What here is common should astonish you
What here's the rule, recognize as an abuse
And where you have recognized an abuse
Provide a remedy!

(The Exception and the Rule, Brecht)

Abstract

In this paper, leveraging on the 2014 Comprehensive Assessment (CA) data, we perform a simulation based on a simple non-RWA sensitive measure, i.e. the leverage ratio. The outcome of such revised exercise shows remarkable differences from the actual 2014 CA results, since the leverage ratio capital shortfall reports a wider distribution across European countries, than the one reported using the CET 1 ratio as a reference measure. The evidence shows that RWA density played a significant role in determining the 2014 CA stress outcomes, generating issues about the RWA heterogeneity across Europe. Overall, our results highlight that the application of different and simpler rules, supported by the economic literature, may change the overall picture.

Keywords: internal models, Basel regulation, shortfall migration effect, risk weighted assets-density, leverage ratio, comprehensive assessment.

The other side of the rules: an alternative way to look at the 2014 Comprehensive Assessment[1]

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1. Introduction

The financial industry and the Supervisory Authorities are facing an increasing number of challenges, characterized by strong efforts from both sides. Over the last years, the banking industry has been strongly regulated with the aim to ensure its stability and its ability to finance the real economy.

The regulatory framework on banking system appears to be at least as complex as the modern finance is. The forward looking perspective seems to show threats on the horizon as well as some opportunities.

In our study we try to investigate the pros and cons of the leverage ratio as a parallel and very simple metric to assess the banks' soundness. We find consistent evidence in the economic literature of regulatory arbitrages and moral hazard effects where the complexity of the rules is too high, while a simple and controllable rule may be an efficient metric to assess the banks' resilience and position, mainly in a cross jurisdiction perspective.

In the paper, in order to assess the possible implications of this trade-off between simple-manageable and complex-accurate rule, we analyze the results of the 2014 Comprehensive Assessment (CA) carried out by the ECB and the EBA. First, we present the outcomes as emerged from the application of the official methodology, secondly we re-perform the exercise in terms of leverage ratio instead of CET1 ratio, disclosing what we call "shortfall migration effect" among countries.

In more details, we implement a multivariate logit regression, applied to the selected banks, in order to identify which balance sheet or regulatory figures (as reported by the

[1] The opinions expressed and conclusions drawn are those of the authors and do not necessarily reflect neither the views of the Banca d'Italia, nor those of the other mentioned Institutions.

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banks in 2013 data) are mostly associated with the capital shortfall emerged in the 2014 CA.

In the second phase of our analysis, we newly perform the CA results by focusing on the leverage ratio, which according to Basel 3 framework should turn into a legally binding 3% requirement starting from 2018. For the scope of this analysis we apply a straight substitution of the reference indicator used in the exercise (CET1 ratio); the purpose of this simulation is to neutralize the banks' model risk by using the leverage ratio instead of CET1 ratio to determine the capital shortfall. This approach gives a different reading of the CA results, sterilizing the relevant findings from the model risks.

We show that the application of such different metric – supported by the economic literature - to the figures of the 2014 CA, would produce different results in terms of shortfall. In particular, applying two different metrics such as CET1 (as in the CA) and Leverage ratio (as in our simulation), the shortfall of the Italian and Greek banking systems remains broadly stable while the results significantly change in the case of Germany and France.

The aim of this paper is to contribute to an open debate in the economic literature, providing additional evidence on the discussion and challenging some of the most common beliefs of the financial community. While there is no definitive evidence supporting one metric more than another, the application of an alternative metric in the contest of the 2014 CA would have led to different results.

This paper is organized as follows: in section 2 we present the review of the literature, in section 3 we analyze the 2014 Comprehensive Assessment dynamics, in section 4 we report our methodology and results and in section 5 we present the conclusions.

2. Complexity vs. simplicity: the debate on optimal capital ratios

Capital ratios have long been a valuable tool to assess safety and soundness of banks, nowadays representing the ground on which the applicable regulatory framework – namely Basel 3 - is based.

Since 1988, following the Basel's approach, the capital ratio requirements have been applied at international level.

With the parallel implementation of Basel 3 and the Single Supervisory Mechanism in Europe, the Common Equity Tier one ratio (CET1) became the common metric used to assess and evaluate the bank's resilience.

Generally speaking, to be successful in their roles, capital ratios as well as any other indicator, should bear a material negative relationship to the risk of banks' failure.

Most of the economic literature focuses on risk weighted ratios, however, both leverage and revenues based ratios should be taken into account, because it is not certain a-priori that the risk based capital ratio is meaningfully superior to simplest ratios in measuring the overall risks of the banks. The regulator faces a complex trade-off between costly measures (e.g. CET1 ratio) and relatively simple measures (e.g. Leverage ratio). The former have an embedded model risk that - in theory – could threaten the level playing field among banks and jurisdictions; moreover, it is focused on credit risk exposures more than other risks.

In a paper, whose sample is composed by German banks, Behn, Haselmann and Vig (2016) show that the introduction of Basel II-type model based capital regulation affected the validity of banks' internal risk estimates, finding that for the same firm in the same year, both reported PDs and risk-weights are significantly lower for loans under the internal model based regulatory approach. Risk forecasts for loans under the model-based approach systematically underestimate actual default rates. Moreover the authors find an incongruence between the reported PDs/risk-weights and interest rates charged for loans under model-based regulation, suggesting that banks were aware of the inherent riskiness of these loan portfolios. Their results suggest that simpler rules may have their benefits, and encourage caution against the current trend towards more complex financial regulation. The authors explain their findings by the incentives for banks to underreport PDs in order to economize on regulatory capital.

On the other hand, the leveraged ratio is simple to implement and monitor and there is evidence within the economic literature that it can play a crucial role. Estrella, Park and Peristani (2000) compare the effectiveness of different types of capital ratios in predicting banks failures, finding that simple ratios – specifically the leverage ratio and the ratio of capital to gross revenues – predict bank failure about as well as the most complex risk weighted ratio over the short term horizon, showing that these simple measures contain

useful information, being virtually costless to compute and providing a consistent metric for cross-country analysis.

The same view is supported by Aikman et al. (2014) who find that on an individual basis, simple indicators (leverage or loan to deposit ratios), often outperformed more complex metrics in predicting failure across a cross-country sample of large banks during the global financial crisis.

Blundell-Vignall and Roulet (2013) support the OECD view on the fact that the Basel system is characterized by high complexity, suitable to limit its effectiveness, while according to their view a simple leverage ratio should be the primary regulatory tool for the banks' capital supervision.

On this regard, concerns have been recently expressed about the opacity of the Basel risk weights and their consistency across firms (Haldane 2011, Avramova and Le Leslé 2012); their granularity makes it hard to account for differences across banks. It also provides potential scope for arbitrages. Consequently, the primary source of complexity in the Basel framework is the model-based risk-weighting.

