17 December 2013

Report on the pro-cyclicality of capital requirements under the Internal Ratings Based Approach

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Abbreviations

AIRB Approach	Advanced Internal Ratings Based Approach
BLS	bank lending survey
CCB	counter-cyclical capital buffer
CRD	Capital Requirements Directive – Directive 2006/48/EC and 2006/49/EC
CRD IV	Capital Requirements Directive IV – Directive EU 2013/36
CRR	Capital Requirements Regulation – Regulation EU 575/2013
EAD	exposure at default
EBA	European Banking Authority
ECB	European Central Bank
EL	expected loss
ESI	economic sentiment indicator
ESRB	European Systemic Risk Board
FIRB Approach	Foundation Internal Ratings Based Approach
GMM	generalised method of moments
IRB Approach	Internal Rating Based Approach
ISG	Impact Study Group
LGD	loss given default
MCR	minimum capital requirements
PD	probability of default
PIT	point-in-time
RWA	risk-weighted asset
SA	Standardised Approach
TTC	through-the-cycle

1. Executive Summary

This report analyses whether the Capital Requirements Regulation (CRR) together with the Capital Requirements Directive IV (CRD IV have a pro-cyclical effect, as mentioned in the EBA mandate in Article 502 of the CRR. Pro-cyclicality is defined as 'the dynamic interactions (positive feedback mechanisms) between the financial and the real sectors of the economy.' A pro-cyclical capital requirement regulation refers to a regulation which tends to amplify business cycle fluctuations and cause or exacerbate financial instability.

The focus of this report is specifically on banks applying the Internal Ratings Based (IRB) Approach, since Minimum Capital Requirements (MCR) of IRB banks are inherently risk sensitive, through the calculation of input risk parameters to IRB models, namely the probability of default (PD), the loss given default (LGD) and the exposure at default (EAD).

The report summarises the main findings of previous analysis on the pro-cyclicality of capital requirements, both from the second EBA-ECB report on pro-cyclicality and from the academic literature. The literature review contains some indications of pro-cyclicality of capital requirements. Moreover, the literature points out that IRB banks that compute 'point-in-time' (PIT) PDs produce highly significant variations in capital requirements from peak (expansion) to trough (recession), as opposed to IRB banks that compute 'trough-the-cycle' (TTC) PDs.

The report also presents the results of two empirical analyses based on the Impact Study Group (ISG) dataset. This dataset contains bank data on a Basel II portfolio breakdown on a semi-annual basis, which are not usually available in other databases. The drawback, however, is the short data history which only begins in 2nd half of 2008. First, an analysis based on descriptive summary statistics is presented. The data reveal a shift towards portfolios with lower risk profiles, as exposures in retail and sovereign portfolios have increased while there has been a decline in exposures in bank and corporate portfolios. Finally, evidence on portfolio parameters in the corporate portfolio (which has the largest share of exposures) leads us to conclude that higher provisioning may be one of the reasons for the decrease in capital requirements. For corporate exposures, the average PD increased substantially and average LGD remained stable for the overall portfolio. Increased defaults, which presumably required higher provisioning, are, therefore, thought to have resulted in lower capital requirements. Second, the econometric analysis suggests that there are some statistically significant negative correlations between the capital that banks are required to hold and the macroeconomic environment. This relationship was found at the bank level, for total capital requirements and for capital requirements stemming from market, credit and operational risk individually. This effect was also found at portfolio level, except for the sovereign portfolio. Overall, the evidence on pro-cyclicality of capital requirements is weak, and a clear causal link between capital requirement regulation and the economic cycle could not be established.

The report finishes with some policy recommendations that aim to provide a better view on pro-cyclicality and improve transparency and documentation. Institutions should provide more information to the competent authorities regarding the rating philosophy, the PD calculation and ensure correspondence in the back-testing methodology and the rating philosophy of internal models.

2. Introduction

Article 502 of the Capital Requirements Regulation (CRR - Regulation EU 575/2013) mandates the Commission to monitor pro-cyclicality periodically, and the European Banking Authority (EBA) to report on (i) the comparability of the capital requirements and (ii) the cyclicality of the capital requirements and potential pro-cyclicality effect, by end 2013:

> *'The Commission, in cooperation with EBA, ESRB and the Member States, and taking into account the opinion of the ECB, shall periodically monitor whether this Regulation taken as a whole, together with Directive 2013/36/EU has significant effects on the economic cycle and, in the light of that examination, shall consider whether any remedial measures are justified. By 31 December 2013, EBA shall report to the Commission if and how methodologies of institutions under the IRB Approach should converge with a view to more comparable capital requirements while mitigating pro-cyclicality.'*
>
> *'Based on that analysis and taking into account the opinion of the ECB, the Commission shall draw up a biennial report and submit it to the European Parliament and to the Council, together with any appropriate proposals. Contributions from credit taking and credit lending parties shall be adequately acknowledged when the report is drawn up.'*

The EBA understands the provision on Article 502 of the CRR as constituting two separate but linked issues, namely (i) *comparability* (the issue of convergence of capital requirements across institutions) and (ii) *pro-cyclicality* (the issue of variations in capital requirements across the economic cycle, the subsequent impact on lending behaviours and the potential pro-cyclicality effect as amplification of the economic cycle by the financial sector). This report elaborates on the pro-cyclicality part of the EBA mandate.

According to the Financial Stability Board (2009), the term 'pro-cyclicality' refers to 'the dynamic interactions (positive feedback mechanisms) between the financial and the real sectors of the economy. These mutually reinforcing interactions tend to amplify business cycle fluctuations and cause or exacerbate financial instability'. 'Pro-cyclicality' is used in reference to the amplification of the natural fluctuations in the economic cycle by the activities of the financial sector. In analysing potential pro-cyclical effects, it needs to be carefully differentiated from 'cyclicality', which refers to the expected adjustments of minimum capital requirements (MCR) to the economic cycle. Cyclicality of capital requirements is inherent to the economic cycle, and does not mean that fluctuations in capital requirements amplify the economic cycle. More specifically,

banks will expand their lending activities during good times, and shrink their lending portfolios during economic downturns, as a consequence of, inter alia, demand for loans. The difference between cyclicality and pro-cyclicality is important, and only the latter is the focus of the report. More specifically, the goal of this report is to analyse whether or not current capital regulations contribute to any pro-cyclical effect of capital requirements.

If capital requirements are pro-cyclical, then this means that (i) CRR and CRD IV have an impact on loan supply and (ii) the supply of loans attenuates the economic cycle. The rationale behind this argument is that bank capital is typically more expensive than other forms of funding, so a situation in which capital requirements become binding may force banks to cut back on lending or increase lending margins rather than raising capital. Indeed, banks' capital may fall below (or close to) the required regulatory minimum during an economic downturn. This may induce banks to reduce lending or increase lending margins, thereby amplifying the cyclicality in lending. Conversely, excess capital holdings (above the required regulatory minimum) during an economic upturn may contribute to expanding credit and fuelling a credit-led boom.

The above mandate suggests focusing specifically on financial institutions applying the Internal Ratings Based (IRB) Approach, since MCR for banks following the IRB Approach are risk sensitive[1]. During a downturn, assessments of credit and market risk typically increase, and consequently MCR for banks will increase and force banks to hold more capital against those increased risks. This risk-sensitivity of capital operates though the input risk parameters to IRB models, namely the probability of default (PD), the loss given default (LGD) and the exposure at default (EAD). The risk-sensitivity of capital requirements was introduced in the Basel II regulation and, therefore, capital requirements may potentially be more risk sensitive than in the previous Basel I regulation. A key issue in this report is, therefore, to assess what is the additional layer of pro-cyclicality generated by the Capital Requirements Directive (CRD) compared with Basel I, especially in the IRB Approach. However, given the complex relationship between capital requirements, banking lending and the real economy, especially in the current economic context, this is not a straightforward exercise and it is difficult to find the correct data to accurately investigate this question.

Various studies suggest that the banking industry is inherently pro-cyclical. This is because banks' lending behaviour tends to reinforce the business cycle, regardless of the design of capital requirements: banks tend to decrease lending during recessions, exacerbating the economic downturn, and increase it during expansions, contributing to an overheating of the economy. Regulation can be one of the factors that can amplify these cycles, but there are other, more relevant, factors. In academia, a number of other sources have been cited as fostering this pro-cyclicality in bank behaviour, namely:

[1] However, the Standardised Approach (SA) is also inherently risk sensitive because of its reliance on external ratings. To the extent that external ratings are assigned on the basis of a point-in-time (PIT) philosophy, capital requirements for banks following the SA may also be pro-cyclical.

- **Information asymmetries between borrowers and lenders:** when economic conditions improve and collateral value rises, these firms are able to gain external finance. However, when economic conditions are depressed and collateral values are low, even borrowers with profitable projects find it difficult to access financing sources, for instance because of high risk aversion among lenders leading to tighter lending standards and limited lending capacity, which increases the length and severity of the downturn.

- **Difficulties in measuring risk:** measurement difficulties tend to underestimate risk in the boom times and overestimate it in recessions. Many of the risk measurement methodologies used by banks and rating agencies imply that risk falls during periods of financial stability or booms, which contributes to lowering the level of provisions and capital requirements, whereas (measured) risk rises in periods of recession or financial instability. However, risk increases in booms, and the recessionary period is just the materialisation of the risk taken. Lending spreads typically fall in a pre-crisis period, and, when this trend reverses, this is an additional factor contributing to the credit restrictions.

- **Incentives:** the current financial crisis has shown that managers of financial institutions may take risks that are excessive in relation to the interests of other stakeholders. Remuneration schemes based on short-term performance may prompt executives to take excessive risks and to overlook inefficiencies in the long term[2]. Some lending practices, such as forbearance, may accentuate and lengthen the recovery phase, although forbearance lending might be considered counter-cyclical, as it ensures funding to borrowers with financial difficulties. It is precisely during a downturn that less credit is available to good borrowers, thus exacerbating the initial difficulties and possibly triggering a credit crunch.

- **Maturity transformation:** funding long-term assets with short-term liabilities constitutes the regular business of banks. However, when the maturity structure of assets and liabilities is excessively divergent, this can expose banks to the risk of runs, the possibility that they might need to contract wholesale lending, hoard liquidity or sell assets at depressed market prices, thus causing pro-cyclical behaviour.

- **Intra-financial system activities:** the financial sector is typically highly interconnected. This feature helps to manage risk and to distribute funds to where they can be most efficiently deployed, but interconnectedness can also hide actual risks and exacerbate losses when the crisis erupts.

In sum, banks' activities are inherently pro-cyclical, and this pro-cyclicality is due to numerous factors. Capital requirements regulation contributes to banks' pro-cyclical behaviour. This is also mentioned by the Financial Stability Board (2009):

"Alongside limitations in risk measurement and distortions in incentives, elements of the policy framework may act as contributing factors to pro-cyclicality. For example, other things equal, the

[2] For example, in good times, bank managers may opt for lax lending standards in order to artificially inflate short-term profits, despite the potential drain on future profits.

more pro-cyclical are the measures of risk embedded in prudential arrangements (such as minimum requirements for capital or liquidity), the more likely it is that they would strengthen the positive feedback mechanisms between credit and the business cycle." However, the focus of this report to analyse whether the current capital regulation, in particular the methodologies of institutions under the IRB Approach, contributes to pro-cyclicality.

The EBA and the ECB have issued two reports on the pro-cyclicality of the CRD, prepared in close cooperation with the joint Financial Services Committee/EBA Impact Study Group (ISG). The second ECB-EBA report on pro-cyclicality was finalised in April 2012 (EBA-ECB, 2012). This report provides a detailed empirical analysis of the pro-cyclicality of the CRD on the basis of data collected by the ISG. The report also includes an analysis and first assessment of the performance of the counter-cyclical buffer mechanism. Based on the second ECB-EBA report, the European Commission published its 'Second Report on Effects of Directives 2006/48/EC and 2006/49/EC on the Economic Cycle' in July 2012[3]. The main empirical findings of the second ECB-EBA report are:

- First, the assessment of the input parameters to MCR calculations suggest some counterbalancing effects between cyclical effects of risk parameters such as PDs or LGDs on the one side and counter-cyclical developments in exposures on the other. These counterbalancing effects may render the cyclical effect on overall MCR somewhat unclear or even unstable over time, as the speed of adjustments may differ across parameters and portfolios.

- Second, findings for MCR at the bank and portfolio levels suggest that there are broad indications for some cyclicality at the level of corporate and retail portfolios. These cyclical effects, however, seem to be mitigated to a large extent at the bank level. As already indicated by the findings on counterbalancing cyclical effects among the MCR parameters, these mitigations are likely to be primarily due to portfolio adjustment concerning the size and composition of banks' overall portfolios, including interbank and sovereign exposures, as well.

