazard, which arises due to limited liability, since banks' shareholders get only the upside of increasing risk taking and thus have an incentive for this behavior[13]. However, Berrospide et al. (2010) found modest effects of bank capital ratio changes on lending, considering that this transmission mechanism is not as straightforward as found by Adrian and Shin (2008).

By the same token, if banks' assets and liabilities management decisions are constrained by risk-adjusted regulatory capital adequacy requirements, the average capital requirement per unit of asset determines the balance sheet size. Hence, in the expansionary phase of the financial cycle, when volatility and risk weights are low, banks are able to increase their balance sheet size[14] and the reverse occurs in the downturn. As such, if institutions deleverage simultaneously, curtailing the provision of credit to the economy, this will probably magnify the downswing of the business cycle.[15]

Relationship between the risk based and leverage based capital requirement

With the introduction of the LR as a capital measure, banks will be subject to both risk-weighted capital requirements and a LR requirement. However, it should be noted that, at a given point in time, an institution's capital requirement will either be determined by the risk-weighted requirement or by the LR requirement, whichever is the most demanding.

In the risk-weighted framework, capital requirements are commensurate to the measured riskiness of each asset, so that banks are required to fund riskier assets with more capital than safer assets. However, when model uncertainty is high (as in the IRB approach to risk weights) and there is a possibility of structural breaks, simple indicators such as the LR might outperform risk-weighting and better guard against the build-up of excessive leverage. Furthermore, when banks try to maintain a constant volume of risk-weighted assets through the cycle, banks' leverage will vary with it. In this context, a regulatory LR requirement may limit the cyclicality of bank leverage.[16]

On the other hand, the LR is insensitive to the riskiness of different assets and, if used on its own, it can create incentives for banks to increase risk taking and induce a shift of activities to less regulated sectors. This suggests that risk-weighted capital requirements and the LR can be very useful complements, as shown by recent empirical evidence[17].

– The Critical Average Risk Weight (CARW)

If an institution is subject to both risk sensitive and risk insensitive requirements, then at a given point, which one is the more constraining will depend, among other things, on the requirements per se and on the balance sheet structure of the institution, in particular the risk weights attributed to different assets.

The ESRB handbook[18], in the chapter dedicated to the macroprudential use of the LR[19], focuses on the notion of an "overall balance in the regulatory framework", in particular the relationship between the LR requirement (non-risk based) and the risk weighted capital requirement (risk based), which will naturally be altered if one of the requirements changes. To assess this relationship, the concept of Critical Average Risk Weight (CARW) is developed[20].

As both ratios may be expressed in terms of Tier 1 capital in the numerator, they only differ in the denominator between using risk-weighted assets (RWAs) or the LR exposure (which relates to total assets).

This implies that there is a relationship between the ratios, which is based on the bank's average risk weight across the portfolio. In particular, in a framework with both a LR and risk-weighted requirements, banks with low average risk weights will be constrained by the LR, while banks with high average risk weights will be constrained by the risk-weighted requirement. The critical average risk weight (CARW) depends on the calibration of both requirements and, being the average risk weight for which both requirements are the same, marks the point at which the LR stops being the most stringent factor.

The CARW can be derived as the average risk weight, which equals the RW and LR capital requirements (equation 1). It should however be noted that this specification overlooks the fact that the RW capital requirement is based on exposure at default values and not total assets and that the LR capital requirement is based on the LR exposure measure and not total assets. Nevertheless, both measures relate to total assets and the additional complexity would not render additional value.

$$K^{RW} = K^{LR} \Leftrightarrow RW_{req} \times \overline{RW} \times TA = LR_{req} \times TA \Leftrightarrow \overline{RW} = \frac{LR_{req}}{RW_{req}} \Leftrightarrow CARW = \frac{LR_{req}}{RW_{req}} \quad [1]$$

Where:

K^{RW} = Minimum RW capital requirement, *quantum*

K^{LR} = Minimum LR capital requirement, *quantum*

RW_{req} = Minimum RW capital requirement, percentage

LR_{req} = Minimum LR capital requirement, percentage

$\overline{RW}$ = Average RW

TA = Total Assets

Hence, given a Tier 1 based LR minimum requirement of 3% and a Tier 1 based RW capital requirement of 8.5%, the CARW would be 35%. This means that a bank with an average risk weight on total assets below 35% would be constrained by the LR requirement.[21]

The macroprudential use of the leverage ratio

Macroprudential policy involves the differentiation of capital buffers across institutions (to address differences in their systemic relevance) and time (to address fluctuations in aggregate risk over the financial cycle). Hence, both a structural and a cyclical (time varying) perspective might be considered regarding the implementation of macroprudential measures.

In this light, it is possible to motivate a higher LR calibration for systemically important institutions (SIIs) as well as a variable calibration over time depending on the stage of the credit cycle.

The structural perspective focuses on the role of the LR in tackling systemic risks arising from misaligned incentives and "too big to fail" issues surrounding SIIs. In that regard, the LR may increase the resilience of large, complex and interconnected institutions against risks arising from limitations to internal models (sometimes referred to as "model risk") and related uncertainties. Given that large and complex institutions are more likely to rely on internal ratings-based approaches to set risk-weighted capital requirements as well as internal trading book models, they may be more exposed to model risk.

In addition, one may argue that SIIs should be more resilient to reduce systemic risks posed in the event of their failure. Consequently, consideration should be given to match increases in risk weighted capital buffers for these institutions with increases in their LR requirements, which is in line with the recent statement from the GHOS regarding G-SIBs.

The cyclical perspective in the ESRB's addendum on LR focuses on the role of the LR in tackling systemic risks arising from excessive credit growth financed through leverage. A higher level of capital may help to mitigate deleveraging in a downturn, thus stabilizing the flow of credit to the economy. As aggregate risk fluctuates over time, the ESRB considers that capital requirements could also be varied over the cycle to ensure that banks remain sufficiently capitalized.

Also regarding the cyclical perspective, a static LR goes some way towards addressing pro-cyclicality during an upturn by operating as an automatic stabilizer which ensures that capital moves in proportion with total exposure. However, aggregate risk varies over time and a static LR could, in principle, be further supported by active countercyclical use, whereby a buffer that is built up in exuberant times could help both to build resilience and to mitigate exuberance, with subsequent release when risks recede, or to help prevent harmful deleveraging when banks incur losses.

In addition, from both the structural and cyclical perspectives, imposing macroprudential risk-weighted buffers without corresponding leverage requirements has no impact on banks that remain constrained by the LR. In the case where only risk-weighted capital surcharges are introduced for systemically important institutions, they might not need to take any

action (if the LR remains their more stringent constraint), or they could be given incentives to rebalance their portfolios towards lower risk-weighted assets (meaning that little or no extra capital would be needed to comply with the higher requirements). In the same way, if only countercyclical risk requirements are introduced for the sector as a whole, banks for which the minimum (static) LR remains the more stringent constraint would not be required to build-up additional capital buffers. This may be particularly the case in periods of exuberance, when typically risk weights are decreasing, and risk-weighted requirements may be easier to comply with. Moreover, the imposition of a risk-weighted countercyclical capital buffer may not sufficiently prevent excessive credit growth and expansion of banks' balance sheets, as banks could continue to grow by investing in low (and, in some cases, zero) risk-weighted assets. In this light, there is a sound case for counter-cyclical time-varying LR requirements.