Haldane and Madouros (2012) find that, for a set of the world's most complex banks, simple measures appear to have a greater pre-crisis predictive power than risk-weighted alternatives. By running a simple horse race of the two capital measures in a logit regression, the dominance of the simpler measure is confirmed. Measures of risk-weighted capital are statistically insignificant, while the leverage ratio is significant at the 1% level. Contrary to the risk-sensitivity doctrine, less appears to offer more.

The same authors show that the choice of optimal regulatory rule structurally depends on the environment; the simpler the environment, the more robust are likely to be regulatory sophisticated rules. The quest for risk sensitivity in the Basel framework, while sensible in principle, could generate concerns in practice. It has spawned startling degrees of complexity and an overreliance on banks' models. A discussion concerning the role and robustness of internal risk models in the regulatory framework should be encouraged considering that these models could generate opacity and complexity, rendering de-facto challenger the cross-banks comparison.

In the Basel 3 framework there is a quite clear hierarchy of solvency rules; the leading role is provided by a risk-weighted capital ratio (e.g CET1) and the leverage ratio represents a backstop. In the hierarchy, leverage is at least second-in-line and in most cases is not considered among the relevant market indicators.

However, as highlighted again by Haldane and Madouros (2012), for the world's largest and most complex banks— the ones for which Basel was designed— that hierarchy is difficult to justify. According to the evidence presented by the authors, the hierarchy should be reversed, with the leverage ratio playing the leading role given its simplicity and superior predictive performance. The more complex the bank, the stronger is the case.

2.1 RWA-based requirements: a Pandora box

Since the prudential supervision is in place, the regulators and supervisors are strongly focused on which capital instruments would be eligible in terms of loss absorption in an on-going perspective, paying relatively less attention to the fairness of risk-weighted assets measure.

This philosophy, notwithstanding the supervisors' effort, does not seem to consider enough the RWA heterogeneity issue observed among banks, as a consequence of different models (standardized and internal rating based), different internal rating system - which can in theory produce different risk-weighted assets for the same counterparty and the same exposure (Behn, Haselmann and Vig, 2016) - and last but not least, among different countries and different risk-measurement methodology across jurisdictions.

Given the above, it should be highlighted that the ratio through which an eventual capital shortfall is assessed, namely the CET 1 ratio, is strongly affected by its denominator, the so called risk weighted assets, which should be a fair estimate of the riskiness of bank's asset side.

In this context, given the RWA dispersion observed among financial institutions, Cannata, Casellina and Guidi 2012 show that the business mix and the models roll-out effect are relevant factors in determining such heterogeneity.

Moreover, as pointed out by Bruno, Nocera and Resti (2014), there is a link between the so called RWA densities (namely the ratio between risk weighted assets and total assets),

and the business model of the supervised entities. Following this approach, we would draw the attention to the fact that this metric penalizes, in terms of RWA density, the smaller and more credit oriented institution, since the RWAs are significantly impacted by the validated internal rating based models, reducing the amount that should be allocated in comparison to the standardized approach. The above-mentioned phenomenon seems to be confirmed looking at the starting point data of the 2014 Comprehensive Assessment: if we divide the sample banks in two sub-groups applying a dimensional criteria[3], we observe that the largest banks have an average RWA-Density of 38.9% while the remaining banks have an average RWA-Density of 49.1%. The example shows that biggest banks have more that 10% of "RWA saving".

As a matter of fact, producing internal models compliant with the relevant regulation, and in line with the supervisors validation approach, is costly and needs resources, hence there is a direct link among the denominator of the CET1 ratio, and the size of the supervised entities. Moreover, the high compliance costs associated with the model-based approach mean that only the larger banks adopted this new approach and consequently benefit from relatively lower capital charges (Behn, Haselmann and Vig, 2016).

In addition, it should be highlighted that measuring the exposure to the same counterparty with different models should produce different RWAs, driving to the doubtful conclusion that a loan granted in the same conditions to a borrower could be riskier for one bank than for another one.

Bruno, Nocera and Resti (2014) find out material differences over time and across institutions, which according to them could be explained by several factors, some of which may reflect the actual risk content of bank's assets, while others may hide distortions due to "RWA tweaking" and supervisory segmentations.

Their empirical analysis made up on a sample of 50 large European banks between 2008 and 2012 evidences various material findings; in particular: i) risk weights are affected by the banks' size, business model and asset mix; ii) the adoption of internal ratings based (IRB) approaches is a significant driver of bank risk-weighted assets; iii) lower risk weights are positively linked to the banks' capital buffer ; iv) IRB adoption is

[3] In the first sub-group we put the first 14 significant banks in terms of total assets while in the second sub-group we put the other banks of the 2014 CA sample.

more common in countries where supervisory capture is potentially stronger, due to a banking industry that is larger (compared to GDP) and concentrated as well; v) risk weights deriving from regulation are not disconnected from market-based measures of bank risk.

In light of the above, the level playing field principle, representing a pillar of the Banking Union, could be at risk, since there is some evidence in the economic literature of a distortion in the capital requirement stemming from the RWAs measurement in the denominator of the supervisory requirements.

As stated by Visco (2014), one of the main points of concern for the future supervisory activity is represented by the evaluation of the criteria to compute RWAs and IRB models.

Besides, as outlined by Blum (2007), banks anticipating the supervisor's behavior, have an incentive to understate their risks, knowing that reporting a high level of risk leads to a higher level of required capital, and this incentive is even stronger when the supervisor's ability to detect or sanction banks is limited.

Complex rules may cause banks to manage rules, for fear of falling foul of them. They may induce to act defensively, focusing more on the small print than on the bigger picture (Haldane and Madouros 2012).

As a matter of fact, following Blum (2007), it might happen that supervisors do not timely sanction banks because the entities became insolvent when it was obvious that they took higher risks than reported.

Given that the actual risk exposure of the supervised intermediaries is not observable, considering that the asymmetric information and the market failures are embedded in the banking system, capital requirements cannot measure precisely the level of risk.

Moreover, risky banks could not be fully transparent about their exposures because they know that the actual riskiness would produce higher financing costs, whereas maintaining opacity about their type does not affect their payoff.

Besides, it should be underlined that the capital ratios of banks also affect their cost of capital, with the risk of a double counting effect. Indeed the cost of equity represents the

remuneration required by the market for holding the banks' shares and bearing the risk of ownership.

Since the capital ratios of banks are perceived as a rough indicator of their soundness, the lower are the capital ratios, the riskier are considered the investments in their shares and debt instruments.

As Baker and Wurgler (2013) highlighted, setting the capital requirements balances a number of factors, including any effects on the cost of capital. In light of the above, RWA calculation could impact materially not only the level of capital needs, but also the cost of this capital, with the risk of a double counting effect. Indeed a biased RWA calculation would result in a unfair cost of capital.