- Evidence from ad hoc questions in the Euro Area Bank Lending Survey (BLS) results of July 2011 and January 2012 points to some notable impact of regulatory changes both on banks' balance sheets and on their lending policies. This in turn would suggest that any cyclically induced regulatory restrictions would translate into a second-round feedback to banks' actual customer lending. Again, however, the caveat applies that findings may largely be linked to the financial crisis.

The report emphasises that the quantitative evidence on the possible pro-cyclicality of the CRD is highly complex, and that the econometric analysis is subject to a number of caveats, such as the lack of data over a whole business cycle, and also because the available sample period covers the recent financial crisis, where the crisis induced behavioural changes and policy interventions that may have distorted general bank behaviour.

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0400:FIN:EN:PDF

3. Literature Review

The topic of pro-cyclical effects of bank behaviour as a consequence of capital requirements is not new and has also been analysed in detail in a number of academic papers. The following section gives an overview of some of the more important contributions from the academic literature.

The general pattern of banks' pro-cyclical behaviour is described as follows by Horvath, Mero and Zsamboki (2002, p 66): 'In periods of economic recession, due to information asymmetry, not even projects which otherwise would be financed profitably and without problems can be assured of obtaining loans. Accordingly, banks' behaviour contributes to further deepening of an emerging crisis. During periods of economic upswing the situation is reversed. Under these circumstances, banks' attitude changes – loans can be more easily received by enterprises, and the easier conditions for obtaining loans facilitate and strengthen the process of economic development'. Consequently, the pro-cyclicality of capital requirements will need to be distinguished from the pro-cyclicality of general bank behaviour.

In addition, Borio, Furfine and Lowe (2001) illustrated the general pro-cyclicality of bank behaviour using a database of information collected about 10 developed OECD member countries for the period 1980–1999. They demonstrated that periods of economic upturn are accompanied by significant increases in the ratio of private sector credit to gross domestic product (GDP), while during periods of economic downturn this indicator generally falls. Similarly, periods of strong credit demand coincide with upward trends in real estate and equity prices. They found the pro-cyclical nature of banks' credit risk provisioning to be even stronger than that of changes in the volume of loans granted and asset prices. A strong negative correlation was demonstrated between banks' provisioning, on the one hand, and business cycles, on the other, with the consequence that the volume of provisions accumulated by banks for covering future losses generally begins to increase only after the rate of economic growth has already slackened significantly.

As regards the pro-cyclicality of capital requirements, a large strand of the academic literature uses simulation techniques based on the IRB foundation formula to analyse the peak-to-trough variation of Basel II capital requirements. These studies analyse the relationship between the credit quality of the borrowers (PD) and the capital charges. Other input factors (such as LGD or EAD) are typically assumed to be constant. For instance, Kashyap and Stein (2004) find that the new Basel II capital requirements have the potential to create an amount of additional cyclicality in capital charges that is, at a minimum, economically significant, and that may be – depending on a bank's customer mix and the credit-risk models that it uses – quite large.

Saurina and Trucharte (2006) find that the cyclicality of capital requirements depends on the way internal ratings systems are implemented under Basel II. Under the IRB Approach, the rating philosophy for the PDs may follow either a 'point-in-time' (PIT) or a 'through-the-cycle' (TTC) approach. PIT ratings represent an assessment of the borrower's ability to discharge his obligations over a relatively short horizon (e.g. a year), and so can vary considerably over the

cycle. The TTC approach focuses on a longer horizon, abstracting in principle from current cyclical conditions. TTC ratings are, therefore, inherently more stable and less cyclical than PIT ratings. Saurina and Trucharte (2006) show that IRB banks that compute PIT PDs produce highly significant variations in MCR from peak (expansion) to trough (recession), as opposed to IRB banks that compute TTC PDs.

External ratings are typically viewed as more TTC than internal ratings; therefore, risk-weighted assets of banks applying the Standardised Approach (SA) (or the risk-weighted assets of IRB banks that fall under partial use) are likely to be less cyclical than risk-weighted assets under the IRB Approach. However, some studies question this view. The second EBA-ECB report, for instance, illustrated a close correspondence between GDP growth and rating upgrades in securitisation products over the period 2007–2012. This implies that capital requirements which are linked to external ratings follow a clear cyclical pattern at the level of the individual exposures. However, given the discreteness of risk buckets, it is not always easy to determine the actual added cyclicality due to cyclicality in ratings. Moreover, overall capital requirements for banks may be less cyclical if adjustments in banks' portfolio composition are also taken into account.

Another strand of literature has focused on cyclicality in the capital buffers. The literature documents a negative relationship between the business cycle and capital buffers. From a quantitative standpoint, Ayuso, Perez and Saurina (2004) show that an increase of 1 percentage point in GDP growth might reduce capital buffers by 17%. Other studies confirm the negative relationship between the economic cycle and capital buffers (Bikker and Metzemakers, 2005; Lindquist, 2004; Stolz and Wedow, 2011).

Although our report, as noted above, focuses particularly on the IRB Approach, it is interesting to note that in the literature the two approaches have not always been looked at in isolation. Daniellson et al. (2001) argue that the reliance on credit ratings in the SA and the general application of uniform risk weights across a number of institutions (leading to so-called 'herd behaviour') creates pro-cyclicality across the financial system when a market downturn occurs.

Finally, some suggestions on how to reduce the pro-cyclicality of capital requirements can be found in the academic literature. Gordy and Howells (2006) suggest that PD estimation could use a TTC approach to limit the pro-cyclicality inherent in the IRB calculation method, and others (Repullo, Saurina and Trucharte, 2010) appear to agree. However, both papers also advocate an additional method of smoothing out PD volatility, by applying a multiplier. Indeed, Gordy and Howell appear to suggest that applying a time-varying multiplier to the IRB formula would be a more sophisticated smoothing rule. The Repullo paper suggests applying a capital output multiplier linked to GDP growth. These papers, therefore, suggest that, by amending the parameters of the IRB model, a less pro-cyclical capital figure may be achieved. However, other authors point to mitigants beyond the IRB parameters to smooth the capital figures. Ayuso, Perez and Saurina (2004) highlight the application of Pillar 2 as a useful mitigant of pro-cyclicality. Fillat and Montoriol-Garriga (2010) suggest that dynamic provisioning could also serve as an instrument for addressing pro-cyclicality. Last but not least, Angelini et al. (2010) suggest that pro-cyclicality can be offset by implementing a

counter-cyclical capital requirements policy – an initiative that has now been implemented in the Basel III approach in the form of a counter-cyclical buffer.

4. Empirical evidence on pro-cyclicality

4.1 Descriptive statistics based on the ISG database

The ISG database has a semi-annual frequency and ranges from H2 2008 to H2 2012. It covers banks from 12 different countries. The database is unbalanced, with the number of banks ranging from 82 to 94. In order to report statistics on the same set of banks over time, the sample was balanced, retaining only banks that have data reported over the full time period of the database. This results in a sample of 60 banks. Note that the ISG database covers only banks that follow the IRB Approach. Table 1 describes the distribution of banks across the different size buckets in EAD at H2 2012. The results in the table indicate that the distribution is skewed, as more than half of the banks in the sample have an EAD below EUR 200 billion. The other banks are scattered in the other size buckets.

On the basis of the selected data contained in the ISG database, and bearing in mind the sample and time series restrictions, the next paragraphs analyse the time series change of selected capital requirement components and their distribution across portfolios.

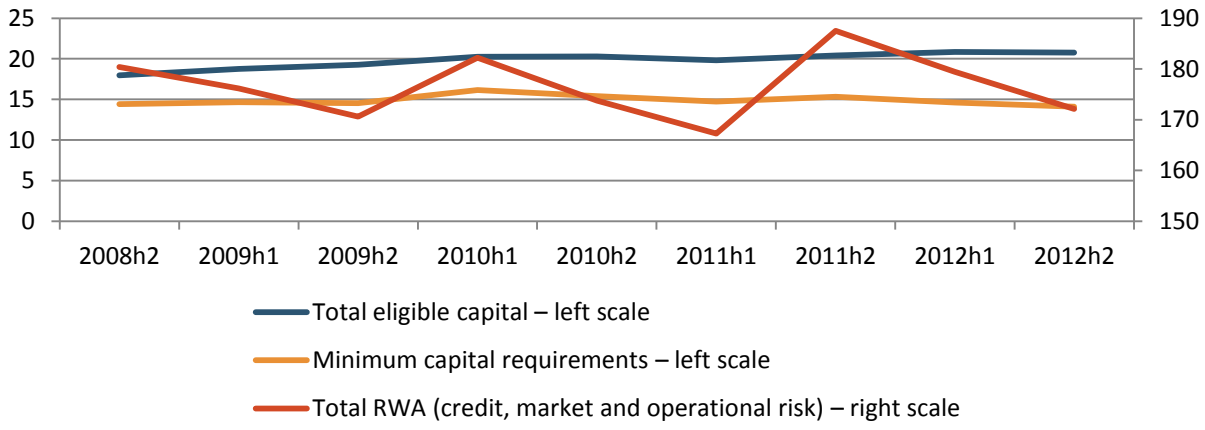
During the observed period, a marked improvement in the average solvency ratio of European banks can be observed, from 11.5% in H2 2008 to 14.5% in H2 2012. The strengthening in banks' capital ratios has been driven both by an increase in capital resources (by 16%) and a reduction in risk-weighted assets (RWA) (by 4.6%). However, as shown in Figure 1, a clear cyclical pattern can be observed in RWA. One potential explanation for the build-up of capital in the most recent period is that banks are gradually taking action in preparation for the introduction of the new capital requirements in CRR and CRD IV. In addition, the EBA 2011 recapitalisation exercise is reflected in the figures. MCR have declined over the sample period by 2.36%. This comes from an initial increase between H2 2008 and H1 2010, and a subsequent decline from H1 2010. MCR for IRB banks are the outcome of multiple endogenous factors, so it is difficult to say what change in capital requirements one would expect if the pro-cyclicality theory held. Given the decline in economic activity that was observed over the sample period, and the corresponding increase in risk, one would expect this to translate into higher MCR for IRB banks, unless portfolio reallocations offset this behaviour. Another complicating factor is the effect of provisions on capital requirements.

Table 1: Size and geographical distribution of the sample

Country	< 10	10–50	50–100	100–200	200–500	500–1000	> 1 000	Total
AT	1	0	0	0	1	0	0	2
BE	0	1	0	1	1	0	0	3
DE	4	4	2	4	4	2	0	20
ES	0	0	1	2	1	1	1	6
FR	0	1	0	0	0	2	2	5
GB	0	0	1	0	1	3	1	6
HU	1	0	0	0	0	0	0	1
IE	0	0	1	2	0	0	0	3
IT	0	1	0	0	1	1	0	3
LU	0	1	0	0	0	0	0	1
NL	0	0	0	0	0	2	0	2
SE	1	3	0	1	2	1	0	8
Total	7	11	5	10	11	12	4	60

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

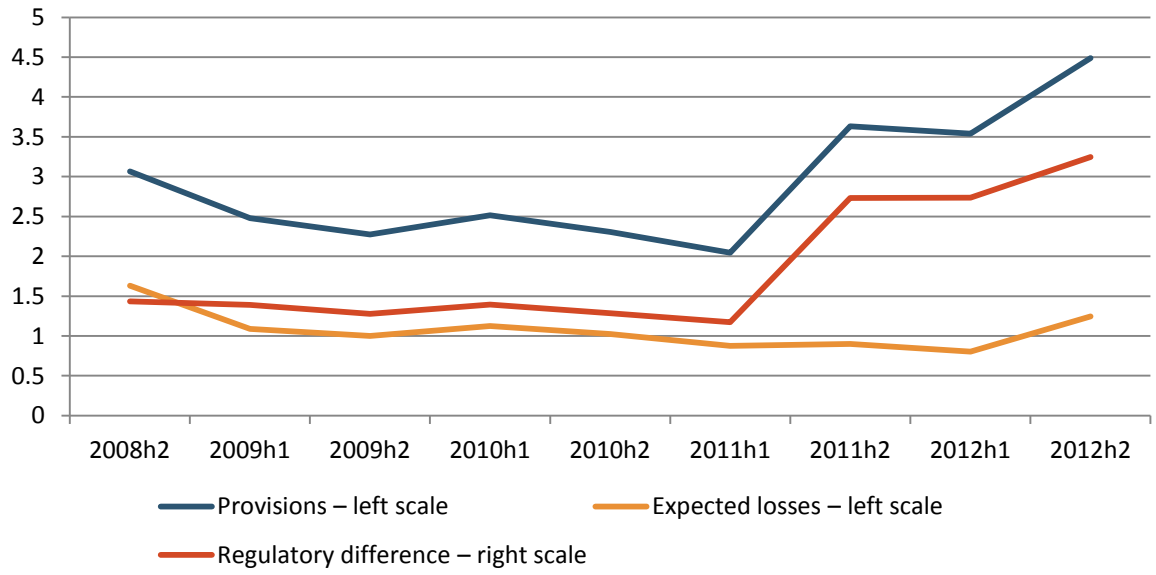
Figure 1: Total capital, minimum capital requirements and change in RWA (EUR billion)



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

A key feature of the new capital framework is that expected credit losses are supposed to be covered by provisions under the IRB Approach. To the extent that banks' provisions are insufficient to cover expected losses (EL) (i.e. there is a shortfall of provisions), capital should provide a cushion for the uncovered risk. In practice, the shortfall of provisions, called 'regulatory calculation difference' (RCD) in the terminology of the CRD, has to be deducted from available capital. The excess of provisions over EL (i.e. a positive RCD) is to be added to the regulatory capital (Tier 2), but only up to a certain limit (maximum 0.6% of RWA calculated under the IRB Approach). Figure 2 illustrates how provisions, expected losses and the regulatory difference have changed over the sample period. The regulatory difference (RD), i.e. the difference between eligible provisions and expected losses, has increased by 56.86%. This stems from an increase in provisions by 31.75%, whereas expected losses have declined by 31.14%.