– Calibrating a macroprudential leverage ratio

There are various approaches to the calibration of macroprudential LR buffers. Like with risk weighted buffers, any macroprudential use of the LR should reflect national specificities and circumstances, including national credit cycles and structural differences across financial systems and institutions.

From a technical design perspective, however, the relationship between risk-weighted capital requirements and the LR offers the possibility of deploying a guide rule linking the two. As discussed above there is a relationship between the levels of LR and risk-weighted capital requirements in a regulatory capital framework that includes both – this can be summarized by the CARW. If either the risk-weighted capital requirement or the LR requirement is changed, the implied CARW also changes and the relative stringency of the two requirements is altered. Thus, when varying the calibration of either the risk weighted or LR requirement, it would be necessary to vary the other requirement in proportion to the CARW in order to preserve the same relative stringency of the two requirements, if the supervision authority considers that this is warranted.

Put simply, the CARW implied by the calibration of the minimum risk-weighted and LR requirements could act as a 'conversion factor' for risk-weighted buffers to determine LR buffers – an institution's LR requirement would be a constant proportion (e.g. the CARW) of its risk-weighted requirement at all times. It would still be the case that the higher of the two requirements would apply for all institutions at any time, and institutions would face a higher LR requirement when they face higher risk-weighted requirements. When compared with a discretionary approach, this 'guide rule' approach may be simpler to convey, may provide more certainty and transparency (including to banks), and may enhance the coherence of the capital framework overall.

But there are more discretionary approaches to the calibration of macroprudential LR add-ons. This may be advantageous when a conversion factor may not imply the most appropriate calibration depending on the macro-financial circumstances. A case-by-case approach could be most useful in taking time-invariant (non-cyclical) decisions like the imposition of systemic buffers (either risk-weighted or leverage-based). Further, changes in the risk weight regime or underlying risk weights may give rise to a change in the relationship between the risk-weighted and un-weighted minimum requirements, providing reason to retain discretion to change the CARW by setting macroprudential leverage ratios independently of risk-weighted buffers. By the same token, the maintenance of a constant CARW may not be the only factor to determine time-varying leverage requirements and there can be circumstances in which macroprudential authorities put more emphasis on risks that could be addressed by either the risk-weighted or the LR framework. These advantages should be weighed against a somewhat more complex decision-making process and less predictability for institutions.

The case of the Portuguese Banking System

– The calibration of the leverage ratio: how does Portugal compare with the other European countries

The LR is a prudential capital requirement that has been introduced as a backstop to the risk-weighted requirements. As such, the respective calibration has been evaluated in order not to be the most demanding requirement for the majority of the institutions[22]. In fact, throughout the observation period (2013-2017) the institutions that did not comply with the 3% minimum requirement have been converging towards it and one of the conclusions of the EBA report on the LR calibration is that only a small proportion of banks still does not comply with the requirement (around 9%). As such, the impact on the supply of credit to the economy is expected not to be significant given a minimum LR of 3%[23]. However, the EBA impact analysis also concludes that the shortfall is very sensitive to calibration and that a requirement above 4% would trigger strong adjustments, either through capital increases or deleveraging.

Whether risk based or non-risk based are the most constraining depends on capital requirements, inter alia, on the (i) relative calibration of the requirements, (ii) the specific balance sheet of the institution and (iii) the models used to determine the risk weighted assets, including exposure at default amounts and specific portfolio RW.

The third aspect will not be developed in this article, but simulations with a theoretical portfolio have shown that different institutions obtain results which differ materially[24]. Further, this has been one of the arguments to introduce the LR as a binding prudential requirement.

Considering equation 1, it is evident that when one of the requirements changes the relative stringency also changes, which can easily be assessed by changes in the CARW. *Ceteris paribus*, if the risk weighted requirements are increased the CARW ($\frac{LR_{req}}{RW_{req}}$) will automatically decrease, hence the number of institutions that are constrained by the LR requirement will also decrease.

Furthermore, if an institution has a $\overline{RW}$ below the original critical level (CARW) and is constrained by the LR, then the increase in risk weighted requirement will not be effective (for instance, if there is excessive credit growth and the countercyclical capital buffer (CCB) is set above zero it would have no effect on LR constrained institutions).

It is also clear that each bank will have a different CARW since i) some institutions are subject to additional risk weighted requirements (G-SIBs; O-SIIs), ii) CCB requirements are institution specific[25] and iii) pillar 2 requirements are material.

The specific balance sheet of the institution will impact the average risk weight across portfolios and determine whether an institution will be above or below the CARW, thus defining if it is constrained by risk weighted capital requirements or by the LR. For instance, if all the assets of a bank were sovereign debt issued and funded in euros by EU central governments (zero risk weight for credit risk) then the average risk would be very low and below the CARW and the LR would be the binding requirement. [26]

In the EBA transparency exercise published in November 2015, with December 2014 as reference date, the major Portuguese banking groups that participated in the exercise (CGD, BCP, BPI) presented a LR clearly above 3%, with a weighted average of 6.2%, which compares with a weighted average of 4.7% for all European banks in the sample. In terms of ranking, Portuguese banks present the 6th highest average LR in a sample of 21 countries (Chart 1). [27]

On the other hand, regarding risk weighted requirements, Portugal ranked only 17th out of 21 countries in the Tier 1 capital ratio (Chart 2).

A key issue to understand these findings is the average risk weight (ARW) of the banks in the sample, by country. As can be observed in Chart 3, Portuguese institutions have one of the highest average risk weights (56.6%), well above the cross-country average of 34.5%.

It should also be stressed that this result is not specific to the reference date or even to the institutions in the sample. For a longer time series (2000-2012) the average risk weight of Portuguese banks has been higher than the ones presented by the European banks (Chart 4).

Chart 1 • Leverage ratio, by country, December 2014

Source: 2015 EBA transparency exercise.
Note: Leverage ratio computed as the quotient between Tier 1 capital and Total Exposure (as defined in the section "Leverage ratio as a new regulatory requirement").