2.2 Leverage ratio: keep it simple and comparable

The risk sensitive requirements (e.g. CET1 ratio), delegating in a way the risk assessment to the banks themselves, which have preference to hold low capital, could be not appropriate, producing regulatory bias. Conversely, the global banks engaged in regulatory arbitrage, taking on leverage via off-balance sheet vehicles (or via embedded leverage) that was not transparent to supervisors. This shadow banking system generated large write downs that threatened the solvency of systemically important financial institutions, requiring public intervention. This build-up of systemic risks was difficult to detect for supervisors (Hannoun, 2010).

Given the above, what seems necessary is fully taking into account another ratio, overtaking the risk sensitive measures limits, while the bank's specific risk should be faced in the context of the on-going supervision, thanks to other supervisory tools (e.g. pillar 2).

In our view, an example could be represented by the leverage ratio as an indicator to be used by supervisors in elaborating general capital requirements, which would avoid any internal model arbitrage; this tool should be used in combination with the on-going supervision (e.g. pillar 2 add-on for banks with risky portfolio, as measured through indicators as NPL ratio, coverage ratio, amount of operational losses, Var-risk and many others), providing a more truthful picture of the riskiness of the supervised entities.

For the sake of clarity, Leverage ratio means the equity capital as a proportion of total assets[4]; the measure proposed in Basel 3 could represent a good proxy.

Following Blum (2007), one of the most effective criticisms moved to the leverage ratio relates to its non-risk sensitive approach, which could penalize the safest banks in comparison to the riskiest, and consequently asking for too much, or too little, capital to the supervised entities.

In other words, it could represent some banks as too safe, producing a sub-optimal and inefficient capital allocation at macroeconomic level, while it would allow other supervised entities, which actually hold a significant risk exposure, to be less capitalized than the financial stability would need.

On the other hand, it should be highlighted that, an eventual leverage ratio requirement would limit the shareholders moral hazard, moving on their shoulders the weight of losses eventually incurred by the banks.

Blum (2007) also states that there is a trade-off among undue cost on safe banks and the reduction of banking system riskiness; as a matter of fact such leverage ratio removes the distortion of excessive risk taking at the expense of introducing another distortion in the form of raising the financial costs of safe banks above their first best level.

In our view, even if it seems commonsense that the non-risk sensitive ratio would simplify too much the reality and could generate unfair costs for the healthiest banks, a tailor made leverage ratio requirement in the context of pillar 2 requirements could solve, or at least offset, this weakness.

More in details, according to the SSM framework, Supervisors regularly assess and measure the risks for each bank. This core activity is called the Supervisory Review and Evaluation Process, or SREP for short.

The SREP assessment often produces pillar 2 capital requirements, which are differentiated for supervised entities, on the basis of specific risks verified thanks to several indicators.

[4] Adjusted for intangible assets and derivative liabilities.

Capital requirements above the minimum regulatory ones reflect the assessment put in place by the supervisors over the riskiness of the banks. In light of the above, the bank specific SREP assessment could have as outcome pillar 2 leverage ratio requirements, which, distinguishing the banks according to their risk profile, could overtake the abovementioned leverage ratio limit.

Once said that, it should be highlighted that simplicity is one of the strengths of a leverage ratio supervisory requirement in comparison with the current capital ratios, thus avoiding high monitoring costs as well as any regulatory arbitrages.

3. The 2014 Comprehensive Assessment

One of the thorough applications of the capital requirements based approach is the 2014 Comprehensive Assessment, which represented the first act of the European Banking Union. The 2014 CA also constitutes a very powerful set of information regarding the most important European banks; for this reason, leveraging on the public information available, we decided to use these data to build an empirical analysis on the most important outcomes.

Before illustrating the outcomes emerging from the 2014 CA we conduct an analysis of the 2013 data that represent the starting points of the exercise. In particular we aim at showing from an empirical perspective the RWA heterogeneity across SSM countries. The data reported in figure 1 show a material gap between the highest and the lowest values, which might be interpreted in several ways, for example as a consequence of different country-risk profiles and supervisory approaches as well. This evidence is also supported by Cannata, Casellina and Guidi (2012) whose empirical analysis of European and Italian banks confirms that a large part of the observed dispersion is due to individual banks' business mix and different internal models implementations.

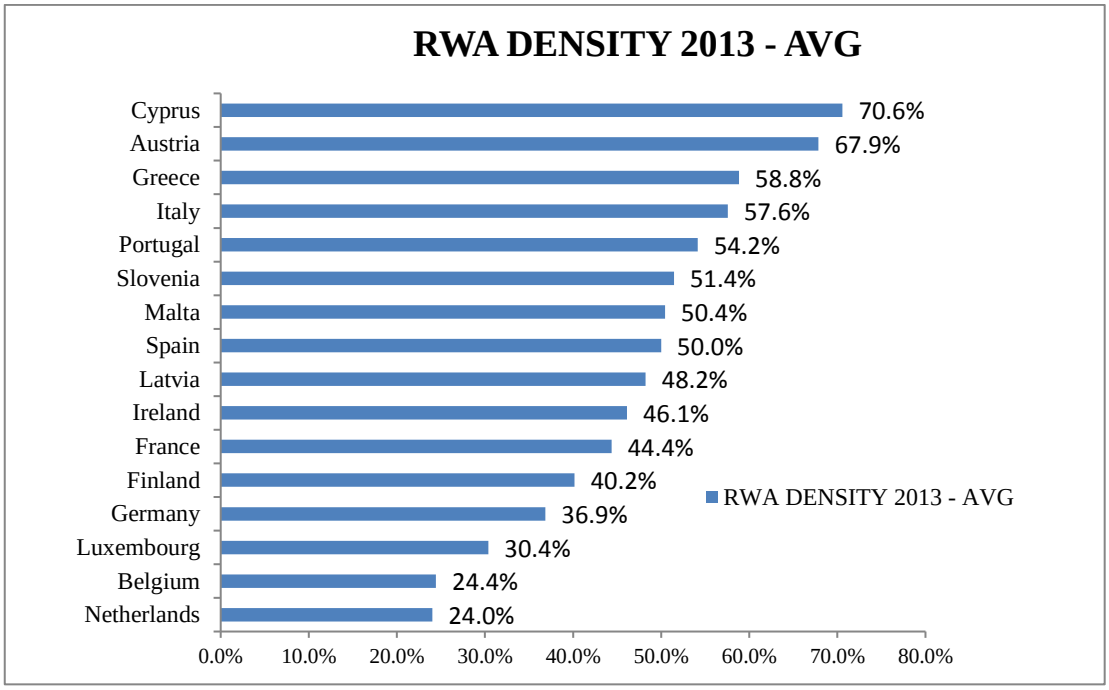

Figure 1: RWA Density 2013 AVG - Source: elaboration on SNL Financial data

In addition, matching the RWA-density and the Leverage Ratio, as reported in figure 2, we find a positive relationship between these two ratios. This might mean that countries with lower RWA-density average values report savings in terms of capital needs compared to the stock of total assets, resulting in lower leverage ratio.