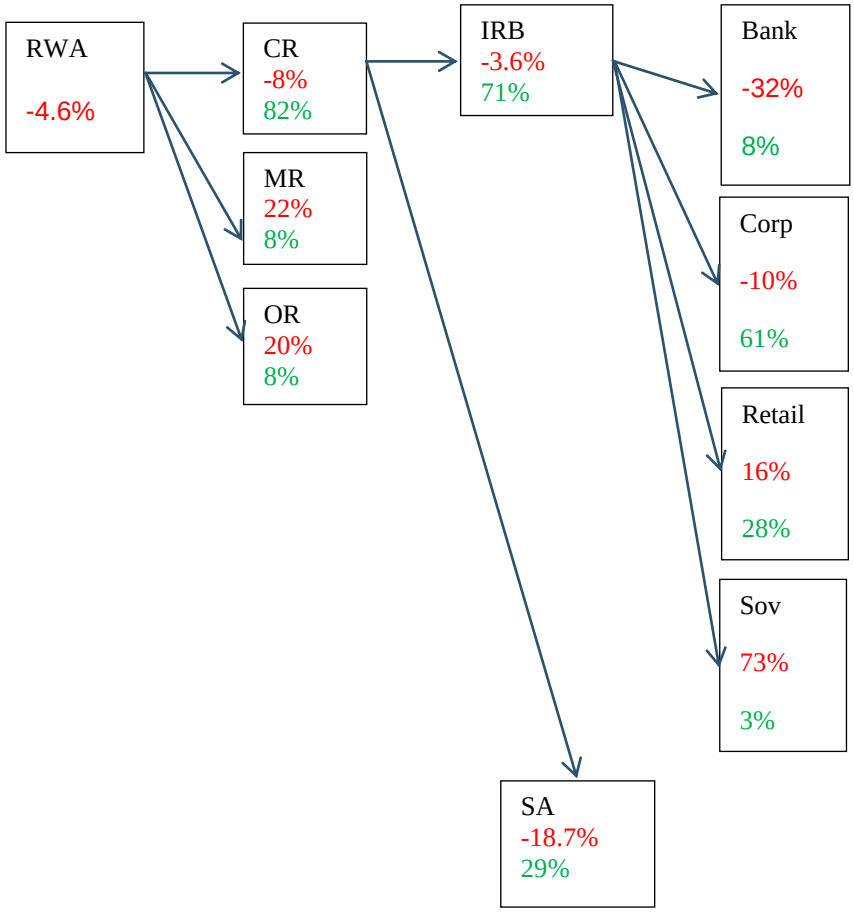
Figure 2: Provisions, expected losses and regulatory difference



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 3 provides a breakdown of the drivers behind the decrease in RWA. The numbers in red (above) represent the growth rate of the underlying variable over the sample period (H2 2008-H2 2012), whereas the figures in green (below) represent the overall share of the variable in total (at H2 2012).

Figure 3: RWA breakdown analysis



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

The following equation illustrates that the distribution of exposures across credit, market and operational risk determines the final RWA outcome.

$$RWA = RWA_{credit} + RWA_{market} + RWA_{op.risk}$$

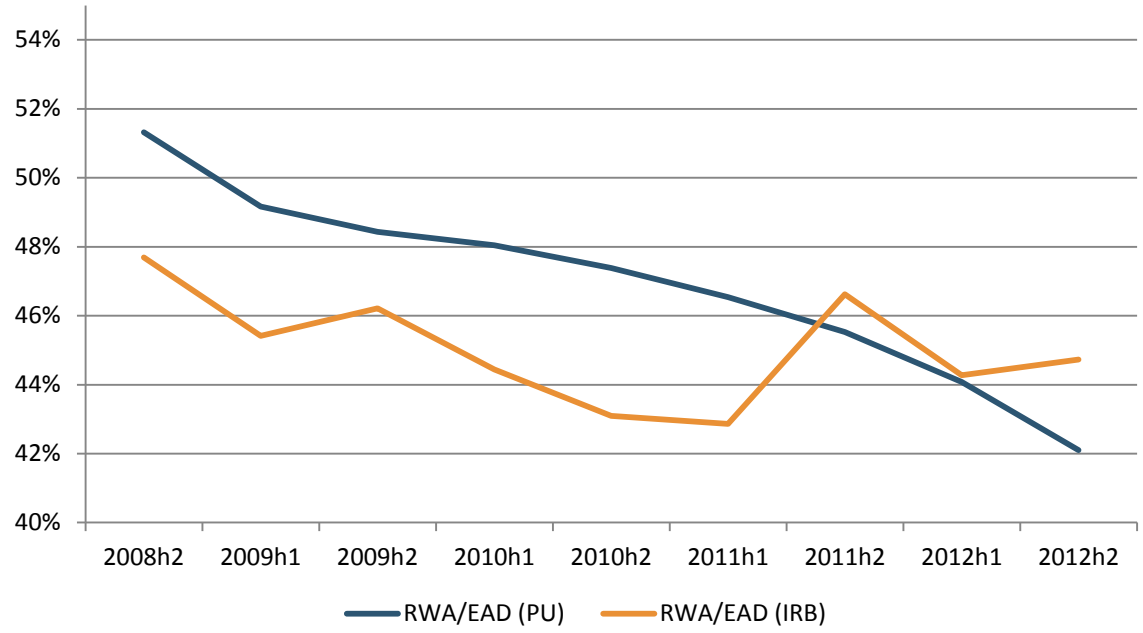
The decline in RWA can be further broken down in RWA stemming from credit, market and operational risk. Credit risk RWA declined by 8%, whereas market and operational risk RWA increased by 22% and 20% respectively. Given that credit risk accounts for the largest part of RWA (82% at H2 2012), the decline in credit risk RWA dominates in the total decline of RWA. However, the decline in RWA can be due to a decline in risk weights or a shift in portfolios from more risky to less risky assets.

Some banks are allowed to compute credit risk RWA under the SA, even though in general, they have approval to apply the IRB Approach (i.e. permanent partial use). Therefore, the decrease in credit risk RWA can be further broken down in the RWA component under the IRB Approach versus the SA. The decrease in RWA reported under the SA is significant at 18.7% but accounts for

only 29% of total credit risk RWA. The more significant part of the credit risk RWA reported under the IRB accounts for 71% but only declined by 3.6%. As the main concern of the pro-cyclicality under Basel II is the higher risk-sensitivity under the IRB Approach, this finding does not support the view that Basel II adds to pro-cyclicality in bank capital, although this approach does not take into account heterogeneity of the portfolios.

As a proxy for the actual risk weights that apply to both components of RWA, the ratio of RWA to EAD is computed. The data show that the total average RWA/EAD ratio decreased by 4.9 percentage points since 2008. If the pro-cyclicality theory holds, we would expect to see an increase in risk weights during crisis times, especially stemming from the IRB part of RWAs. Figure 4 indicates that the decline in effective risk weights was strongest for the RWA under the SA (-18%, versus only -6% for the component in the IRB Approach). In absolute terms too, the decline in effective risk weights was largest for RWA under the SA (-9 percentage points, versus -3 percentage points for the IRB part).

Figure 4: RWA/EAD for IRB part and SA (partial use)



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

RWA can be further broken down into the RWA that fall under the different portfolios, i.e. corporate, bank, retail and sovereign, as shown in Figure 3 and the equation below:

$$RWA = RWA_{corp} + RWA_{bank} + RWA_{retail} + RWA_{sov}$$

In general, three channels affect the change over time in RWA: a portfolio mix effect (how exposures are distributed across the corporate, bank, retail and sovereign portfolios), a portfolio composition effect (the distribution of exposures within each portfolio) and an IRB ratings effect (the average risk weight for each portfolio). The challenge is to disentangle the effects that operate simultaneously through the different channels. The following equations show how evolutions in RWA consist of different components:

$$RWA = EAD_{corp} \cdot \frac{RWA_{corp}}{EAD_{corp}} + EAD_{bank} \cdot \frac{RWA_{bank}}{EAD_{bank}} + EAD_{retail} \cdot \frac{RWA_{retail}}{EAD_{retail}} + EAD_{sov} \cdot \frac{RWA_{sov}}{EAD_{sov}}$$

$$RWA_{corp} = EAD_{corp} \cdot \left[\sum_i \frac{EAD_i}{EAD_{corp}} \cdot \frac{RWA_i}{EAD_i}\right]$$

$$RWA_{corp} = EAD_{corp} \cdot [\sum_i Share_i \cdot RW_i]$$

Portfolio mix effect

Portfolio composition effect

IRB effect

However, the ISG dataset does not contain data on individual exposures. Therefore, the actual risk weights and exposure shares can be computed only at the portfolio level. This implies that we can analyse only the portfolio mix channel and a combination of the portfolio composition and the IRB ratings effect. In order to make strong statements about the pro-cyclicality of capital requirements, more granular data (loan level data) are necessary. In the absence of such granular data, the IRB ratings effect cannot be quantified[4].

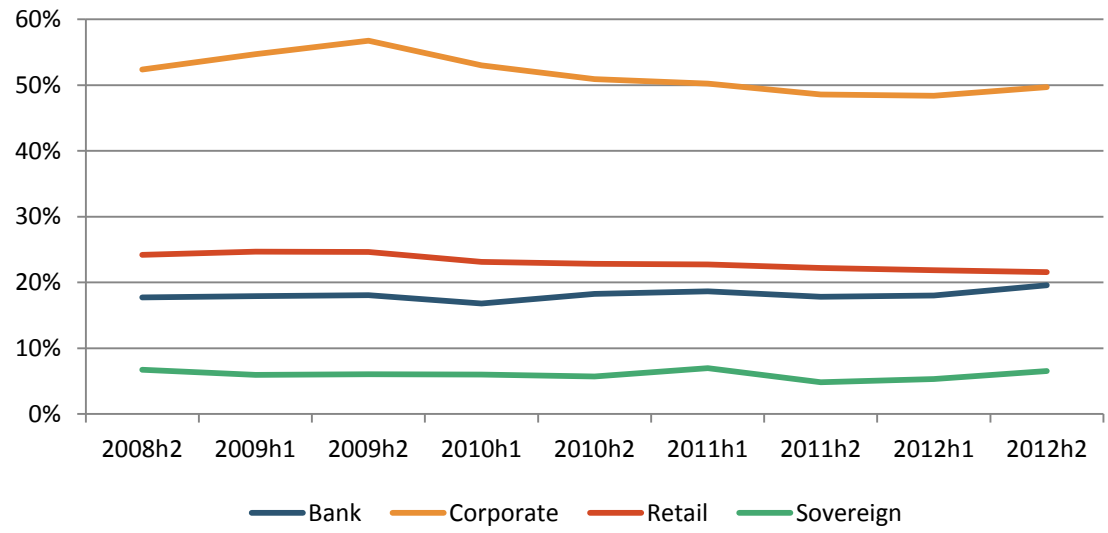
Therefore, in very general terms, the decline observed in RWA can be due to a decline in risk weights, but it can also be due to a reallocation in banks' portfolios towards less risky portfolios or asset classes. We now look at both the change over time in the relative shares of EAD in the different portfolios and the actual risk weights.