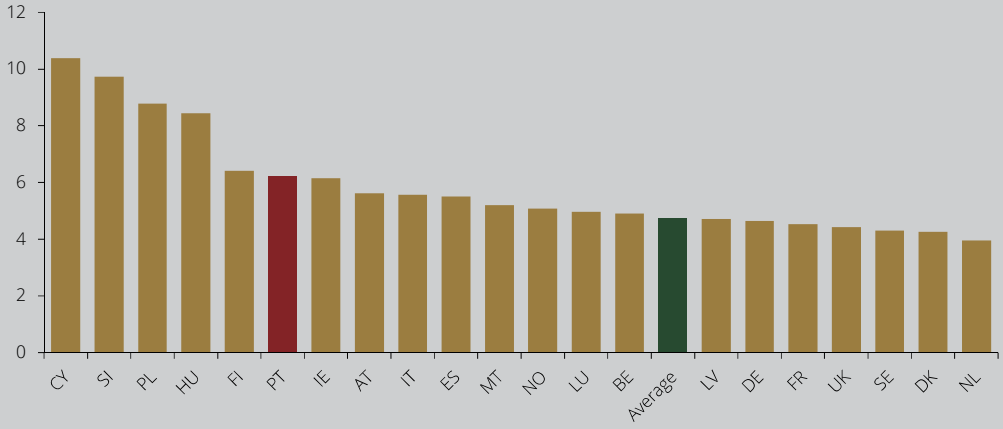


Chart 2 • Tier I capital ratio, by country, December 2014

Source: 2015 EBA transparency exercise.
Note: Tier 1 capital ratio computed as the quotient between Tier 1 capital and Risk Weighted Assets.

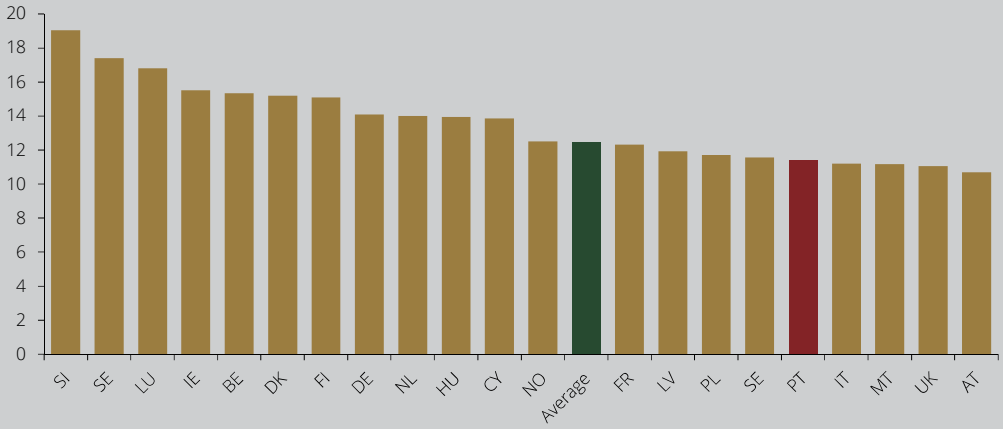


Chart 3 • Average risk weight, by country, December 2014

Source: 2015 EBA transparency exercise (RWA) and SNL (Assets).
Note: Average Risk Weight computed as the quotient between Risk Weighted Assets and Total Assets.

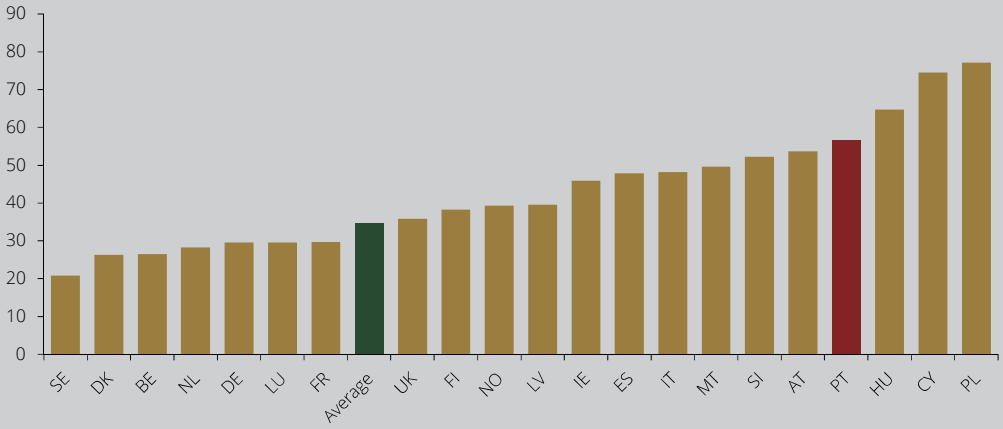
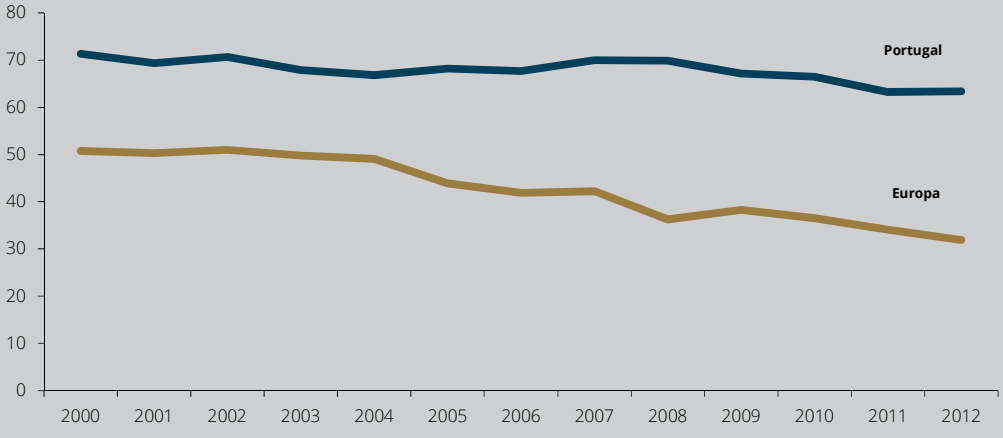


Chart 4 • Average risk weight (2000-2012)

Source: Bankscope.
Note: Average Risk Weight computed as the quotient between Risk Weighted Assets and Total Assets.



In addition, it can be observed that the average risk weight has been falling since the crisis, both in Portugal and in the whole sample, even though the gap widened further. One of the possible reasons behind that gap is the greater reliance by the Portuguese banks on SA (instead of IRB) to compute minimum capital requirements, when compared to other European banks.

– The Critical Average Risk Weight for Portuguese banks

At present, risk-based requirements for Portuguese banking groups consist in the 6% minimum (article 92 CRR) plus 1.25%[28] from the phasing in of the Capital Conservation Buffer plus pillar 2 requirements, which are institution specific and confidential. The Countercyclical Capital Buffer (CCB) is zero and the O-SII buffer will only enter into force in 2018 and, as such, for the time being, is also zero.

In 2021, the Capital Conservation Buffer will be at its steady state level of 2.5% and the defined O-SII buffers will be phased in. For illustrative purposes, it is assumed that the CCB will remain at zero since the indicators that would support a change in that buffer do not signal excessive credit growth [29] and that the O-SII buffer is at 1% of RWA.[30] The simulation does not account for pillar 2 requirements and pillar 2 guidance. As a consequence, capital requirements are underestimated and the CARW is overestimated, which reinforces our conclusions.