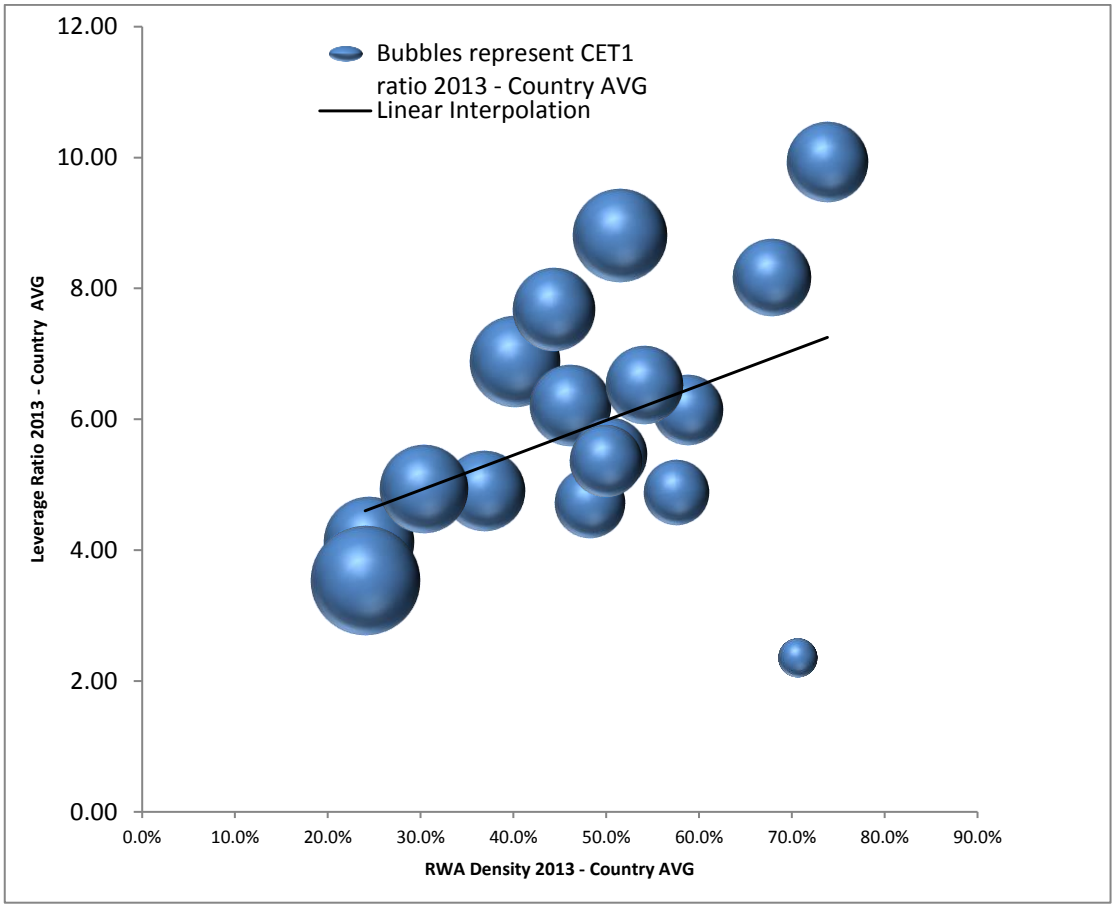

Figure 2: RWA Density - Leverage Ratio. Each bubble represents one country. Source: elaboration on SNL Financial data

3.1 2014 Comprehensive Assessment: Rationale and Description

The Comprehensive Assessment (CA) represented a major milestone towards the operational start of the Single Supervisory Mechanism (SSM) in November 2014. The CA has been an exercise of unprecedented scope and its outcomes provided a significant improvement in the knowledge of the European banking system.

The 130 credit institutions included in the exercise had total assets of 22 trillion, representing more than 80% of the total banking assets in the SSM countries.

The CA consisted of two pillars, the Asset Quality Review (AQR) and the Stress Test (ST).

The Asset Quality Review (AQR) was a point in time assessment of the accuracy of the carrying value of banks' assets, using as a starting point the balance sheet values as of 31 December 2013. The AQR results represented the reference values for the Stress Test that

was undertaken by the ECB and National Competent Authorities (NCAs) applying a uniform methodology and harmonized definitions, largely developed by the EBA with the contribution of ECB and ESRB. The Capital Requirement Regulation and Directive (CRR – CRD IV) represented the ground on which the exercise was based and under the AQR banks were required to have a minimum CET1 ratio of 8% after the so called AQR adjustments. Within this phase a detailed review was performed for more than 800 portfolios, representing 57% of the RWA of the banks involved. This resulted in a detailed assessment of circa 120,000 debtors and 170,000 collateral items, the building of 765 models to challenge the banks' estimates of collective provisions and several other efforts regarding the CVA calculation, the FVO re-valuations. All in all, AQR employed 6,000 experts, leveraging also on an external consultants.

The Stress Test (ST) had the aim of testing the banks' resilience in a forward looking perspective (2014-2016), starting from the 2013 data adjusted for the AQR results. The banks' solvency has been tested applying a common methodology, based on two different scenarios, developed by the EBA with the contribution of ECB and ESRB. Under the baseline scenario, banks were required to maintain a minimum CET1 ratio of 8%, while under the adverse scenario, they were required to maintain a minimum CET1 ratio of 5.5%.

It should be noted that the stress test has been a prudential exercise to address banks' ability to face adverse economic conditions and for these reasons the banks' projections were subject to centrally defined hypothesis, in order to ensure consistency among countries and banks. For example, one of the core assumptions was the static balance sheet approach, according to which the balance sheet values were assumed to be constant over the stress test horizon in terms of total exposures, maturity and product mix.

Generally speaking, the methodology had the objective to reduce the possible arbitrages, ensuring the highest level in terms of level playing field.

The baseline scenario was provided by the European Commission while the adverse one was proposed by the ESRB in close collaboration with the ECB and finally approved by the EBA Board of Supervisors. The adverse scenario – country specific – tried to capture the current risks facing the financial system in the EU, as identified by the ESRB. It

provided forward-looking paths for key macroeconomic and financial indicators for all EU countries and for a large number of non-EU countries. This scenario was designed to reflect these systemic risks at least: 1) an increase in global bond yields amplified by adverse market conditions in the emerging economies; 2) a further deterioration of credit quality, mainly in countries with weak demand; 3) stalling policy reforms jeopardizing confidence in the sustainability of public debt; 4) the lack of bank balance sheet repair to maintain stable market funding.

These theoretical risk factors have been transferred in economic provisions and finally incorporated by the banks in their balance sheets and financial statements. For example, on average the adverse scenario led to the deviation of euro area GDP from its baseline level by -1.9% in 2014, -5.1% in 2015 and -6.6% in 2016; moreover, the euro area unemployment rate has been assumed higher than in the baseline scenario by 0.3% in 2014, 1.2% in 2015 and 2.2% in 2016.