Figure 5 displays the change over time in RWA/EAD over different portfolios. The data show that the effective risk weights declined for all portfolios, except the bank portfolio, for which risk weights increased by 10%. However, it seems hard to believe that risk weights that applied to the same portfolio (held constant) would have declined over the observed sample period. In fact, this decline in effective risk weights could be due to a wide range of factors, such as change in the portfolio quality, the impact of roll-out plans or changes in banks' modelling or supervisory

[4] To draw inferences on the IRB ratings effect, the portfolio would need to be held constant. The RWA/EAD ratio can provide evidence on the IRB ratings effect only if the ratio applies to the same portfolio over time.

practices. More specifically, portfolio quality may have changed because banks changed the composition of their portfolios towards less risky assets. Banks may, for instance, have decided not to renew the riskier loans or have written off losses on the riskier assets, consequently changing the composition of the portfolio. Alternatively, banks may have applied stricter criteria in approving new loans or renewing existing loans. These can take the form of stricter collateral, or even guarantees. Finally, the picture that emerges from the data is potentially confused by forbearance. In general, supervisors are concerned by a general trend of deteriorating asset quality across the European Union due to the current environment of low growth. Asset quality issues can slow new lending down and delay economic recovery. Concerns mostly relate to the extent of the use of forbearance for delaying loss recognition and masking asset quality deterioration, and the consistency of non-performing loan recognition across the EU.

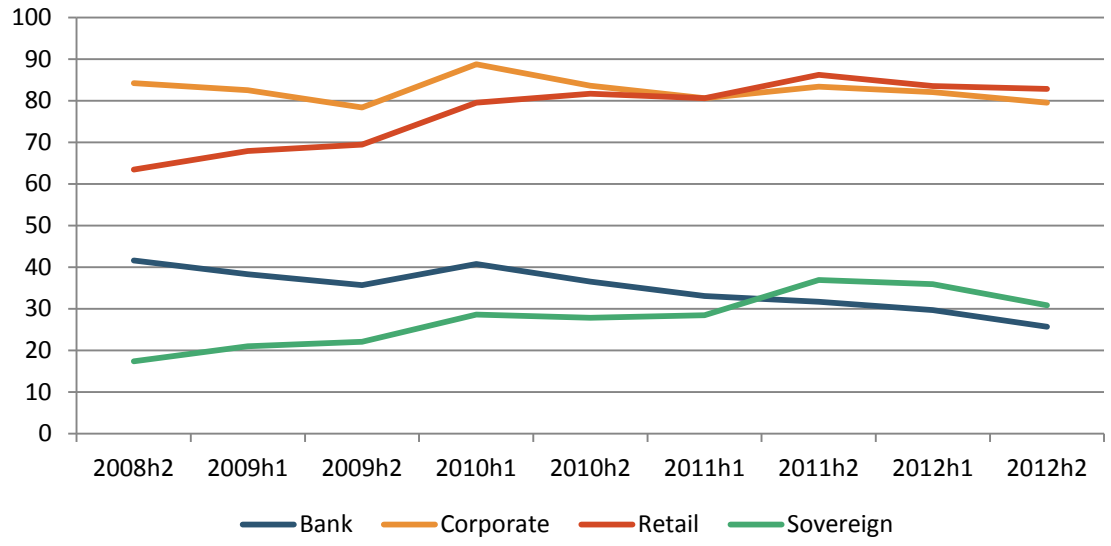
Figure 5: RWA/EAD at portfolio level – IRB only



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

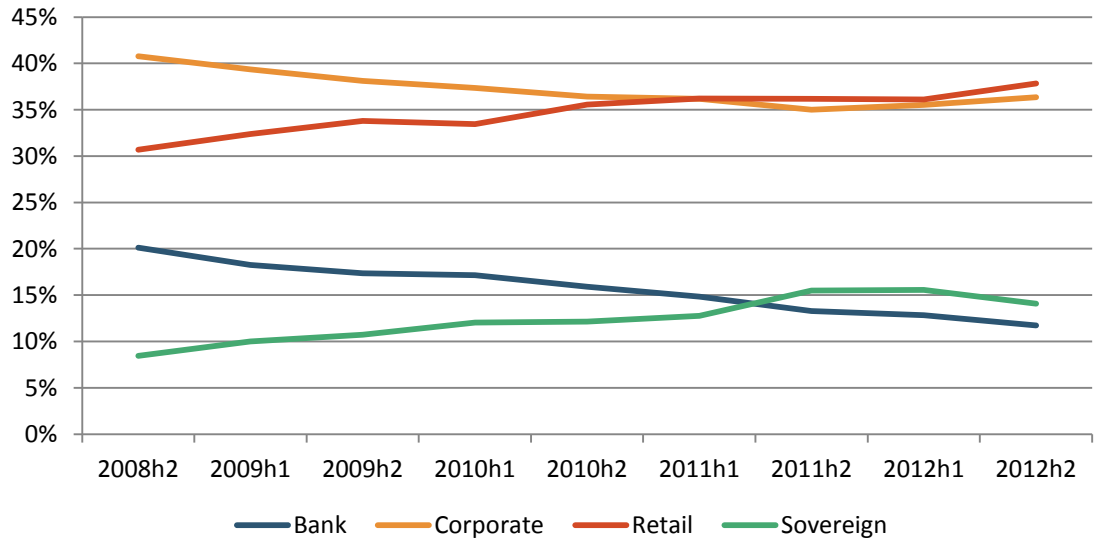
Figures 6 and 7 show the change of EAD in the different portfolios, both in absolute levels and in percentages. We can observe that exposures have increased in the retail and sovereign portfolios and decreased in the corporate and bank portfolios. On a relative basis, the share of exposure in the retail and sovereign portfolio has increased over the sample period, by 5 and 6 percentage points respectively. The share of exposure in the bank and corporate portfolio has decreased, by 7 and 4 percentage points respectively. Consequently, there is evidence of portfolio reallocation towards portfolios with lower risk profiles.

Figure 6: EAD at portfolio level (EUR billion) – IRB only



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 7: EAD at portfolio level – IRB only



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

We now turn to the change over time in the portfolio parameters to complete the picture on what happened to the (risk) composition over the different portfolios. Figure 8 shows how the share of defaulted exposures changed over time. A sharp increase can be observed in the corporate and retail portfolios. Figure 9 shows that the exposure in default increased also in absolute levels. In the retail and corporate portfolios, the increase in the share of defaulted exposures may be an important factor in a decrease in the effective risk weights. Defaulted

exposures will however also affect the capital position of the institutions, and may hence contribute to pro-cyclicality, despite the drop in minimum capital requirements.

Figure 8: Average share of default at portfolio level

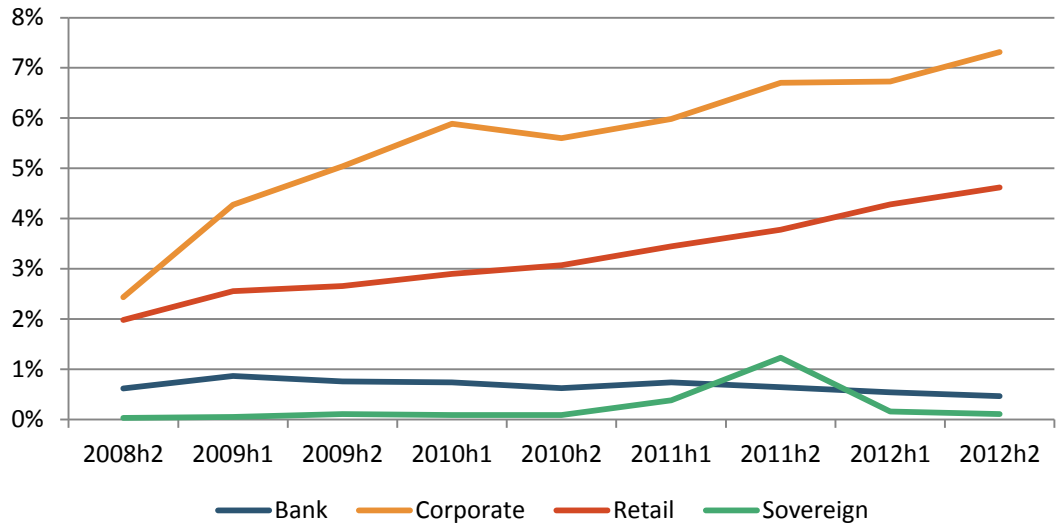
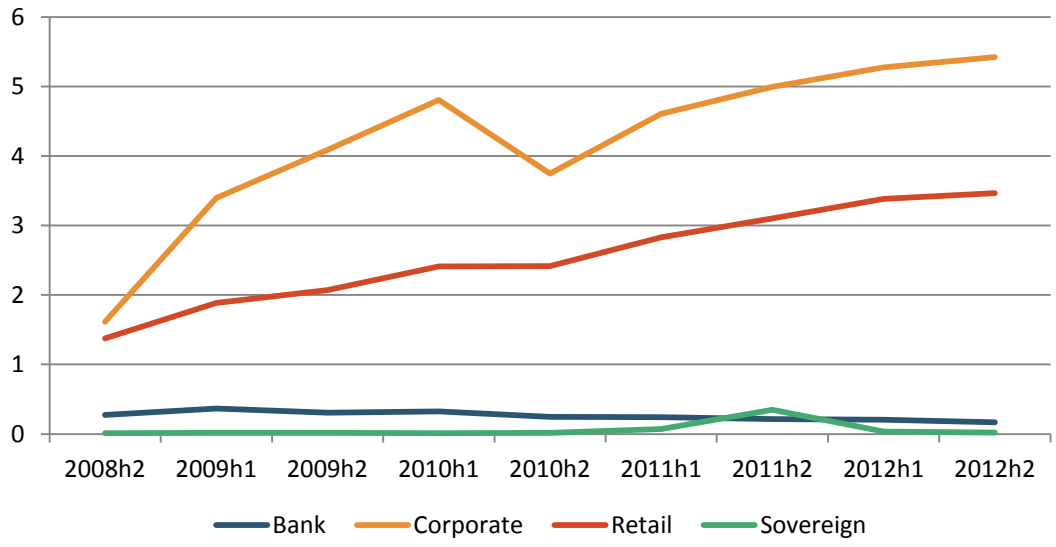


Figure Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 9: EAD, defaulted exposure (EUR billion)

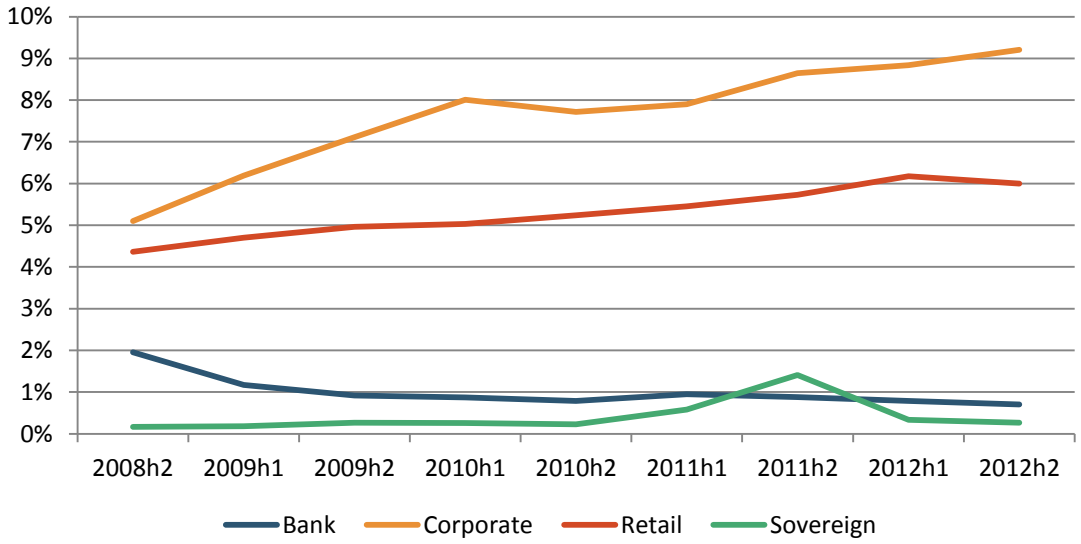


Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Turning now to the other portfolio parameters, PD and LGD, we observe that the average PD in the corporate and retail portfolios has increased over time, whereas the average LGD remained relatively stable. However, Figure 10 shows that the increase in average PD is mainly due to a shift in EAD to the defaulted exposures, as PDs in non-defaulted exposures have declined by 25% and

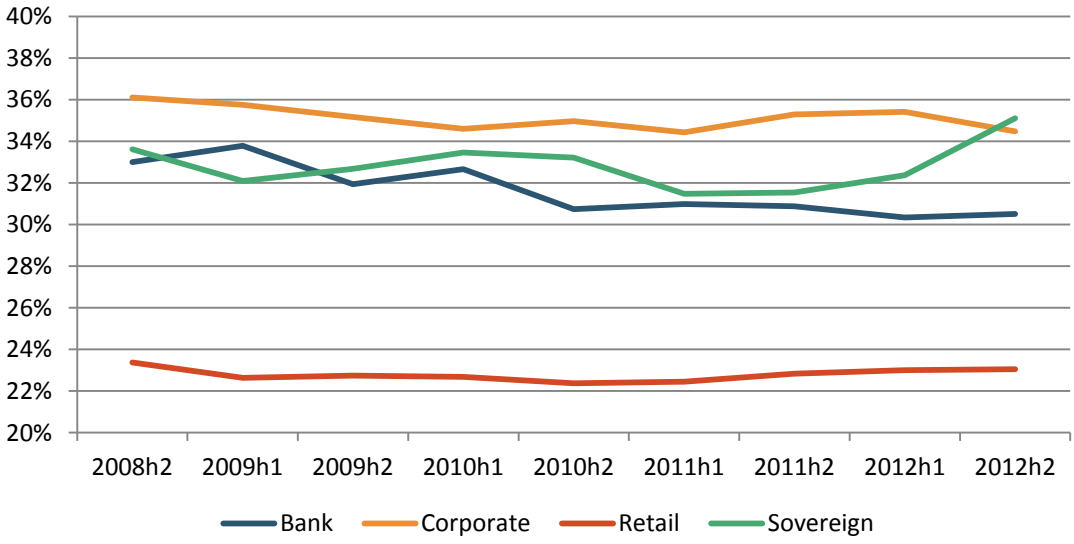
15% respectively and LGDs have fallen 9% and 5% respectively for the corporate and retail portfolios. Increased defaults, which presumably required higher provisioning, have thus resulted in lower capital requirements. However, it should again be noted that defaulted exposures will also affect the capital position of the institutions, and may hence contribute to pro-cyclicality, despite the drop in minimum capital requirements.