Table 1 • The CARW under different scenarios

	Minimum risk based requirements	Macroprudential Buffers – Illustrative case		Total risk based requirements	Leverage Ratio	CARW
		Max of O-SII	CCB rate			
2016	6%+1.25%=7.25%	0%	0%	7.25%	3%	41%
2021	6%+2.5%=8.5%	1%	0%	9.50%	3%	32%

It should be noted that: (i) as expected, changes in one of the requirements materially change the CARW; ii) the relative stringency of the LR would decline with the phasing in of the Capital Conservation Buffer and iii) in both situations the CARW is below the average risk weight of the sample of Portuguese banks considered, even at present.

Cyclical Perspective

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.[31] Hence, a capital ratio can be deemed countercyclical if it tends to move in the opposite direction of the economic cycle. Additionally, it is also possible to analyze the cyclical properties of the ratio components.

If the countercyclical properties of a given capital ratio are assessed vis-à-vis those of other capital ratios, the one that displays the strongest countercyclical properties will in general be the first to signal the need for corrective action. In this sense, it will be a tighter constraint in booms and a looser constraint in recessions.

The assessment of pro-cyclicality can be performed vis-à-vis different cycle indicators, like banks' total assets, the economic cycle or the financial cycle (e.g. proxied by the credit-to-GDP gap). Naturally all those aggregates are interdependent, since banks' balance sheets expand when economic activity augments and the credit gap also tends to widen, although not necessarily in a simultaneous manner.

Brei and Gambacorta (2016) were the first to study empirically how the new LR (computed according to Basel III definition) behaves over the cycle.[32] Their paper establishes an empirical framework to compare the cyclical properties of different capital ratios. 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. By introducing in their empirical specification a binary variable that accounts for the financial crises and the subsequent regulatory reform[33], the authors conclude that results are different in "normal times" as compared with the crisis period; all capital ratios tend to be less countercyclical (more pro-cyclical) during the crisis period.

In stylized terms, a weaker counter-cyclicality of the RW capital ratio can be imputed to the behavior of risk weights over the cycle. Asset prices tend to behave pro-cyclically, which increases total assets in good times and thus makes both the LR and the RW capital ratios counter-cyclical. However, in the case of the RW ratio, this effect can be mitigated by the fact that in good times risk weights tend to decrease, therefore dampening the increase in the ratio´s denominator.

This section proposes a model that attempts to answer the following research questions:

- How do leverage and risk weighted capital ratios react to the business cycle in Portugal?
- Do they behave pro-cyclically or counter-cyclically?
- If both ratios are counter-cyclical, which one displays a highest degree of counter-cyclicality?

Based on Brei and Gambacorta (2016) the following model is specified:

$$L_{it} = \alpha_i + \beta L_{it-1} + \gamma Y_t + \theta R_t + + \delta X_{it-1} + \varepsilon_{it}$$

The dependent variable, L_{it} is the capital ratio in year t, of bank i. Three definitions of capital ratio are tested: the Basel III LR (computed as the quotient between Tier 1 capital and total exposure); the accounting leverage ratio (ALR - calculated as the ratio of Tier 1 capital to total assets) and the capital-to-risk-weighted-assets ratio (defined as the ratio of Tier 1 capital to risk-weighted assets). α_i is bank fixed effects; The inclusion of L_{it-1} acknowledges the persistence in capital ratios, that is to say, the existence of short term adjustment costs to raise capital; Y_t is the explanatory variable related to the business cycle (growth rate of real GDP);[34] R_t is a dummy variable that accounts for changes in banks´ behaviour due to more stringent capital requirements, taking the value of one from 2009Q3 onwards.[35] Finally, 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: Size_{it} accounts for banks´ size, measured by the log of total assets; ROA_{it} is the return on assets, which measures banks´ profitability; and Risk_{it}, computed as the standard deviation of the last three periods of ROA, measures the relative riskiness of the bank[36].

The dataset comprises quarterly data from 2000Q4 to 2014Q1 for the 7 largest banking groups operating in Portugal. Considering that the System GMM estimator is better suited to panels with small T and large N[37] which is not the case of the panel used in this article, the estimation was based on the model with a fixed-effects and IV fixed-effects estimators.[38]

Taking into account two studies that analyze the possible counter-cyclical nature of Basel III LR, developed by Brei and Gamabacorta (2016) and adapted in EBA (2016), it is expected that the LR shows, at least slightly, a higher counter-cyclical behavior, when compared with risk-based capital ratio (Tier 1 ratio).

The results depicted in Table 2 evidence that both Basel III LR and Tier I ratio are counter-cyclical. However, contrary to what was expected (compared with EBA and Brei and Gambacorta´s results – see Table 3), the Tier 1 ratio shows a slightly higher countercyclical behavior than the LR. Economically speaking, the table shows that an increase of 1 percentage point in GDP growth decreases the LR by two basis points. In the other hand, the impact of the same change in GDP reduces the Tier 1 ratio in three basis points.

In order to enhance the comparison between our results and the ones set out in Brei and Gambacorta (2016) and EBA (2016) a model using the system GMM estimator was performed. The results outlined in Table 4 point to a slightly more counter-cyclicality of LR and ALR than the Tier 1 capital ratio, given

that the latter is not statistically significant which is similar to the one presented in the aforementioned studies (Table 5).[39]

In sum, the results outline that, in Portugal, both Basel III LR and the Tier 1 ratio are counter-cyclical. Indeed the former ratio does not outperform the latter in a consistent and robust manner. Therefore, it can be concluded that the differences between them in the way they react to the cycle are only of second-order importance. As referred in section "The calibration of the leverage ratio: how does Portugal compare with other European countries", Portuguese banks mainly use the standard approach instead of the internal rating based method, which limits the response of risk weights to the economic cycle. [40]

To understand the difference between the results obtained for Portugal and those from previous studies, it is useful to disentangle the effects of the business cycle on the numerators and denominators of the Tier 1 capital ratio and Basel III LR. In order to perform this exercise the dependent variable in model 1 is replaced with Tier 1 growth, Exposure growth[41] and RWA growth using all the estimators mentioned before (System GMM, Fixed-Effects and IV Fixed-Effects). Growth rates were chosen to avoid the problem of spurious regressions, given that the log of those variables is non-stationary.

Table 6 sheds some light on the differences between our results and those obtained by the other studies. While in our sample the pro-cyclicality of RWA growth and Exposure growth is quite similar (except for IV fixed-effects), in the study carried out by the EBA (and, to a smaller extent, in Brei and Gambacorta (2016)) the Exposure measure outperforms RWA in terms of pro-cyclicality (Table 7). As both ratios share Tier 1 as the numerator, the relative pro-cyclicality of the denominators will define the countercyclical properties of the ratios.