3.2 Comprehensive Assessment Outcomes

The first step of the CA2014, namely the AQR, resulted in aggregate adjustments of 47.5 billion originated from additional provisions on banks' balance sheets.

In addition to adjustments made directly to current carrying values, the AQR result was also reflected in the projection of banks' capital adequacy under the hypothetical scenario performed in the stress test. Under the adverse scenario, the banks' aggregate available capital was projected to be depleted by 215 billion, representing 22% of total available capital of the participating banks. Moreover, the RWAs increased about 860 billion by 2016; considering this increase in terms of additional capital requirement, the total capital impact should be 262.7 billion in the adverse scenario.

The above-mentioned capital depletion led to a decrease of CET1 for the median participating bank by 400 bps, from 12.4% to 8.3% in 2016.

The figure below shows the Comprehensive Assessment median projected adverse scenario reduction in terms of CET1 ratio by country of participating bank.

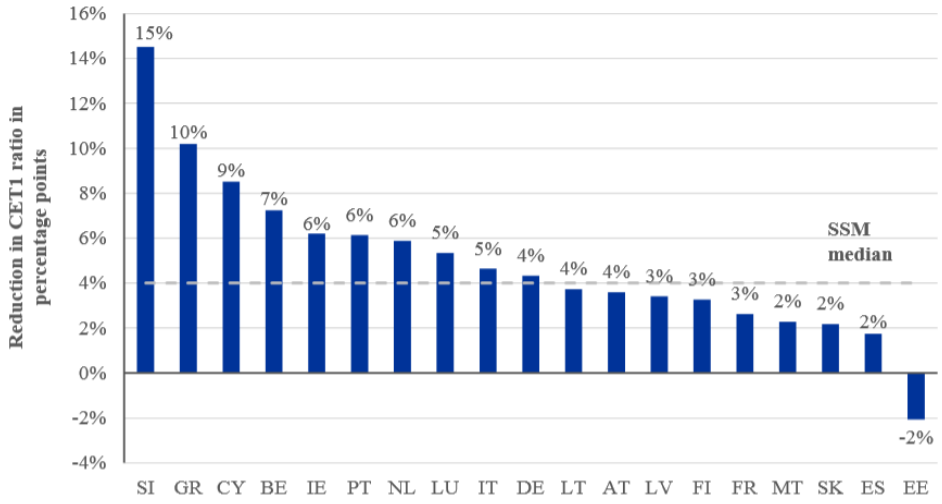

Figure 3: Comprehensive Assessment median projected adverse scenario reduction in terms of CET1 ratio by country of participating bank

Overall, the CA2014 identified a capital shortfall of 24.6 billion across 25 banks. The shortfall arises comparing the bank's capital position (CET1 ratio) during the horizon of the exercise, with the defined thresholds (8% in the baseline scenario and in the AQR, 5.5% in the adverse scenario, respectively).

The capital shortfall could have been covered in the context of capital plans by the participating banks; in most cases banks performed capital increase during the exercise. From 1 January 2014 to mid-October several banks reinforced their capital position for an overall value of 57.1 billion that are not included in the above-mentioned capital shortfall but have been considered as a mitigation measures. The column named "capital shortfall" in the table below considers the capital shortfall as it emerged after the comprehensive assessment (25 banks in shortfall) while the final column shows the capital shortfall post capital measures adopted during the exercise (in 12 cases the shortfall disappeared).

The SSM requested every bank which reported a capital shortfall to implement a capital plan.

Bank Name	CET1 ratio starting point	CET1 ratio post AQR	CET1 ratio baseline scenario	CET1 ratio adverse scenario	Capital shortfall (€ billion)	Net eligible capital raised (€ billion)	Capital shortfall post net capital raised (€ billion)
Eurobank[4]	10.6%	7.8%	2.0%	-6.4%	4.63	2.86	1.76
Monte dei Paschi di Siena	10.2%	7.0%	6.0%	-0.1%	4.25	2.14	2.11
National Bank of Greece[4]	10.7%	7.5%	5.7%	-0.4%	3.43	2.50	0.93
Banca Carige	5.2%	3.9%	2.3%	-2.4%	1.83	1.02	0.81
Cooperative Central Bank	-3.7%	-3.7%	-3.2%	-8.0%	1.17	1.50	0.00
Banco Comercial Português	12.2%	10.3%	8.8%	3.0%	1.14	-0.01	1.15
Bank of Cyprus	10.4%	7.3%	7.7%	1.5%	0.92	1.00	0.00
Oesterreichischer Volksbanken-Verbund	11.5%	10.3%	7.2%	2.1%	0.86	0.00	0.86
permanent tsb	13.1%	12.8%	8.8%	1.0%	0.85	0.00	0.85
Veneto Banca	7.3%	5.7%	5.8%	2.7%	0.71	0.74	0.00
Banco Popolare	10.1%	7.9%	6.7%	4.7%	0.69	1.76	0.00
Banca Popolare di Milano	7.3%	6.9%	6.5%	4.0%	0.68	0.52	0.17
Banca Popolare di Vicenza	9.4%	7.6%	7.5%	3.2%	0.68	0.46	0.22
Piraeus Bank	13.7%	10.0%	9.0%	4.4%	0.66	1.00	0.00
Credito Valtellinese	8.8%	7.5%	6.9%	3.5%	0.38	0.42	0.00
Dexia[2]	16.4%	15.8%	10.8%	5.0%	0.34	0.00	0.34
Banca Popolare di Sondrio	8.2%	7.4%	7.2%	4.2%	0.32	0.34	0.00
Hellenic Bank	7.6%	5.2%	6.2%	-0.5%	0.28	0.10	0.18
Münchener Hypothekenbank	6.9%	6.9%	5.8%	2.9%	0.23	0.41	0.00
AXA Bank Europe	15.2%	14.7%	12.7%	3.4%	0.20	0.20	0.00
C.R.H. - Caisse de Refinancement de l'Habitat	5.7%	5.7%	5.7%	5.5%	0.13	0.25	0.00
Banca Popolare dell'Emilia Romagna	9.2%	8.4%	8.3%	5.2%	0.13	0.76	0.00
Nova Ljubljanska banka[3]	16.1%	14.6%	12.8%	5.0%	0.03	0.00	0.03
Liberbank	8.7%	7.8%	8.5%	5.6%	0.03	0.64	0.00
Nova Kreditna Banka Maribor[3]	19.6%	15.7%	12.8%	4.4%	0.03	0.00	0.03
Total	**10.0%**	**8.4%**	**7.2%**	**2.1%**	**24.62**	**18.59**	**9.47**

[4] These banks have a shortfall on a static balance sheet projection, but will have dynamic balance sheet projections (which have been performed alongside the static balance sheet assessment as restructuring plans were agreed with DG-COMP after 1 January 2014) taken into account in determining their final capital requirements. Under the dynamic balance sheet assumption, these banks have no or practically no shortfall taking into account net capital already raised.