Figure 10: Average PD



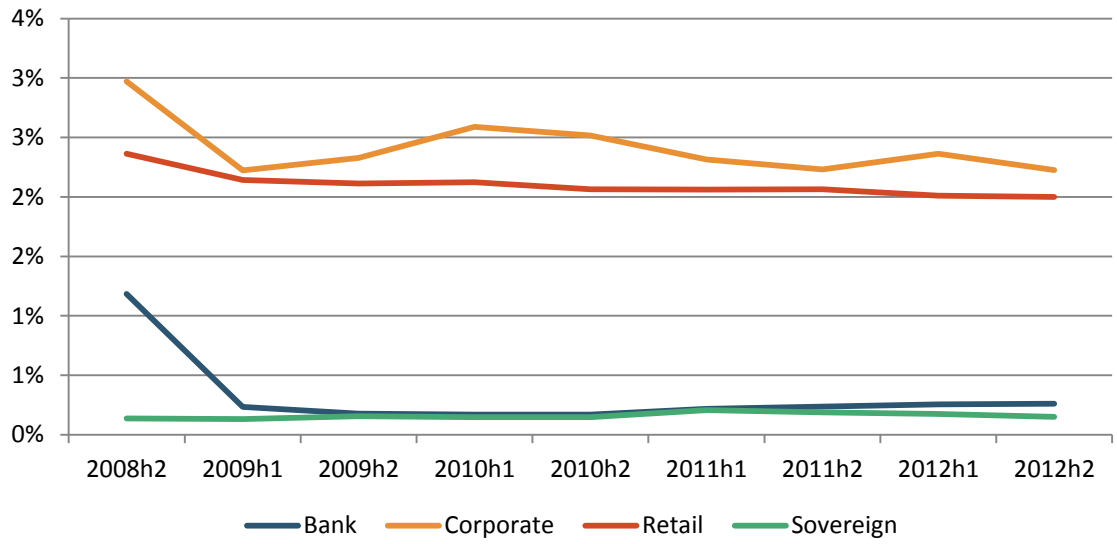
Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 11: Average LGD (%)



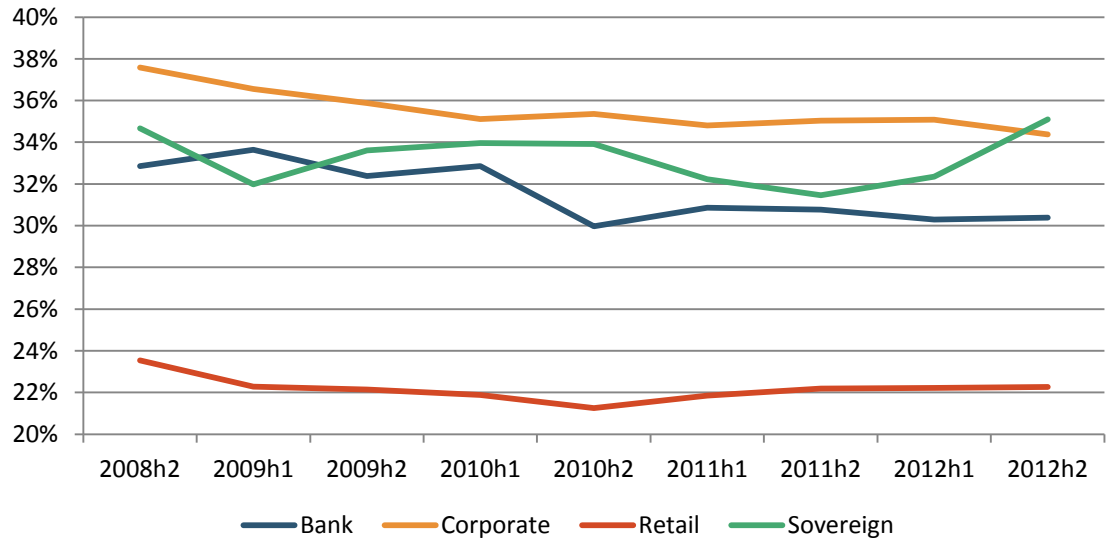
Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 12: Average PD (non-defaulted exposure)



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Figure 13: Average LGD (non-defaulted exposure)



Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Conclusions

Overall, given the lack of granular data at the asset level (loan level), it is not possible to isolate the IRB ratings effect from the portfolio mix and portfolio composition effect. Even if these data were available, the limited time period covered by the dataset remains an obstacle to making

strong conclusions about the pro-cyclicality of capital requirements, especially since the dataset covers the crisis period, during which changes in banks' behaviour and government interventions have been significant.

Despite the data limitations, the evidence seems to suggest that there has been a shift towards portfolios with lower risk weights, as exposures in the retail and sovereign portfolio have increased relative to a decline in the share of the bank and corporate portfolio. This finding is in line with the conclusions of Cannata, Casellina and Quagliariello (2011), who mention that banks seem to have adopted dynamic strategies aimed at reallocating their exposures towards less risky portfolios to benefit from lower capital charges. However, the evidence that is presented does not allow us to conclude whether this is good or bad in terms of lending policies. In particular, the data do not reveal to what extent portfolio reallocations have caused undesired restrictions for some borrowers. Should this be the case, then policy tools aimed at mitigating the cyclicality of capital requirements should be considered.

Evidence on portfolio parameters in the corporate portfolio (which has the largest share of exposures) leads us to conclude that the higher provisioning may be one of the reasons for the decrease in capital requirements. A remarkable increase in the PD of the corporate portfolio has been observed during the recent period of financial crisis, while the PD has declined in the non-defaulted share of the portfolio. The increase in EAD required higher provisioning, as evidenced in our dataset, and this in turn helps in explaining the decrease in capital requirements.

4.2 Econometric analysis

In addition to the analysis based on graphical plots and descriptive statistics of key bank variables, the following section shows the results of the econometric analysis that was carried out based on the ISG dataset and key macroeconomic variables. The regression model captures all bilateral co-variances between bank and macroeconomic variables and distinguishes between merely random co-movements and 'statistically significant' relationships based on objective criteria. This approach uses the information contained in the micro data on banks most effectively and can uncover (possibly counterintuitive) relationships between regression variables that may not be apparent from visual inspection or summary statistics. Given that the empirical question of (pro-) cyclicality of capital requirements hinges by definition on co-variances between bank and macroeconomic variables, including regression analysis is of particular importance for addressing this question.

As highlighted above, the ISG dataset comprises very few time periods (nine semi-annual observations from H2 2008 to H2 2012), but a reasonably large number of banks (96 banks based on our selection criterion[5]), which is typically referred to as a 'micro panel' in the literature (characterised by a short time dimension and a large cross-section dimension). This data panel poses a number of challenges since the information on (pro-)cyclicality needs to be derived from the data variation in the time dimension, which to date does not even cover a full business cycle.

[5] We require each bank in the sample to report data for at least four time periods.

In addition, the sample period is almost entirely dominated by the aftermath of the 2007/08 financial crisis, i.e. all relationships we uncover reflect a crisis event and might look rather different during tranquil or 'normal' times. This caveat, of course, applies identically to all empirical results in this report. Another caveat to any empirical analysis on pro-cyclicality is that large-scale government interventions took place in several countries in Europe.

The majority of financial and economic time series display a high degree of persistence (also referred to as 'state dependence' or simply 'smoothness'), implying that the absolute size of changes in a variable from one period to the following period tends to be small relative to the current level of that variable. It is important to account for this property in the econometric analysis because, in addition to being persistent, these time series also tend to be correlated with each other over time. In order to address these features of the dataset, we employ a so-called 'dynamic regression model' that includes a (time) lag of the dependent variable as an additional regressor on the right-hand side of the regression equation. The lagged dependent variable captures the dependent variable's own persistence and thereby allows us to capture the (unbiased, or at least less biased) marginal effect of the macroeconomic regressors. The regression model is estimated by the generalised method of moments (GMM). We apply the 'Arellano–Bond' or 'Difference GMM' dynamic panel model to the ISG dataset, which is particularly suited for addressing the two statistical problems described above. For further details on this model, see Arellano and Bond (1991), Arellano and Bover (1995) and Roodman (2009). A more easily accessible exposition of how to apply dynamic panel models to micro datasets is provided by Bond (2002). The specification in this report employs two-step (i.e. optimal) GMM estimation based on a 'forward orthogonal deviations' data transformation (instead of first differences) and robust standard errors as proposed by Windmeijer (2005). There are two post-estimation hypothesis tests available to assess the validity of the regression specification, a test of second-order autocorrelation of the transformed regression residuals, and the so-called 'Hansen *J*-test' of the validity of the over-identifying moment restrictions (see Hansen, 1982). Under a valid specification, both tests should *not* reject the null hypothesis and display a *p*-value in excess of 0.05. Given the importance of these two hypothesis tests, we show the results of these tests at the bottom of each table.

Results at bank level

The numbers at bank level represent aggregate figures for each bank in the sample. Apart from total aggregate RWA and MCR for each bank, there are also separate aggregate numbers available for credit risk, market risk and operational risk. We regress the MCR and RWA positions on domestic industrial production, which most closely mirrors the dynamics of the economic cycle, a forward-looking economic sentiment indicator (ESI) and an aggregate index of industrial production in the euro area. Our empirical results show that bank variables typically show no significant reaction to current values of (domestic or euro area) industrial production, but often react with a time lag of one or, more often, two periods, which, therefore, we choose as our default specification. Given the forward-looking nature of the ESI, this variable is included at its current value rather than with a time lag.

Table 2: Regression of MCR and RWA on the business cycle

	MCR total	**MCR credit**	**RWA mkt. risk**	**RWA op. risk**
Lagged dependent variable	**0.855*** **	**0.743*** **	0.385	**0.669*** **
	(0.204)	(0.284)	(0.287)	(0.170)
Industrial prod. (2-period lag)	0.432	-0.730	2.065	-0.193
	(0.410)	(0.734)	(1.366)	(0.241)
Economic sentiment indicator	**-0.561** **	**-0.527***	**-0.970** **	**-0.294** **
	(0.282)	(0.312)	(0.488)	(0.126)
Ind. prod. euro area (2-period lag)[1]	**-1.425** ** (0.568)	-0.167 (0.303)	**-3.391*** (1.852)	**-0.375** ** (0.179)
Dummy Basel 2.5	---	---	0.041 (0.075)	---
Number of banks	98	98	88	98
Countries	16	16	16	16
Observations	567	567	502	568
Instruments	16	16	17	16
AR(2) test in diff. (*p*-value)	0.814	0.784	0.259	0.600
Hansen *J*-test (*p*-value)	0.456	0.377	0.275	0.745

[1] For MCR credit, only a one-period lag of euro area industrial production was specified for stability reasons.
All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

The results in Table 2 show that the dynamic specification is the appropriate econometric model as witnessed by the large positive and statistically significant coefficient on the lagged dependent variable (only for RWA market risk is the coefficient insignificant). The coefficient on the ESI is negative and statistically significant in all of the four regressions, and the coefficient on the two-period lag of industrial production in the euro area is negative and statistically significant in all cases except for the MCR credit regression. Since all variables are defined in logarithms, coefficient estimates represent elasticities, e.g. a coefficient estimate of -0.5 on the ESI variable implies that a 1% increase in the ESI index will lead to a 0.5% decrease in the level of the dependent variable. The dummy variable for the implementation of 'Basel 2.5' (which is set to '1' for all periods from H2 2011 onwards and to '0' before) in the regression of RWA market risk is not statistically significant. The negative and statistically significant coefficients all imply that MCR and RWA tend to *decrease* as current economic sentiment or lagged industrial production in the euro area improve. However, given the parsimonious specification owing to the relatively small dataset, it would be hard to infer a causal link from these results.