Additionally, in order to test if the variable chosen to represent the cycle (the growth rate of real GDP) is adequately capturing the time-varying effects which are common to all banks, the re-estimation of equation 2 has been done, replacing the cyclical variable with time-fixed effects. Both for the LR and the capital-to-risk-weighted-assets ratio as dependent variables, it turns out that the variable chosen to characterize the cycle is well correlated with the coefficients of time fixed effects, suggesting that the growth rate of real GDP is capturing in an adequate manner the evolution of the cycle.[42]

To conclude this section, it is worth acknowledging that the empirical analysis performed above uses a much smaller sample of banks than the EBA and Brei and Gambacorta studies. Moreover, due to data limitations, this analysis also covers a shorter time period than Brei and Gambacorta (2016), which undermines the ability to capture the cyclical behavior of any indicator. Moreover, it was on the downturn phase of the cycle that banks were required to rise regulatory risk weighted capital ratios, which continued to be the binding requirement for Portuguese banks.

Table 2 • Results from a set of dynamic panel data regressions (Fixed-Effects and Instrumental Variables Fixed-Effects

	Leverage Ratio		Tier 1 Ratio		Accounting Leverage Ratio	
	Fixed-Effects	Instrumental Variable Fixed-Effects	Fixed-Effects	Instrumental Variable Fixed-Effects	Fixed-Effects	Instrumental Variable Fixed-Effects
Dependent Variable$_{t-1}$	0.835***	0.839***	0.888***	0.891***	0.820***	0.824***
	(0.03)	(0.029)	(0.030)	(0.027)	(0.022)	(0.019)
Y_t	-0.022*	-0.012	-0.030*	-0.038	-0.023**	-0.004
	(0.012)	(0.014)	(0.017212)	(0.026)	(0.010)	(0.018)
R_t	0.001	0.001	0.003**	0.003**	0.001*	0.001*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Size$_{t-1}$	0.003**	0.003**	0.003	0.002	0.003**	0.004**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Roa$_{t-1}$	0.609**	0.624**	0.878**	0.924**	0.659***	0.665***
	(0.260)	(0.267)	(0.372)	(0.428)	(0.243)	(0.252)
Risk$_{t-1}$	2.085***	2.247***	3.447***	3.685***	2.187***	2.348***
	(0.348)	(0.353)	(0.889)	(0.933)	(0.346)	(0.33)
Observations	351	351	351	351	351	351
R-squared (within)	0.875	0.874	0.919	0.919	0.867	0.865
Number of banks	7	7	7	7	7	7

Notes: Bootstrap standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1. LR stands for Basel III LR which is computed as the quotient between Tier 1 capital to total exposure (as defined in the section "Leverage ratio as a new regulatory requirement"); Tier 1 Ratio is calculated as Tier 1/Risk-weighted assets; ALR stands for accounting LR which is calculated as the ratio of Tier 1 capital to total assets; Dependent variable$_{t-1}$ acknowledges the persistence in capital ratios, that is to say, the existence of short term adjustment costs to raise capital; Y_t is the cycle explanatory variable (measured by the growth rate of real GDP); Rt is a dummy variable that accounts for changes in banks´ behaviour due to more stringent capital requirements; Size t-1 accounts for banks´ size, measured by the log of total assets; ROA$_{t-1}$ is the return on assets, which measures banks profitability and Risk$_{t-1}$ is computed as the standard deviation of the last three periods of ROA, measuring the relative riskiness of the bank. In IV Fixed-Effects estimator this variable is instrumented by European Union (28) real GDP´s growth.

Table 3 • Comparison between the results obtained in this document and the ones outlined by Brei and Gambacorta (B&G) and EBA

	Leverage Ratio			Tier 1 Ratio			Accounting Leverage Ratio		
	Banco de Portugal	EBA	B&G	Banco de Portugal	EBA	B&G	Banco de Portugal	EBA	B&G
Y_t	-0.022*	-0.101***	-0.052**	-0.030*	-0.05	-0.045	-0.023**	-0.067*	-0.039
	(0.012)	(0.030)	(0.026)	(0.017)	(0.034)	(0.037)	(0.010)	(0.040)	(0.032)

Table 4 • Results from a set of dynamic panel data regressions (System GMM)

	Leverage Ratio	Tier 1 Ratio	Accounting Leverage Ratio
Dependent Variable$_{t-1}$	0.818***	0.865***	0.796***
	(0.030)	(0.027)	(0.027)
Y_t	-0.022*	-0.028	-0.023**
	(0.012)	(0.019)	(0.011)
R_t	0.001	0.003*	0.002*
	(0.001)	(0.002)	(0.001)
Size$_{t-1}$	0.003**	0.005***	0.003**
	(0.001)	(0.002)	(0.002)
Roa$_{t-1}$	0.618***	0.726*	0.650***
	(0.211)	(0.395)	(0.230)
Risk$_{t-1}$	2.136***	3.489***	2.298***
	(0.261)	(0.767)	(0.259)
AR (2) test (p-value)	0.416	0.331	0.497
Observations	351	351	351
Number of banks	7	7	7

Notes: Robust standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1. LR stands for Basel III LR which is computed as the quotient between Tier 1 capital to total exposure (as defined in the section "Leverage ratio as a new regulatory requirement"); Tier 1 Ratio is calculated as Tier 1/Risk-weighted assets; ALR stands for accounting LR which is calculated as the ratio of Tier 1 capital to total assets; Dependent variable$_{t-1}$ acknowledges the persistence in capital ratios, that is to say, the existence of short term adjustment costs to raise capital; Y_t is the cycle explanatory variable (measured by the growth rate of real GDP); Size$_{t-1}$ accounts for banks´ size, measured by the log of total assets; R_t is a dummy variable that accounts for changes in banks´ behaviour due to more stringent capital requirements; ROA$_{t-1}$ is the return on assets, which measures banks´ profitability and Risk$_{t-1}$ is computed as the standard deviation of the last three periods of ROA, measuring the relative riskiness of the bank. The lagged dependent variables and Y_t are instrumented by their lags using System GMM estimator.