[2] Taking into account the orderly resolution plan of this institution, which benefits from a State guarantee, there is no need to proceed with capital raising following comprehensive assessment results.

[3] The impact on 2014 of the restructuring measures already taken to improve structural profitability and the maintenance of retained earnings in banks will cover the shortfalls identified.

Figure 4: Participating banks with capital shortfall. Source: Aggregate report on the Comprehensive Assessment

Analyzing the country breakdown of the capital shortfall (pre-eligible capital measures adopted during the exercise) we found that 39.4% is due to Italian banks and 35.3% is due to Greek banks. The capital shortfall in Germany, France, Spain, Netherlands and Belgium is not material.

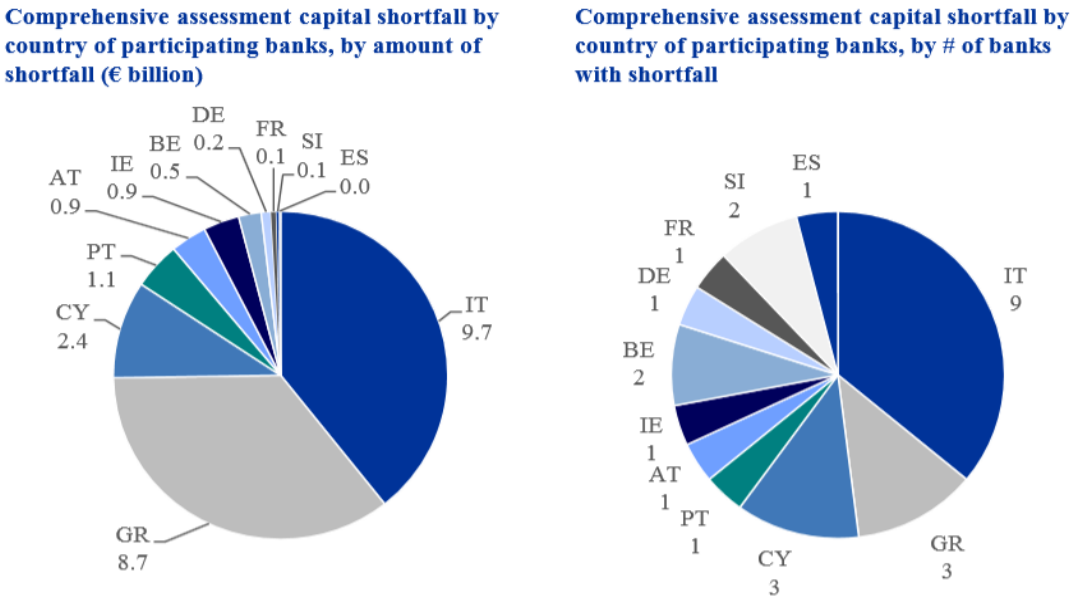

Figure 5:Capital Shortfall by country of participating bank – data before eligible capital measures. Source: Aggregate report on the Comprehensive Assessment

4. An empirical analysis leveraging on the 2014 CA data

As highlighted in the previous paragraphs, leveraging on the shortcomings identified by the economic literature, we apply a leverage ratio approach to the results stemming from the Comprehensive Assessment carried out by the ECB during 2014.

Consequently we tried to re-perform the CA results using the Leverage ratio as regulatory threshold instead of the classic CET1 ratio, assessing the main implications as well as the differences between the approaches. In particular, it seems interesting to see how the capital shortfall would be distributed among countries, if the Leverage ratio is applied to the results published in the banks' specific templates by the ECB. The evidence shows a significant "shortfall migration effect", remarkable in a cross country perspective.

In the next paragraph, we present the dataset, the methodology and the variables used in this research.

4.1 Data

In order to investigate the stress test exercise, we built a unique dataset from SNL Financial data warehouse, from which we obtained balance sheet figures and data used in

the CA 2014, for each bank of interest. The final dataset is composed of 103 banks, as selected by EBA and ECB for the exercise, reported in Annex 1. For the sake of simplicity we only considered groups whose parent company belongs to the SSM perimeter in this way excluding the significant subsidiaries consolidated within extra-SSM banking groups. This choice does not have any material influence on the overall results.

4.2 Methodology

Our analysis can be divided in two main phases. The first phase is a preliminary study, whose aim is to verify which balance sheet figures are mainly associated with the capital shortfall emerged in the 2014 stress test result. In the second phase, we re-perform the CA exercise by focusing on the Leverage ratio indicator as defined by the Basel 3 regulatory approach threshold (e.g.. 3 % starting from January 1st, 2018).

Specifically, we implemented a multivariate logit regression, applied to the selected banks, in order to identify which balance sheet and regulatory figures, actually reported by the banks in 2013, are mostly associated with the capital shortfall emerged in the 2014 CA. The model is reported in the equation below:

$$\Pr(S_i = 1 | V_i) = \Phi(\omega_0 + \omega_1 LR_i + \omega_2 ROAA_i + \omega_3 CI_i + \omega_4 IMP_i + \omega_5 RWA\_D_i + \omega_6 RWA\_CR + \omega_7 RWA\_MK_i)$$

Where S is a dummy variable which takes value 1 for the ith-bank which reported a CET1 capital shortfall in the contest of CA, 0 otherwise; LR is a leverage ratio indicator, consistent with the Basel's definition and calculated as the ratio between CET 1 capital and total assets (with intangible assets and derivative liabilities deducted); CI is a cost-income indicator; IMP is the ratio between the sum of impairments (on both financial and non-financial assets) and total assets; RWA_D is the RWA density ratio, namely the ratio between risk-weighted assets and total assets; RWA_CR is the ratio between RWA for credit risk and total RWA; RWA_MK is the ratio between RWA for market and total RWA. All variables have been standardized in order to compare the magnitude of the different effects. Variables are described in Table 1.

Table 1: Description of variables adopted in regressions are described below.

Variable name	Description
S	Dummy variable which takes value 1 if the bank incurred in a CET 1 ratio capital shortfall during 2014 CA, 0 otherwise.
LR	Leverage ratio, i.e. the ratio between CET 1 capital and Total Assets, deducted intangible assets and derivative liabilities.
ROAA	Return on average assets; net profit as a percent of average assets.
CI	Cost-to-income, operating expense as a percent of operating income.
IMP	Ratio between the sum of impairments (on both financial and non-financial assets) and total assets.
RWA_D	RWA density ratio, namely the ratio between risk-weighted assets and total assets.
RWA_CR	Ratio between RWA for credit risk and total RWA
RWA_MK	Ratio between RWA for market risk and total RWA

In the second phase of our analysis, we perform a simulation of the CA by considering as a variable of interest the Leverage ratio introduced by Basel 3, setting the shortfall threshold at 3%. Such choice has been driven by the requirement which is going to be introduced in 2018; moreover, we implemented the exercise conservatively, since we did not challenge the institutions with a higher threshold as in the 2014 stress test (where the minimum CET 1 ratio was set at 5.5%, while the legally binding requirement is 4.5%). By applying such revised framework, we will be able to challenge the effective level of CET1 capital for given amount of banks' assets, in this way neutralizing the model risk for the CA outcome. Coherently with the EBA's methodology, the analysis relies on a static balance sheet assumption. As described above, stressed figures for CET1 capital in the 2014-2016 time horizon have been obtained by SNL financial but they fully replicate the official outcomes.