Table 3: Comparison of Basel I with Basel II for MCR and RWA

	MCR		**RWA**	
	Basel I	**Basel II**[1]	**Basel I**	**Basel II**[1]
Lagged dependent variable	**0.873*** **	**0.976*** **	**0.744*** **	**0.907*** **
	(0.162)	(0.139)	(0.145)	(0.082)
Industrial prod. (2-period lag)	0.155	0.653	0.109	0.508
	(0.424)	(0.408)	(0.270)	(0.386)
Economic sentiment indicator	-0.404	**-0.699** **	-0.340	**-0.514** *
	(0.310)	(0.335)	(0.232)	(0.274)
Ind. prod. euro area (2-period lag)	-1.054 (1.233)	-1.789 (1.158)	-0.781 (0.907)	-1.483 (1.001)
Ind. prod. euro area (2-period lag) * Group 1	0.401 (0.732)	0.103 (0.840)	0.010 (0.600)	0.218 (0.638)
Number of banks	82	96	81	96
Countries	13	16	13	16
Observations	489	565	486	566
Instruments	15	15	15	15
AR(2) test in diff. (*p*-value)	0.696	0.751	0.767	0.488
Hansen *J*-test (*p*-value)	0.715	0.201	0.404	0.268

[1] The Basel II series reflect positions *before* application of the respective floor.

All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

At the aggregate or bank level, the ISG dataset contains a few series reflecting banks' MCR and RWA positions calculated under Basel I definitions. Although these series are counterfactual, as banks manage their assets and capital according to current Basel II and increasingly according to Basel III requirements, these series do play an active role because of the floor applied under Basel II requirements. Thus we can compare them with their current Basel II counterparts, but for this purpose we employ Basel II series that do not apply the Basel I-based floor. Therefore, the series for both regimes are counterfactual, and the regressions for the Basel I regime are based on a somewhat smaller sample data than the Basel II results. For these reasons, we should be cautious in drawing major conclusions from these regressions, but it appears that the Basel II series are somewhat more persistent (or 'smooth') than the Basel I series (as shown by the higher autoregressive coefficient) and, unlike the Basel I series, show at least some significant negative reaction to current economic sentiment. Again, the negative and significant coefficients would be consistent with a pro-cyclical impact of the macroeconomy on MCR and RWA, although this does not prove a causal link between the two variables.

Table 4: Regression of total capital on MCR and the business cycle for Basel I and Basel II

	Total capital	
	Basel I	**Basel II**
Lagged dependent variable	0.363 (0.237)	0.141 (0.363)
MCR total[1]	**0.951**** (0.413)	**0.682*** (0.362)
Industrial production (2-period lag)	**0.937**** (0.470)	0.966 (0.786)
Economic sentiment indicator	0.247 (0.205)	**0.469*** (0.260)
Industrial production euro area (2-period lag)	-0.526 (0.384)	-0.128 (0.832)
Number of banks	82	96
Countries	13	16
Observations	481	565
Instruments	15	15
AR(2) test in diff. (*p*-value)	0.883	0.853
Hansen *J*-test (*p*-value)	0.708	0.159

[1] The Basel II series reflect positions after application of the respective floor.

All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

In Table 4, we try to get an indication of the degree to which total capital is determined by MCR and if other explanatory factors (in this case, the business cycle variables from previous regressions) may play a role. It needs to be emphasised that these results can only be indicative, as most likely a number of important other factors that drive total capital are missing from the specification. Still, by comparing the results for Basel I with Basel II estimates based on the same econometric specification, we should at least arrive at an internally consistent comparison. Under both regimes, MCR is the dominating determinant of total capital, as the coefficient on MCR is large, positive and significant, whereas the lagged dependent variable shows a small and statistically insignificant parameter value. Whereas total capital under Basel I appears to increase with lagged industrial production, Basel II total capital displays a positive and significant response to current ESI. Interestingly, total capital under Basel I appears to both more immediately reflect any changes in MCR but also react more strongly to changes in the business cycle than under the Basel II regime. A possible explanation for the positive coefficients on industrial production and ESI respectively could be that total capital is simply smoother and less responsive to the macroeconomy than MCR. Since we found that MCR tends to *decrease* in response to an improvement in the business cycle, the apparent increase in total capital following a business cycle expansion could simply 'undo' the negative correlation between MCR and the economic cycle.

Results at portfolio level

The ISG data panel contains time series for portfolio MCR and portfolio risk factors such as PD, LGD and EAD. For reasons of data coverage and based on the relative size of different portfolios, we include in our econometric analysis the four 'main' portfolios: bank, corporate, retail and sovereign. Portfolio MCR always represents capital requirements for credit risk only, which allows us to compare the responsiveness of MCR for the different portfolios with MCR at bank level. In an additional step, we can compare the cyclicality of the different risk factors to see which of the factors contributes the most to the cyclicality of portfolio MCR.

Table 5: Regression of portfolio MCR (for IRB exposures) on the business cycle

	Portfolio MCR for IRB exposures			
	Bank	**Corporate**	**Retail**	**Sovereign**
Lagged dependent variable	**0.948*** **	**0.696*** **	**0.420*** **	**0.624** **
	(0.118)	(0.145)	(0.151)	(0.283)
Industrial prod. (2-period lag)	0.258	0.219	---	-3.477
	(0.728)	(1.046)		(3.203)
Unempl. rate (2-period lag)	---	---	0.042	---
			(0.083)	
Economic sentiment indicator	**-0.530***	**-0.626*** **	**-0.230***	0.186
	(0.322)	(0.203)	(0.122)	(0.500)
Ind. prod. euro area (2-period lag)	-0.161 (1.296)	**-1.469*** (0.762)	---	3.655 (4.873)
Ind. prod. euro area (2-period lag) * Group 1	-1.332 (0.882)	0.365 (0.614)	---	-2.217 (4.382)
Unempl. rate euro area (2-period lag)	---	---	**0.510** ** (0.199)	---
Unempl. rate euro area (2-period lag) * Group 1	---	---	**-0.326** ** (0.153)	---
Number of banks	56	81	83	44
Countries	14	15	16	10
Observations	346	470	483	264
Instruments	15	15	15	15
AR(2) test in diff. (*p*-value)	0.300	0.295	0.421	0.652
Hansen *J*-test (*p*-value)	0.445	0.342	0.407	0.735

All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

The dynamic panel model proves also to be the appropriate specification for the regressions at portfolio level of MCR on the business cycle, as shown by the large, positive and statistically significant coefficient on the lagged dependent variable in Table 5. For the retail portfolio only, we replace industrial production as lagged business cycle regressor with the unemployment rate, since previous results have clearly demonstrated that the unemployment rate is a much more important driver of retail MCR than is industrial production. We replace both the domestic and the euro area variables for this purpose. While the sovereign portfolio does not significantly respond to any of the macroeconomic regressors, the other three portfolios all show a negative and statistically significant reaction to ESI. While none of the portfolios responds significantly to domestic industrial production (or the domestic unemployment rate, in the case of the retail portfolio), the corporate portfolio shows a negative and statistically significant reaction to euro area industrial production. This effect is identical for Group 1[6] and Group 2 banks, so there is no statistically significant difference in the response among these two groups. The retail portfolio significantly responds to the euro area unemployment rate, whereby an increase in lagged euro area unemployment would lead to an increase in retail MCR. In this case, the reaction to the euro area regressor differs between Group 1 and Group 2 banks in a statistically significant way: whereas Group 2 banks respond more strongly, with a coefficient of 0.510, Group 1 banks show a smaller response, with a coefficient of only 0.184 (= 0.510 – 0.326). Particularly for the retail portfolio, it may at first appear a little surprising that MCR are more strongly influenced by euro area unemployment than by the domestic national unemployment rate. However, each of the national unemployment rate series will always be correlated to some degree with the euro area series as a result of how the series are defined. The higher this correlation, the more difficult it will be for the regression estimator to distinguish between these two regressors and to identify them individually.

When we run portfolio MCR on each portfolio's risk factors, we obtain the expected pattern of positive and often significant coefficients. These relationships exist by construction, and the empirical results are mainly meant to confirm that the theoretical relationships are also reflected in our dataset. Depending on whether we look at portfolio MCR for IRB exposures or for non-defaulted exposures, the significance levels of the different coefficient estimates vary somewhat across regressors, but whenever an estimate is statistically significant it has a positive sign. This finding confirms that any effect that the macroeconomy may have on individual risk factors (PD, LGD, EAD) should be transmitted with the same sign to portfolio MCR. Consequently, we would expect to find a very similar sign pattern in the regressions of portfolio MCR on the business cycle to that in the regressions of portfolio risk factors on the business cycle.

[6] Group 1 banks have Tier 1 capital in excess of EUR 3 billion and are internationally active, whereas Group 2 banks are all other banks.

Table 6: Regression of portfolio MCR (for IRB exposures) on risk factors

	Portfolio MCR for IRB exposures			
	Bank	**Corporate**	**Retail**	**Sovereign**
Lagged dependent variable	**0.205****	**0.484*****	**0.131****	**0.289*****
	(0.100)	(0.058)	(0.065)	(0.099)
Avg. PD (non-def. exposures)	**0.129*****	**0.528*****	0.070	**0.371*****
	(0.048)	(0.090)	(0.387)	(0.137)
Avg. LGD (non-def. exposures)	**0.516*****	0.165	1.029	**0.207***
	(0.175)	(0.185)	(0.631)	(0.113)
EAD (non-def. IRB exposures)	**0.647*****	**0.489*****	**1.088*****	**1.006*****
	(0.097)	(0.075)	(0.100)	(0.174)
Share of defaulted exposures	0.003	-0.035	-0.041	-0.044
	(0.035)	(0.039)	(0.310)	(0.045)
Number of banks	52	79	82	26
Countries	13	15	16	10
Observations	286	436	458	138
Instruments	10	10	10	10
AR(2) test in diff. (*p*-value)	0.803	0.352	0.493	0.425
Hansen *J*-test (*p*-value)	0.550	0.890	0.747	0.550

All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Table 7: Regression of portfolio MCR (for non-defaulted exposures) on risk factors

	Portfolio MCR for non-defaulted exposures			
	Bank	**Corporate**	**Retail**	**Sovereign**
Lagged dependent variable	0.021	0.023	-0.139	**0.291****
	(0.093)	(0.024)	(0.133)	(0.137)
Avg. PD (non-def. exposures)	**0.071***	**0.368*****	0.183	0.358
	(0.042)	(0.068)	(0.113)	(0.252)
Avg. LGD (non-def. exposures)	**0.661*****	**0.567*****	0.127	0.384
	(0.226)	(0.160)	(0.270)	(0.305)
EAD (non-def. IRB exposures)	**0.847*****	**1.048*****	**0.776*****	**1.097*****
	(0.116)	(0.075)	(0.185)	(0.403)

Share of defaulted exposures	0.016	-0.027	0.276	0.033
	(0.031)	(0.017)	(0.278)	(0.079)
Number of banks	51	74	80	25
Countries	13	15	16	10
Observations	277	415	441	134
Instruments	10	10	10	10
AR(2) test in diff. (*p*-value)	0.585	0.196	0.399	0.227
Hansen *J*-test (*p*-value)	0.155	0.587	0.598	0.656

All variables are defined in logarithms. Windmeijer-corrected, country-clustered standard errors are given in parentheses, and ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels respectively. Marginal *p*-values are given for the null hypotheses of the Arellano-Bond AR(2) test for the absence of serial correlation in first differences and of the Hansen *J*-test for the joint validity of all instruments.

Source: EBA's Impact Study Group (ISG) dataset, EBA calculation

Conclusions

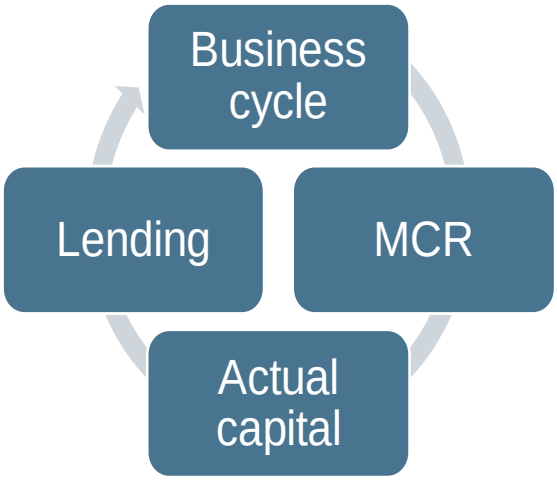
The regression results show some patterns of a negative relationship between MCR and the business cycle, both at the bank and portfolio levels. However, this negative empirical relationship between macroeconomic variables and capital requirements is not a proof of a causal relationship. Furthermore, evidence of pro-cyclicality in capital requirement regulation requires evidence that shows also a causal link between MCR and the economic cycle. This link is not investigated empirically, but the reader is referred to Section 3 for further details on this relationship. While some of the estimates are statistically significant, they are in the majority of cases moderate in absolute size, implying that it would require a major movement in the business cycle to trigger a large shift in MCR.