Table 5 • Comparison between the results obtained in this document and the ones outlined by Brei and Gambacorta (B&G) and EBA

	Leverage Ratio			Tier 1 Ratio			Accounting Leverage Ratio		
	Banco de Portugal	EBA	B&G	Banco de Portugal	EBA	B&G	Banco de Portugal	EBA	B&G
Y_t	-0.022*	-0.101***	-0.052**	-0.028	-0.05	-0.045	-0.023**	-0.067*	-0.039
	(0.012)	(0.030)	(0.026)	(0.019)	(0.034)	(0.037)	(0.011)	(0.040)	(0.032)

Table 6 • Results from a set of dynamic panel data regressions - Disentangle the effects of the business cycle on the numerators and denominators of the Tier 1 capital ratio and Basel III LR

	Tier 1 Growth		RWA Growth			Exposure Growth	
	Fixe-Effects	Instrumental Variable Fixed-Effects	Fixed-Effects	GMM	Instrumental Variable Fixed-Effects	Fixed-Effects	Instrumental Variable Fixed-Effects
Dependent Variable$_{t-1}$	-	-	0.258***	0.220***	0.250***	-	-
	-	-	(0.056)	(0.055)	(0.046)	-	-
Y_t	-0.130	-0.027**	0.207***	0.219***	0.456***	0.223***	0.09
	(0.182)	(0.011)	(0.073)	(0.074)	(0.159)	(0.079)	-0.138
R_t	-0.027**	0.054**	-0.015	-0.0126	-0.017**	-0.012*	-0.013*
	(0.011)	(0.024)	(0.001)	(0.008)	(0.007)	(0.007)	-0.007
Size$_{t-1}$	0.041**	8.632***	0.005	0.001	0.015*	-0.007	-0.009
	(0.018)	-2.436	(0.009)	(0.011)	(0.008)	(0.011)	-0.011
Roa$_{t-1}$	8.831***	35.813***	0.090	1.630	-0.175	0.049	-0.054
	-2.473	-7582	-1.352	-1.910	-1.242	-1.115	-1.118
Risk$_{t-1}$	32.453***	-0.027**	2.986*	5.423**	4.756**	1.426	0.373
	-8435	-0.011	-1701	-2560	-1861	-2314	-2006
AR (2) test (p-value)	-	-	-	0.459	-	-	-
Observations	351	351	321	321	321	351	351
R-squared (within)	0.113	0.115	0.20	-	0.21	0.07	0.09
Number of banks	7	7	7	7	7	7	7

Notes: Bootstrap standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1 except for GMM which presents robust standard errors. Tier 1 growth is calculated as the difference between Tier 1 in period n and Tier 1 in period n-1, RWA growth is computed as the difference between RWA in period n and RWA in period n-1; Exposure growth is calculated as the difference between the exposure in period n and the exposure in period n-1; Dependent variable$_{t-1}$ acknowledges the persistence in RWA; Y_t is the cycle explanatory variable (measured by the growth rate of real GDP); R_t is a dummy variable that accounts for changes in banks´ behaviour due to more stringent capital requirements; Size$_{t-1}$ accounts for banks´ size, measured by the log of total assets; ROA$_{t-1}$ is the return on assets, which measures banks´ profitability and Risk$_{t-1}$ is computed as the standard deviation of the last three periods of ROA, measuring the relative riskiness of the bank. The Lagged dependent variables and Y_t are instrumented by their lags using the system GMM estimator whereas in IV Fixed-Effects model the latter variable is instrumented by European Union (28) real GDP´s growth. The table only presents GMM estimator in the case of RWA growth given that is the one whose dependent variable shows persistency.

Table 7 • Differences between the results obtained in this document and the ones outlined by Brei and Gambacorta (B&G) and EBA

	Tier 1 Growth				RWA Growth					Exposure Growth			
	Fixed-Effects	Instrumental Variable Fixed-Effects	"EBA GMM"	"B&G GMM"	Fixed-Effects	GMM	Instrumental Variable Fixed-Effects	"EBA GMM"	"B&G GMM"	Fixed-Effects	Instrumental Variable Fixed-Effects	"EBA GMM"	"B&G GMM"
Y_t	-0.13	-0.027**	-0.008**	0.948	0.207***	0.219***	0.456***	0.005	1.375**	0.223***	0.09	0.008***	1.442***
	(0.182)	(0.011)	(0.004)	(0.597)	(0.073)	(0.074)	(0.159)	(0.004)	(0.545)	(0.079)	(0.138)	(0.003)	(0.514)

– Structural Perspective

According to the structural perspective, the Basel III LR might be a useful tool to mitigate "moral hazard" issues linked to systemically important institutions. Therefore, by imposing a higher LR on the largest banks, the policy maker aims to reduce the probability of failure of those systemically important institutions, avoiding the huge economic costs of their distress. Moreover, it is often considered that larger banks are more willing to rely on internal models to compute risk weights (IRB approach), exposing these institutions to model risk, which can be mitigated by the use of the LR as a macroprudential tool.

This section attempts to answer the following questions:

1. Do Portuguese banks´ Basel III leverage and risk-based capital ratios vary with either bank size or the model used to compute risk weights?
2. Does the risk-based capital ratio (Tier 1) of IRB banks present a less counter-cyclical behavior than that of the remaining banks?

In order to answer the first question, the sample is split into two types of banks, those eligible for group one in QIS (G1 - banks whose Tier 1 capital stands above or equal 3 billion euros with international activity summing up 3 banks) and the remaining ones (G2 – 4 banks). Banks are also split between IRB banks and SA banks. Hypotheses tests are then performed for the mean (Tables 8 and 9).

Concerning whether Basel III leverage and risk-based capital ratios vary, either with bank size or with the model used to compute risk weights, Tables 8 and 9 show that G1 banks present a lower LR, when compared with smaller banks, but also a lower Tier 1 capital ratio. As a result, it cannot be concluded that larger banks actively target risk-based capital ratios. Therefore, the increase of the LR for systemically important institutions can be obtained, indirectly, through the imposition of risk-based capital buffers, as is the case, in Portugal, of O-SII capital buffers.

A similar conclusion holds for the comparison between banks using SA and banks using IRB to compute their minimum capital requirements. As shown in both tables, IRB banks have, both, lower LR and lower Tier 1 capital ratios vis-à-vis banks that use the SA.

Table 8 • Hypothesis Tests – Leverage Ratio

	OBS	Mean		OBS	Mean
Size			Approach used to compute RWA		
G1	162	0.049	Padrão	366	0.053
G2	216	0.055	Notações Internas	12	0.049
Difference (p-value)		0	Difference (p-value)		0.0148

Table 9 • Hypothesis Tests – Tier 1 Capital Ratio

	OBS	Mean		OBS	Mean
Size			Approach used to compute RWA		
G1	162	0.079	Padrão	366	0.089
G2	216	0.091	Notações Internas	12	0.074
Difference (p-value)		0	Difference (p-value)		0.0041

To address the second question, an econometric model similar to the one presented before was estimated, including an IRB dummy and the interaction of this dummy with the cyclical measure (real GDP growth) – Table 10.

Regarding question 2, Table 10 shows that the cyclicality of the Tier 1 capital ratio and RWA of banks using IRB are not statistically different from the SA banks.