4.3 Results: the shortfall migration effect

Table 3 reports results emerging from the logit regression in equation (2):

Table 2 reports the results of the logit regression with S as dependent variable with robust standard errors

VARIABLES	(1)	(2)	(3)
LR	-3.794***	-7.733***	-6.831***
	(1.420)	(2.221)	(2.189)
RWA_D	2.489***	4.775***	3.829***
	(0.733)	(1.389)	(1.406)
RWA_CR	0.0442	0.00688	0.218
	(0.477)	(0.623)	(0.701)
RWA_MK	-0.0323	0.0416	0.393
	(0.493)	(0.514)	(0.576)
ROAA		-1.345***	-0.865
		(0.418)	(1.116)
CI		1.424**	1.217*
		(0.674)	(0.677)
IMP			-2.206**
			(1.045)
Constant	-1.739***	-2.770***	-2.520***
	(0.426)	(0.618)	(0.675)
Observations	103	102	102

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The logit regression provides results which can be intuitively explained. Since the capital shortfall was based on the ratio between CET1 capital and RWAs, the coefficient of the leverage ratio variable is negative and significant at 1% level, while the coefficient of RWA density is positive and also significant at 1% level. Even if such evidence might be considered as obvious and descriptive (a bank with higher levels of CET 1 capital and low RWA density has lower probability to incur in a capital shortfall), it shows from a statistical point of view that RWA density has been an essential driver to determine banks' soundness in the context of 2014 CA. The relatively high coefficient shows that the issue concerning model risk might lead to concerns as regards the "level playing field" perspective of the applicable regulatory framework. Specifically, different banks with exposures towards the same customer might report different risk weights because of the use of the standardized or IRBA method estimating credit risk. Moreover, internal models have been tested and approved by several National Competent Authorities before the introduction of the SSM, being subject to different supervisory approaches and recommendations concerning a certain internal model. To this purpose, no statistical

significance emerged from the amount of RWAs referred to credit and market risk, suggesting no clear links with the probability to incur in a capital shortfall.

Moreover, it should be noted that the cost-income ratio reported a positive association with the capital shortfall, showing that also efficiency represented a considerable driver in the CA outcome. Finally, the level of the impairments (both on financial and non-financial assets) on total assets reports a negative association with the capital shortfall emerged at the end of the stress tests; such evidence, at a glance counterintuitive, could be explained by the fact that those banks with higher levels of impairment aimed to strengthen their balance sheet before the 2014 exercise.

In the second phase of our analysis, we set the CA results by focusing on the Leverage ratio, which should turn into a legally binding 3% requirement starting from 2018. For the scope of this analysis we apply a straight substitution of the reference indicator used in the exercise (CET1 ratio); the purpose of this simulation is to neutralize the model risk by using the leverage ratio instead of CET1 ratio to determine the capital shortfall. What we want to provide to the reader is a different perspective over the CA results, not affected by the models factor and aimed to measure the soundness of the banks in the sample with an alternative (maybe more robust) methodology. As described above, we used the 2014 CA figures and we calculated the leverage ratio in the 2014-2016 time horizon as it has been done for the CET1 ratio during the official exercise. At the end of the simulation, there are 41 banks reporting a capital shortfall as regards leverage ratio, with the following distribution across Europe as reported in the Figure 4 below.

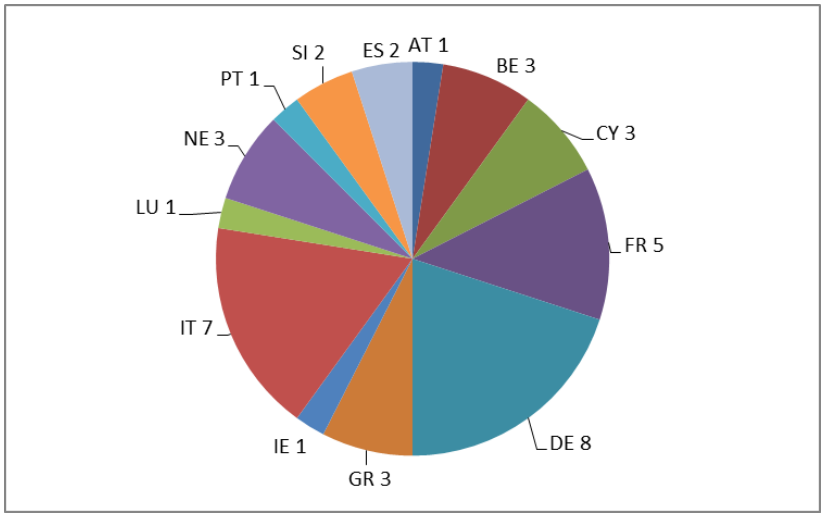

Figure 6:Revised stress tests capital shortfall across countries of participating banks, by number of banks

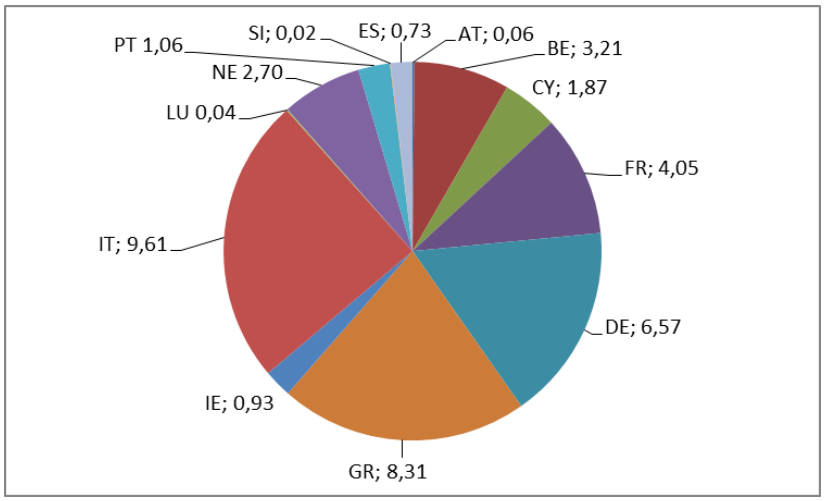

Figure 7: Revised stress tests capital shortfall across countries of participating banks, by amount of shortfall (€ bn)

Such distribution shows higher equilibrium across European countries both in terms of number of banks and amount of capital shortfall. Once the simulation is performed, a clear shortfall migration effect appears among countries. In particular, comparing the official 2014 CA outcomes, the shortfall remains relatively stable in countries such as Italy (9.6 billion in our alternative CA, compared to 9.7 in the official one), while it materializes in some countries such as Germany and France, reaching 6.5 and 4.0 billion respectively. In terms of number of banks in shortfall we see that 5 banks are in shortfall in France, 8 in Germany and 7 in Italy. The data for the Italian banking system are strongly influenced by the capital shortfall of an outlier that accounts for 60% of the overall shortfall.