As far as the ISG data set allows for a comparison of Basel I with Basel II figures, their respective interaction with the macroeconomy appears to be qualitatively similar, with a somewhat stronger responsiveness to changes in the business cycle for Basel II capital requirements and risk-weighted assets relative to Basel I.

5. Relationship between capital requirements and the economic cycle

Now that we have examined the degree of cyclicality of MCR, it is necessary to analyse if MCR have an effect on the actual level of capital that banks desire or hold and, thus, if higher levels of capital requirements have an effect on lending and on the economic cycle. Figure 14 contains a graphical presentation of the different channels at work. In order draw a conclusion on the relationship between MCR and the economic cycle, it is necessary to review also the impact of MCR on the actual or desired level of capital, the impact of the actual level of capital on bank lending activity and the impact of credit availability on the economic cycle.

Figure 14: Overview of the relationship between MCR and the business cycle



Source: EBA analysis

5.1 Actual versus minimum level of capital

The extent to which cyclicality in MCR affects the actual (or desired) level of capital (and thus lending), depends on whether or not the capital requirements are binding. More specifically, an increase in MCR is less likely to affect lending decisions if the bank has a capital buffer well above the minimum.

According to the data, over the period H2 2008–H2 2012, the total capital has increased by 15.7%. The econometric analysis based on the ISG dataset and discussed in the section above indicated a positive and significant relationship between the macroeconomic cycle (quantified by IP growth or the ESI) and total capital buffers. Since we found that MCR tend to *decrease* in response to an improvement in the business cycle, the apparent increase in total capital following a business cycle expansion seems to revert the negative correlation between MCR and the economic cycle.

The econometric analysis indicated that MCR and the macroeconomic cycle are important drivers of total capital buffers. However, the actual level of capital that banks hold is also driven by other factors. First, market discipline, described in the third pillar of Basel II/III, is an additional factor that banks take into account in their business model decisions. Second, the recent EBA recapitalisations exercise set capital targets for 70 European banks. Third, any other additional capital requirements at national level may also cause divergence between capital requirements and capital levels. A fourth factor that affects bank capital levels is the requirements set by credit rating agencies. Banks aiming to maintain or reach a target rating may take certain business model decisions affecting the actual level of capital. Finally, it is worth mentioning that there is a difference between the actual and desired levels of capital that banks hold. This implies that banks may cut back on lending because they foresee an increase of capital ratios in the future. In this respect, any anticipation of a future regulatory increase in capital ratios may already have an effect on the actual level of capital. Given the timing of our sample (the sample period ends in H2 2012) and the foreseen implementation of Basel III, this regulatory change may also have affected actual capital decisions.

5.2 Capital effect on lending

The presence of a direct relationship between capital requirements and credit supply represents the main theoretical assumption underpinning the call for a non-cyclical MCR regulation. Following this assumption, an increase in capital requirements would directly translate into a decrease in credit supply. Although this description is appealing, the existence of such a causal relationship between a change in capital requirements and credit supply is not straightforward and has been the subject of numerous studies.

Some recent studies have analysed the quantitative impact of an increase in capital requirements on banks' lending conditions. Although the results differ according to the methodologies employed and whether permanent or temporary shocks are being analysed, most find that an increase in regulatory capital requirements generates only a modest tightening in credit conditions (Elliott, 2009; Macroeconomic Assessment Group, 2010; Aiyar, Calomiris and Wieladek, 2012; Francis and Osborne, 2012; Bank of England, 2013).

The effect of capital on lending is known as the 'lending channel', but capital is only one of the factors that may affect lending. The reasons for the tightening of lending standards may originate to some extent from banks' capital constraints, but it is also due to other supply drivers; the bank's liquidity position, the access to market financing and the economic outlook play an important role. Lending decisions are also driven to a large extent driven by demand-side factors, which depend on the performance and expectations of the corporate and the household sectors. On the credit demand side, in a downturn, companies tend to ask for less credit, as they tend to delay investments and accumulate cash. Companies also see a decrease in sales, profits and delays of client payments. On the credit supply side, in a recession, banks would tend to tighten their credit standards. Additionally, this relationship varies in time and depends on the economic circumstances. The ECB BLS analyse and separate supply from demand effects and show how these factors have changed over time. Data from the ECB BLS show that the net tightening of

banks' credit standards on loans to non-financial corporations increased sharply from 2007 to 2009, as shown by the change in the diffusion index[7]. Lending conditions seem to have eased between 2009 and mid-2012, after which an increase in lending conditions is observed.

Between 2007 and 2009, a sharp decline in the net demand for loans from non-financial corporations was observed, with a subsequent return to pre-crisis levels in mid-2011. Afterwards, net demand for loans declined again until the first quarter of 2012. A moderate increase has been observed since then. If we look at the historical trend of the factors driving banks' supply, capital is just one of the drivers for lending restrictions and not the most important of them since 2007. According to the ECB BLS, the main reason for the tightening credit standards is the sluggish economic outlook. Banks' capital constraints also contribute to this tightening, but so do banks' liquidity positions and/or access to market financing. On the other side, it can be observed that bank competition is the main driver for loosening credit conditions.

If we look in further detail at balance sheet restrictions, we see that capital is the main driver for lending restrictions since 2008, except for the year 2011, when conditions tightened more because of banks' liquidity and market finance. In fact, credit tightening during 2011 was probably due to the sovereign debt crisis, which has rapidly decreased banks' ability to obtain market funding. In the first quarter of 2012, the ECB's 3-year long term refinancing operation (LTRO) provided significant temporary relief, especially in terms of liquidity and funding, and, therefore, contributed to the decrease in the tightening of credit standards.

The July 2013 results of the ECB BLS (ECB, 2013) contained answers to one additional question, which referred to the impact of on-going regulatory changes on banks' lending policies. With respect to the contribution of CRR and CRD IV and other new regulatory requirements to the tightening of banks' credit standards, 17% of the euro area banks acknowledged that they had tightened their credit standards on loans to large enterprises as a result of adjustments to new regulations and capital requirements, while 9% of the euro area banks reported that they had done so for loans to small and medium-sized enterprises (SMEs). For loans to households, in net terms, 8% of the euro area banks reported a tightening of credit standards owing to the new regulatory capital requirements for housing loans, and 6% reported the same for consumer credit. Overall, banks stated that they were continuing the deleveraging process pursued in the first half of 2013 with a view to adjusting to the new requirements; this process is still being perceived as having somewhat tightened banks' lending policies for firms and households.

A final piece of information regarding the relationship between capital and lending stems from a recent study conducted by the BIS (2013). The paper analyses how banks have recently adjusted to higher capital requirements. The study finds that banks have steadily increased their capital ratios since the financial crisis (2009-2012), and that retained earnings accounted for the bulk of

[7] The 'diffusion index' regarding banking lending policies refers to the share of banks reporting that credit standards have been tightened and the share of banks reporting that they have been eased (the higher the result, the tighter the standards). Likewise, regarding the demand for loans, the diffusion index refers to the weighted difference between the share of banks reporting an increase in loan demand and the share of banks reporting a decline. The diffusion index is constructed in the following way: lenders who have answered 'considerably' are given a weight twice as high (score of 1) as lenders having answered 'somewhat' (score of 0.5).

this increase. The study further suggests that neither the starting capital ratio nor the increase in the capital ratio had an impact on how quickly European banks expanded assets and lending. Our findings in the ISG database analysis are consistent with the latter. We have observed that the strengthening in capital ratios has been driven largely by an increase in capital resources (16%) and to a lesser extent by a reduction in RWA (4.16%). Despite banks increasing their capital resources by 16% in this period, lending has not declined (it has risen by more than 5%). This increase in lending is not evenly distributed: while there has been a substantial increase in sovereign and retail exposures (52 and 25% respectively), bank exposures have contracted sharply (31%) and corporate exposures have fallen by 6%.

5.3 Impact of credit availability on the economic cycle

Assessing the final step in the chain, the impact of credit availability on the economic cycle, remains the most difficult task. The Macroeconomic Assessment Group (BIS, 2010) analysed the macroeconomic effects of the transition to higher capital and liquidity requirements under Basel III. In a review of these results by the ECB, it was concluded that it is too early to make a quantitative estimate of the magnitude of the pro-cyclical effect of capital requirements on lending and the economic cycle. Given the lack of significant additional data points, this report will, therefore, not attempt to provide any more conclusive findings. In their absence, only a qualitative assessment is included in this report.

The effect of bank lending on overall economic activity may vary depending on enterprises' dependence on banking versus other sources of funding. Traditionally, Europe has had a larger dependence on bank funding than other jurisdictions. Companies in the USA tend to rely more on market debt than companies of the same size in the EU. This holds true for bigger corporations and smaller ones and it has been a traditional difference between US and EU markets. Recent trends, subsequent to the crisis, show that European corporations are starting to tap the capital market, and this tendency is increasing, as bank loans become more reflective of their risk. However, the difference from the USA is still substantial, and this can mean a higher pro-cyclicality in the European arena in this downturn. The development of the corporate debt market could mitigate the effects of financial crises or reduce their effects when there is a high reliance on banking debt, as alternative sources of finance are available for companies when banks are in a constrained position.

In addition, European banks have grown considerably in relation to the real sector in the last 15 years. They have also become more complex and interconnected. This growing role of financial intermediation in Europe can certainly have a large effect on the propagation of business cycles. Moreover, banks have become more leveraged over time. However, any financial crisis, especially one generated by a credit or real estate bubble, is followed by a deleveraging process, which brings indebtedness of banks and their borrowers down to sustainable levels. This is the case in most euro area economies and they will need to repair imbalances.

6. Pro-cyclicality mitigation

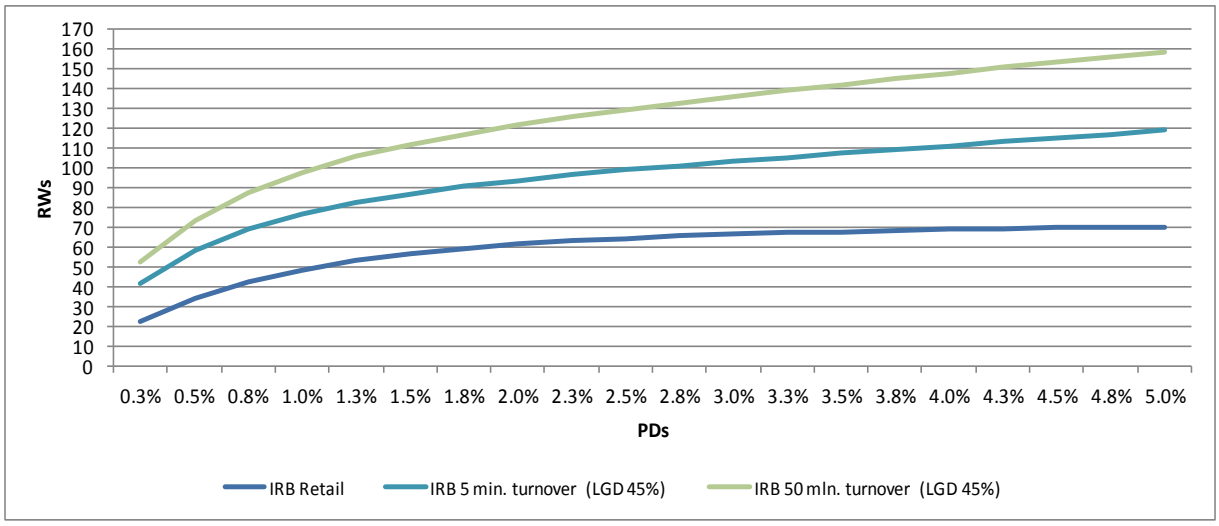
6.1 In the CRD

Some of the fundamental concerns raised around pro-cyclicality of capital requirements have already been partially considered in the design of the Basel II capital framework.