Table 10 • Assessment of the pro-cyclicality of Tier 1 Capital ratio and RWA growth for IRB banks

	Tier 1 Capital Ratio			RWA Growth		
	Fixed-Effects	GMM	Instrumental Variable Fixed-Effects	Fixed-Effects	GMM	Instrumental Variable Fixed-Effects
Dependent Variable$_{t-1}$	0.889***	0.860***	0.887***	0.254***	0.189***	0.243***
	(0.030)	(0.033)	(0.029)	(0.050)	(0.049)	(0.047)
Y_t	-0.031*	-0.030	-0.038	0.206***	0.224***	0.475***
	(0.019)	(0.018)	(0.029)	(0.075)	(0.081)	(0.164)
R_t	0.003*	0.003	0.003*	-0.013	-0.011	-0.015*
	(0.002)	(0.003)	(0.002)	(0.008)	(0.009)	(0.008)
Size$_{t-1}$	0.003	0.005**	0.002	0.001	-0.001	0.012
	(0.002)	(0.002)	(0.003)	(0.010)	(0.013)	(0.009)
Roa$_{t-1}$	0.877**	0.684*	0.908**	0.166	2049	-0.061
	(0.423)	(0.413)	(0.400)	-1202	-1978	-1115
Risk$_{t-1}$	3.438***	3.364***	3.410***	3.090*	5.644*	5.079***
	(0.931)	(0.658)	(0.914)	-1661	-2927	-1764
IRB	0.000	-0.000	-0.038	0.008*	0.007	0.017
	(0.002)	(0.002)	(0.029)	(0.004)	(0.006)	(0.014)
IRB*Y_t	0.096	0.117	0.531	0.186	0.029	0.832
	(0.126)	(0.124)	(0.410)	(0.667)	(0.630)	-1639
AR (2) test (p-value)	-	0.345	-	-	0.4476	-
Observations	351	351	351	351	351	351
R-squared (within)	0.920	-	0.920	0.206	-	0.214
Number of banks	7	7	7	7	7	7

Notes: Bootstrap standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1 except for GMM which presents robust standard errors. Tier 1 is computed according to the regulatory framework; RWA growth is computed as the difference between RWA in period n and RWA in period n-1; Dependent variable$_{t-1}$ acknowledges the persistence in Tier 1 Capital Ratio and RWA Growth; Y_t is the cycle explanatory variable (measured by the growth rate of real GDP); R_t is a dummy variable that accounts for changes in banks´ behaviour due to more stringent capital requirements; Size^{t-1} accounts for banks´ size, measured by the log of total assets; ROA$_{t-1}$ is the return on assets, which measures banks´ profitability; Risk$_{t-1}$ is computed as the standard deviation of the last three periods of ROA, measuring the relative riskiness of the bank; and IRB is a dummy variable that assumes the value of 1 if the bank uses IRB to compute its risk weighted assets and 0 otherwise. In the GMM estimator the Lagged dependent variables and Y_t are instrumented by their lags and in IV Fixed-Effects estimator this variable is instrumented by European Union (28) real GDP´s growth.

As referred above, the introduction of the LR in the macroprudential toolbox can be used either as a countercyclical or as a structural instrument if it proves to be useful to mitigate the risks stemming from banks´ excessive balance sheet´s growth in the upswing of the business cycle, as well as the risks that derive from the miscalibration and pro-cyclical nature of the models behind the computation of risk weights, in particular regarding the banks that use IRB models.

In this vein, according to the results presented in this paper, the introduction of the LR as a microprudential requirement, with no associated macroprudential use, is, for the time being, considered as sufficient to mitigate excessive leverage in the financial system.

Conclusions

This special topic comprises an assessment of whether the Basel III LR would be binding for Portuguese banks by computing their Critical Average Risk Weight (CARW). Additionally, it presents a number of univariate and multivariate analyses to gauge to what extent the cyclical and structural perspectives of using the LR as a macroprudential instrument hold for Portugal.

The available evidence shows that the largest Portuguese banking groups have an average risk weight substantially above the CARW and, as such, risk weighted ratios will most likely remain the binding capital requirement.

Furthermore, empirical results give support to conclude that: i) contrary to the most recent studies based on a multi-country sample, in Portugal the counter-cyclicality of LR does not outperform the one of the Tier 1 capital ratio (risk-based capital ratio); and ii) larger and IRB banks present a lower LR, when compared with, respectively, smaller and SA banks, but also a lower Tier 1 capital ratio. As a result, no evidence could be found that those banks actively target risk-based capital ratios.

Therefore, the introduction of the LR as a microprudential requirement, with no associated macroprudential use, is, for the time being, considered as sufficient to mitigate excessive leverage in the financial system.

References

Acharya, V., Mehran, H., Shuermann, T. and Thakor, A. (2012): Robust capital regulation, CEPR Discussion papers 8792.

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.

Baglioni, a., Beccalli, E., Boitani, a., & Monticini, a. (2013). Is the leverage of European banks procyclical? Empirical Economics, 45(3), 1251–1266.

Beccalli, E., Boitani, A., & Di Giuliantonio, S. (2014). Leverage pro-cyclicality and securitization in US banking. Journal of Financial Intermediation.

Berrospide, J. and Rochelle, E. (2010). "The effects of bank capital on lending: what do we know, and what does it mean?" International Journal of Central Banking, vol. 6, no. 4, pp. 5-54

Brei, M., & Gambacorta, L. (2016). Are bank capital ratios pro-cyclical? New evidence and perspectives, Economic Policy, pp. 357-403.

Committee, B. (2014). Basel Committee on Banking Supervision, Basel III leverage ratio framework.

Committee, B. (2010). Basel Committee on Banking Supervision, Basel III: A global regulatory framework for more resilient banks and banking systems.

European Banking Authority (2016), EBA Report on the leverage ratio requirements under article 511 of the CRR

Fostel, A., & Geanakoplos, J. D. (2013). Reviewing the leverage cycle. Annual Review of Economics.

Galo, N. & Thomas, C. (2013). Bank Leverage Cycles, Banco de España, Working Paper No. 1222.

Gambacorta, L. and S. Karmakar (2017), "Leverage and risk-weighted capital requirements". International Journal of Central Banking, forthcoming.

Kalemli-Ozcan, S., Sorensen, B., & Yesiltas, S. (2012). Leverage across firms, banks, and countries. Journal of International Economics, 88(2), 284–298.

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.

Roodman D. (2009), How to do xtabond2: An introduction to difference and system GMM in Stata, The Stata Journal, Vol. 9, pp. 86-136.

Annex: Variables´ descriptive statistics

	Obs	Mean	Std.Dev.	Min	Max
LR	378	0.0525	0.1093	0.0304	0.0824
Tier 1 Ratio	378	0.0855	0.21	0.0495	0.1623
ALR	377	0.0567	0.0112	0.0347	0.0862
Y_t	378	0.0019	0.0209	-0.0414	0.0441
Assets	378	47,133	31,316	6,694	120,389
ROA	372	0.0011	0.0017	-0.0097	0.0044
Risk	358	0.0006	0.0008	0.0002	0.0049

Notes: LR stands for Basel III Leverage ratio which is computed as the quotient between Tier 1 capital to total exposure; Tier 1 Ratio is calculated as Tier 1/Risk-weighted assets; ALR stands for accounting leverage ratio which is calculated as the ratio of Tier 1 capital to total assets; Y_t is the cycle explanatory variable (the l growth rate of real GDP); Assets stands for banks´ total liquid assets (in million euros); ROA is the return on assets, which measure the direct cost of remunerating capital and Risk is computed as the standard deviation of the last three periods of ROA, measuring the relative riskiness of the bank.

List of Abbreviations

ALR – Accounting Leverage Ratio
CARW – Critical Average Risk Weight
CCB – Counter-Cyclical Capital Buffer
CRD – Capital Requirements Directive
CRR – Capital Requirements Regulation
ESRB – European Systemic Risk Board
GHOS – Group of Governors and Heads of Supervision
G-SIBs – Global Systemically Important Banks
IRB – Internal Rating Based approach
LR – Basel III Leverage Ratio
RW – Risk Weights
RWA – Risk Weighted Assets
SA – Standard Approach
SIIs – Systemically Important Institutions

Notes

1. Tier 1 consists of Common Equity Tier 1 (CET 1) plus other instruments eligible to be included in the Additional Tier 1 category.

2. Derivatives and SFT exposure are included in the exposure measure applying specific rules, in order to overcome differences in accounting systems and ensure a comparable LR across jurisdictions. In particular, as a first step, any netting due to the consideration of collateral and other risk mitigation techniques is reversed. In a second step, the specific rules regarding the computation of the LR exposure measure are applied.

3. http://www.bis.org/bcbs/publ/d365.htm.

4. Commission Delegated Regulation (EU) 2015/62 of 10 October 2014 amending Regulation (EU) No. 575/2013 of the European Parliament and of the Council with regard to the leverage ratio.

5. Article 511 CRR.

6. http://www.eba.europa.eu/-/eba-recommends-introducing-the-leverage-ratio-in-the-eu.

7. The legislative proposal regarding the introduction of a minimum leverage ratio requirement is encompassed in the overall package concerning the review process of CRR/CRD IV.

8. Risk weights are computed using either a standardised risk-weighting approach set by the regulator (the standardised approach) or through use of a bank's own internal risk-weighting models based on the bank's historical experience (the internal ratings based (IRB) approach).

9. Gordy (2003).

10. Uncertainty and the possibility of structural breaks mean that the distributions of PD and LGD might not be fully known for certain types of exposure.

11. Adrian and Shin (2008).

12. Adrian and Shin (2008).

13. Merton (1973) derives the same conclusion by using option pricing to the value of an enterprise with a strike price equal to its debt.

14. This argument is akin to Adrian and Shin (2013), which explores the link between the value-at-risk (VaR) per unit of capital disclosed by banks and their leverage fluctuations.

15. If risk weights are calculated using the 'through the cycle' approach (as in Basel III), they are expected to be less procyclical than the formerly used 'point in time' estimates.

16. Adrian and Shin, 2008; Baglioni et al., 2011 and Becalli et. al., 2014.

17. Grill, M., Lang, J.H., and Smith, J., "The impact of the Basel III leverage ratio on risk-taking and bank stability", ECB *Financial Stability Review*, Special Feature, November 2015.

18. ESRB Handbook on Operationalizing Macroprudential Policy in the Banking Sector. Handbook available at: https://www.esrb.europa.eu/pub/pdf/other/140303_esrb_handbook_mp.en.pdf?4e2022c21a736ff4ca6a1eaf0085dd78.

19. Chapter available here: https://www.esrb.europa.eu/pub/pdf/other/150625_esrb_handbook_addendum.en.pdf.

20. This approach is akin to the Bank of England Financial Policy Committee's review of the leverage ratio: http://www.bankofengland.co.uk/financialstability/Pages/fpc/fscp.aspx.

21. The 8.5% risk based capital requirement corresponds to the minimum Tier 1 requirement plus the fully phased in Capital Conservation Buffer.

22. In this context, the leverage ratio is deemed constraining if it is the most demanding capital requirement. It is deemed binding if it will imply that the bank does not have enough capital to comply with the requirement.

23."The analysis suggests that the potential impact of introducing a LR requirement of 3% on the provision of financing by credit institutions would be relatively moderate, while, overall, it should lead to more stable credit institutions".

24. https://www.eba.europa.eu/risk-analysis-and-data/review-of-consistency-of-risk-weighted-assets.

25. For a description of the institution specific countercyclical capital buffer, please see the Banco de Portugal *Financial Stability Report* of November 2016, Box 1.

26. Indeed that is what happens, inter alia, with Public Development banks in France and Germany, which hold large portfolios of exposures that are guaranteed by the Government.

27. There was a more recent transparency exercise published in December 2016 but it did not include an analysis of LR.

28. http://www.bportugal.pt/pt-PT/EstabilidadeFinanceira/MedidasMacroprudenciais/ReservaConservacao/Paginas/default.aspx.

29. http://www.bportugal.pt/pt-PT/EstabilidadeFinanceira/MedidasMacroprudenciais/ReservaContraciclica/Paginas/inicio.aspx.

30. http://www.bportugal.pt/pt-PT/EstabilidadeFinanceira/MedidasMacroprudenciais/ReservaOSII/Paginas/inicio.aspx.

31. Financial Stability Forum, 2009

32. The authors use data from 14 countries for the period 1994-2012, including nine countries from the European Union, but do not include data for Portuguese banks. There was other study, published by EBA, which has used the same model and has obtained almost the same results as Brei and Gambacorta (2016) but was focused on European countries, including a Portuguese sample, and the period 2000-2014. This assessment is part of the EBA Report on the leverage ratio requirements under Article 511 of the CRR.

33. This variable takes the value 1 for the period 2008-2012 and zero in all the other years.

34. Other variables that could represent the cycle were tested, such as the annual growth rate of quarterly nominal GDP and the credit-to-GDP gap, which did not materially change the results obtained in this document.

35. The quarter when the recommendation by Banco de Portugal to increase capital ratios entered into force, opening a period of successive new recommendations and notices aiming at strengthening banks´ resilience. Please note that this dummy largely coincides with a possible "crisis dummy" and also with the introduction of changes to the regulatory framework. As noted, the interaction between this dummy variable and the other explanatory variables as outlined by Brei and Gambacorta (2016) is not presented in this analysis. Nevertheless, the inclusion of these interactions have been test but they showed up as non-statistically significant.

36. The proxy for specific bank risk taking in Brei and Gambacorta (2016) is the standard deviation of the percentage change in market value of assets.

37. According to Roodman (2009) if T is large relatively to N the bias associated to the lag of dependent variable becomes insignificant and a more straightforward fixed-effects estimator works.

38. In the IV fixed-effects estimators the real GDP growth rate for Portugal is instrumented by European Union (EU28) real GDP growth rate.

39. Moreover the coefficients from the GMM model used suffer from over identification due to the high number of instruments (lags of the endogenous variables) when compared with the number of variables.

40. However, even in using the internal rating based method, if risk weights are calculated using the 'through the cycle' approach (as in Basel III), they are expected to be less pro-cyclical than the formerly used 'point in time' estimates.

41. Table 6 only presents GMM estimator in the case of RWA growth given that is the one whose dependent variable shows persistency.

42. For the sake of brevity, these results were not shown.