First, the CRD includes some requirements to reduce the cyclicality in the estimation of the IRB parameters. In the Foundation IRB (FIRB) Approach, banks are encouraged to base their Pillar 1 calculation of MCR on a so-called 'long run PD'. In the Advanced IRB (AIRB) Approach, banks also calculate a 'downturn/long run LGD' and a 'downturn/long run EAD'. This requires that 'credit institutions shall estimate PDs by obligor grade from long run averages of one-year default rates' (Article 180 of the CRR). LGDs and conversion factors (CF) need to be calculated at the facility level and need to reflect economic downturn conditions if those are more conservative than the long run average.

Second, the design of the IRB supervisory curve (shown in Figure 15) with respect to PDs reduces the sensitivity of capital requirements to downgrades in internal ratings, as capital requirements for higher quality portfolios are more sensitive to volatility in borrower PDs than is capital on lower-quality portfolios.

Figure 15: IRB supervisory curve



Source: EBA calculation

The supervisory curve changes for different portfolios. As we can see, the retail portfolio has a lower and flatter curve. This lower curve implies that, for the same PDs, the capital charge in the retail portfolio will be lower than in the corporate portfolio, and that PDs and capital

requirements remain lower. The flatter curve implies that, for the same increase in PDs, the retail portfolio will attract a proportionally lower increase in capital requirements than the corporate portfolio. Thus, the retail portfolio will have less cyclical capital requirements. Other measures in the IRB Approach designed to address the potential pro-cyclical effects of MCR include the maturity adjustment in the Advanced IRB Approach, which has been specified as a decreasing function of PD, thus reducing the sensitivity of capital downgrades compared with the Foundation IRB Approach.

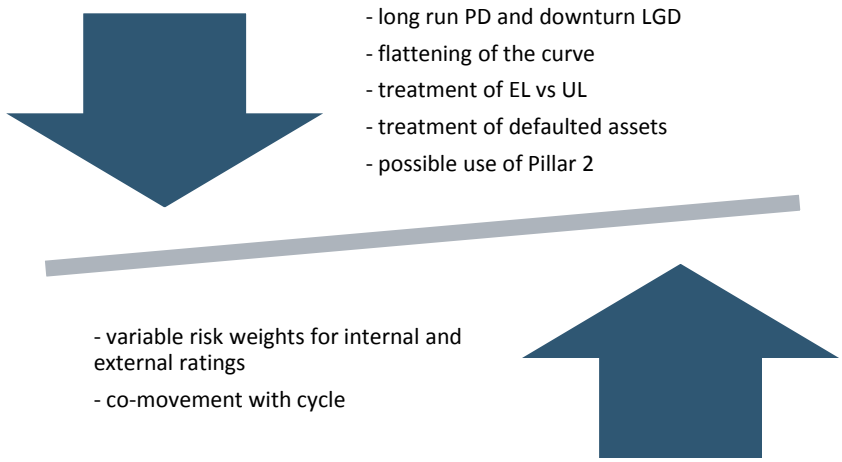
Additionally, the regulatory treatment of expected losses (EL) versus unexpected losses (UL) may reduce pro-cyclicality, as, in a downturn, we would expect an increase in expected losses and, therefore, a potential decline in banks' capital. In the previous regulation, banks were required to hold capital for both EL and UL (provisions set aside for credit losses would reduce only the RWA by the amount of provisions actually built). In the Basel II framework, capital would be required only for absorbing UL. Banks are expected in general to handle their EL on an ongoing basis, e.g. by provisions and write-offs. This new regulatory treatment implies that in bad times, when losses become more 'expected' than 'unexpected', capital requirements can fall sharply.

Further, capital requirements for defaulted exposures have a great impact on the level of MCR; one would expect an increase in the share of defaulted exposures (and provisions) during times of economic distress. Capital charge for defaulted assets is desirable in order to cover the uncertainty in realised recovery rates. The difference between the LGD in default and the best estimate of EL results in the UL capital charge for defaulted assets. However, the Basel II framework does not give details about the calculation of LGD in default, which results in different interpretations and methods of implementation.

Finally, the Pillar 2 mechanism could mitigate pro-cyclical movement that may arise from Pillar 1 capital requirements. Pillar 2 requires that all banks make their own assessments of capital required, including risks not properly captured in Pillar 1. Consequently, while the measurement techniques of some risks may lend themselves to pro-cyclical effects, the expectation is that, under Pillar 2, supervisors make an overall assessment, keeping other risks and business cycle effects in mind, and require banks to hold capital buffers or otherwise mitigate against them.

To summarise, the CRD has embedded several provisions to dampen pro-cyclicality (summarised in Figure 16).

Figure 16: Provisions in the CRD affecting pro-cyclicality



Source: EBA analysis

6.2 In CRD IV (Basel III)

As a regulatory response to the perceived pro-cyclicality of bank lending, the newly revised prudential regulation CRR and CRD IV has introduced a counter-cyclical capital buffer (CCB). The objective of this approach is to develop a policy tool that strengthens the resilience of the banking sector in periods of excessive credit growth. The CCB is a capital buffer that is raised or reduced in a counter-cyclical manner according to variations in systemic risk over time. Its objective is to protect the banking system against potential losses when excessive credit growth is associated with an increase in system-wide risk. The CCB is expected to have a direct effect on resilience: when risks crystallise, the additional capital will help the banking system to absorb losses while continuing to provide credit to the real economy. In doing so, it aims to counter the pro-cyclical amplification of financial shocks through the banking system and financial markets to the real economy that has been one of the most destabilising elements of the crisis. As a potential favourable side-effect, the CCB may help to counter the expansionary phase of the credit cycle by reducing the supply of credit and/or increasing its cost.

The second EBA-ECB report on pro-cyclicality contained a detailed assessment of the CCB. The report finds that, although cross-country variation is substantial, the overall amount of CCB would have followed a clear counter-cyclical trend if it had been implemented since 2005. In line with the dynamic credit growth in the years before the crisis, the CCB would have increased gradually, reaching around 1.5% of RWA (or EUR 300 million) at its peak in 2008. If released, this amount would have compensated for the increase in the MCR, thus smoothing the overall capital requirements over the cycle. Furthermore, the study finds that it would have reduced the need for government intervention and the involvement of taxpayer money in bank recapitalisation, and ultimately would have mitigated the deleveraging pressure on a number of banks.

The new prudential regulation also introduces a leverage ratio. The proposal seeks to reduce *excessive* leverage. The financial crisis highlighted that credit institutions and investment firms were highly leveraged, i.e. they had taken on more and more assets on the basis of an increasingly thin capital base. Since the leverage ratio is a new regulatory tool in the EU, there will be a transitional period for its inclusion and the final decision on the leverage ratio as a binding measure is scheduled for 2018. For this reason, the impact of this measure, if any (given that the ratio may not be binding), cannot be assessed in the short term.

The revised CRR and CRD IV also proposes higher levels and better quality of capital. The impact of this measure on pro-cyclicality is not clear cut. In the short term, raising the quality of capital could be equivalent to raising the level of capital. However, in the longer run, banks with large capital positions will tend to be less pro-cyclical, less sensitive to cyclical shocks and, thus, more likely to pursue lending-growth strategies even in more difficult markets. In contrast, banks with lower capital levels are more sensitive to cyclical shocks and more likely to have problems in accessing funding and maintaining lending levels in a downturn. Given that these provisions have not been fully implemented or finally defined, it is difficult to anticipate their impact on pro-cyclicality.

As mentioned in Section 1.2, cyclicality in credit ratings may also affect cyclicality in capital requirements. This is the case for banks that apply the SA, and for banks that apply permanent partial use. To the extent that credit ratings are correlated with the economic cycle, capital requirements linked to credit ratings will tend to increase during downturns and decrease during upswings. However, the CRD IV proposal contains elements that encourage financial institutions to develop and use their own rating models, thereby reducing the reliance on external ratings. To the extent that reliance on external ratings in the Standardized Approach is a cause of pro-cyclicality of capital requirements, this can be seen as an additional mitigant of pro-cyclicality.

7. Conclusions

The MCR for banks under the EU CRD (and also in the CRD IV), based on the Basel II (III) framework, are inherently risk sensitive. This raises the possibility that the CRD may contribute to pro-cyclicality in the financial system. The question this report tries to answer is whether or not the CRD contributes to banks' pro-cyclical behaviour.

Pro-cyclicality is defined as 'the dynamic interactions (positive feedback mechanisms) between the financial and the real sectors of the economy. These mutually reinforcing interactions tend to amplify business cycle fluctuations and cause or exacerbate financial instability' (FSB, 2009).

To answer the question above, the report contains an overview of previous conclusions on pro-cyclicality, two empirical assessments on pro-cyclicality based on the ISG dataset, an overview of the interaction between capital requirements and the economic cycle, and an overview of how current capital regulation tries to address pro-cyclicality.

The report summarises the main findings of previous analysis on the pro-cyclicality of capital requirements, both from the second EBA-ECB report on pro-cyclicality and from the academic literature. The literature review contains some indications of pro-cyclicality of capital requirements. Moreover, the literature points out that IRB banks that compute PIT PDs produce highly significant variations in capital requirements from peak (expansion) to trough (recession), as opposed to IRB banks that compute TTC PDs.

The report also presents the results of two empirical analyses based on the ISG dataset. This dataset contains bank data on a Basel II portfolio breakdown on a semi-annual basis, which are not usually available in other databases. The drawback, however, is the short data history which only begins in H2 2008. First, descriptive statistics based on the ISG dataset are presented. Second, econometric regression techniques provide further evidence of the link between the macroeconomic cycle on the one hand and capital (requirements) on the other.

The descriptive statistics show that RWA have declined over the observed sample period (H2 2008–H2 2012), and actual capital has increased. Actual risk weights have declined over the sample period. The summary statistics reveal a shift towards portfolios with lower risk profiles, as exposures in retail and sovereign portfolios have increased while there has been a decline in exposures in bank and corporate portfolios. Finally, evidence on portfolio parameters in the corporate portfolio (which has the largest share of exposures) leads us to conclude that higher provisioning may be one of the reasons for the decrease in capital requirements. For corporate exposures, the average PD increased substantially and average LGD remained stable for the overall portfolio. However, for non-defaulted exposures both parameters decreased. Increased defaults, which presumably required higher provisioning, are, therefore, thought to have resulted in lower capital requirements.

The findings of the econometric analysis suggest that there are some statistically significant negative correlations between the capital that banks are required to hold and the macroeconomic environment. This relationship was found at the bank level, for total capital requirements and for capital requirements stemming from market, credit and operational risk individually. This effect was also found at portfolio level, except for the sovereign portfolio. Regressions of total capital buffers on macroeconomic indicators suggest an increase in total capital following a business cycle expansion. This would imply that part of the negative relationship between the economic cycle and capital requirements is restored in the effect on actual capital levels.

However, a number of caveats apply to the emprical analyses. First, the time period covered is very limited. Second, the econometric evidence itself is not sufficient to suggest a clear causal relationship between capital requirements and the economic cycle. Third, the covered sample period has been very turbulent, with many confusing events taking place. Examples are the recent financial crisis, the 2011 EBA bank recapitalisation exercise and the anticipation of Basel III implementation. Finally, neither analysis above includes a quantitative analysis of (i) whether or not bank capital levels also affect bank lending and (ii) whether or not credit availability in turn affects the economic cycle. Evidence about both transmission mechanisms is necessary to draw a

conclusion on any pro-cyclical effect of capital requirements, that is whether or not capital requirements amplify the economic cycle.

On the basis of the current analysis, it is difficult to conclude that there is proof that implementing the capital requirements legislation has brought about pro-cyclicality. There are, nevertheless, indicators that suggest that Basel II and the IRB Approach lend themselves more to such a conclusion than the SA under Basel I. As noted above, the authors of the capital requirements legislation, both in the original text and in the recent revisions, foresaw such pro-cyclicality and have built in tools to counter it.

8. Policy options

In order to have a better view on pro-cyclicality in the future and in particular to improve transparency and documentation, the competent authorities should put special emphasis to the following recommendations when assessing IRB-systems. The EBA will put forward these policy recommendations in the Regulatory Technical Standard on Article 144(2) of the CRR.

a. Institutions should adopt and document policies to explain the philosophy of each rating system and how grades and risk parameters are expected to vary with movements in the general economic cycle or more specific cycles relevant to each risk parameter.
b. Institutions should systematically record the following information on their approach to PD estimation, separately for each rating system:
    i. the historic time horizon over which default rates have been averaged for the calculation of grade-level long run PDs;
    ii. the planned frequency with which PDs will be re-estimated (if at all) and how the historic time horizon will change at each point of re-estimation;
    iii. the level of conservatism that has been applied to compensate for uncertainty in PD estimation, specifically from the use of historical default rate time series that are shorter than at least one economic cycle (as required by Article 179(1)(a) of the CRR – 'the less data an institution has, the more conservative it shall be in its estimation').
c. Institutions should ensure the back-testing measures for PD parameter quantification are accurate with respect to intended rating philosophy/philosophies.

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