Following the same logic of the 2014 CA[5], we also apply a more conservative threshold for the Leverage ratio, increasing it from 3% to 4%. Results are again interesting. A material shortfall appears, in particular with reference to France and Germany, whose shortfalls reach 37 and 22.8 billion respectively, while the shortfall of the Italian banking system reaches 16 billion. Looking at the data simulation in terms of number of banks we see that in this very stressed conditions 16 banks in Germany show a capital shortfall as well as 11 banks in Italy and 7 in France.

The results described above show possible issues emerging from the RWA density driver in assessing banks' capital soundness. In the actual regulatory framework, it seems obvious to weight the banks' assets for their risk profile, but such evaluation has to be carefully conducted in order to avoid the possible distortions highlighted by the economic literature. We show that applying another metric, which is in any case supported by the economic literature and is going to be implemented also in the Basel framework, we would see different results across European banking systems from those seen during the 2014 CA. In particular, our analysis shows that in certain countries the banking industry relies on higher Leverage ratio. However, this phenomenon may be not properly captured by the CET1 ratio that leverages on the RWA measures that have an embedded model risk.

[5] The CA threshold has been fixed 1% above the minimum regulatory one (4.5%) in the stress test horizon.

5. Conclusions

In this paper we show that re-performing the 2014 CA results with an additional and simplest metric – the Leverage ratio – leads to a surprising result. We call this result "shortfall migration effect". At a glance we can argue that while the shortfall of the 2014 CA is mainly (75%) concentrated in two countries, namely Italy and Greece, we find that if we re-calculate the results applying the Leverage ratio as regulatory thresholds, the outcome would return a different picture of the health state of the European banking system players, and it would lead to different conclusions. Applying the 3% threshold, a material shortfall would appear also in Germany and France, significantly smoothing the distribution across countries.

Moreover applying a simple logit regression we show from a statistical point of view that RWA density has been an essential driver to determine banks' soundness in the context of 2014 CA.

In this paper we also analyze the relevant literature that finds potential model risk in the RWA set-up. Quite robust evidence shows that the more complex are the banks, the hardest is to fairly assess them through an RWA-based measure, even harder in a cross-county perspective.

Without the claim to provide definitive evidence, we would like to put on the table some arguments against the complexity of the rules.

We believe that combining a risk-based indicators with a more plain measure, such as the Leverage ratio, would grant more consistency among the banking groups figures, and transparency for the financial community, strengthening the effectiveness of the supervisory activity.

As a matter of fact, the modern financial industry is characterized by a high degree of complexity that in several cases generates uncertainty. We believe that replying with additional levels of complexity in terms of rules could be potentially dangerous; the environment requires a regulatory response grounded in terms of simplicity, not in complexity. A simple rule can be easily monitored and the outcomes can be compared with a sufficient degree of certainty. One example fits all: Basel 1 was only 37 pages, Basel 2

came in at 347 pages while Basel 3 is now composed of 616 pages. Basel 4 is an on-going process and if the trend is confirmed we can expect more than one thousand pages. The greatest part of the six hundred pages of Basel 3 are dedicated to the "denominator", in other terms the definition of RWA. The Supervisory Authorities all over the world spend energies and resources to properly assess the RWA-calculation but the benefit of this effort could not be justified by the outcomes[6]. We wonder if the RWA-based framework is *le meilleur des mondes possibles.*

[6] A useful example is the TRIM project (Target Review of Internal Models) that has been recently launched by the ECB in order to address discrepancies among IRB capital requirements' figures across banks. According to the supervisory priorities for 2016, as announced by the ECB, the TRIM project is addressed to directly supervised institutions and will be followed by an effort to harmonize the features that display differences not clearly justified by prudential considerations.

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Annex 1: the name and country of the banks considered in the sample are reported in the table below.

Name of the bank	Country	Name of the bank	Country
BAWAG P.S.K.	Austria	Banca Carige	Italy
Erste Group Bank	Austria	Banca Monte dei Paschi	Italy
Österreichische Volksbanken	Austria	Banca popolare dell'Emilia	Italy
Raiffeisen Zentralbank	Austria	Banca Popolare di Milano	Italy
Raiffeisenlandesbank NÖ-Wien	Austria	Banca Popolare di Sondrio	Italy
Raiffeisenlandesbank OÖ AG	Austria	Banca Popolare di Vicenza	Italy
Argenta Bank	Belgium	Banco Popolare	Italy
AXA Bank Europe	Belgium	Credito Emiliano	Italy
Belfius Banque	Belgium	Credito Valtellinese	Italy
Dexia	Belgium	Iccrea Holding	Italy
KBC Group	Belgium	Intesa Sanpaolo	Italy
Bank of Cyprus	Cyprus	Mediobanca	Italy
Cooperative Central Bank Ltd.	Cyprus	UBI Banca	Italy
Hellenic Bank	Cyprus	Veneto Banca	Italy
OP Financial Group	Finland	UniCredit	Italy
Banque PSA Finance	France	ABLV Bank AS	Latvia
BNP Paribas	France	Banque et Caisse d'Epargne	Luxembourg
Bpifrance Financement SA	France	Precision Capital SA	Luxembourg
Caisse de Refinancement	France	Bank of Valletta	Malta
Crédit Agricole Group	France	ABN AMRO Group	Netherlands
Crédit Mutuel Group	France	ING Bank	Netherlands
Groupe BPCE	France	Nederlandse Waterschapsbank	Netherlands
La Banque Postale	France	NV Bk Nederlandse Gemeenten	Netherlands
RCI Banque SA	France	Raiffeisen-Boerenleenbank	Netherlands
Société de Financement Local	France	SNS Bank NV	Netherlands
Société Générale	France	Banco BPI	Portugal
Aareal Bank	Germany	Caixa Geral	Portugal
Bayerische Landesbank	Germany	Millennium BCP	Portugal
Commerzbank	Germany	Nova KBM d.d.	Slovenia
DekaBank Deutsche Girozentrale	Germany	Nova Ljubljanska Banka	Slovenia
Deutsche Apotheker	Germany	SID - Slovenska izvozna	Slovenia
Deutsche Bank	Germany	ABANCA Corporación	Spain
DZ Bank AG	Germany	Banco de Sabadell	Spain
HASPA Finanzholding	Germany	Banco Mare Nostrum	Spain
HRE Holding AG	Germany	Banco Popular Español	Spain
HSH Nordbank	Germany	Banco Santander	Spain
IKB Deutsche Industriebank	Germany	Bankinter	Spain
KfW IPEX-Bank GmbH	Germany	BBVA	Spain
Landesbank Baden-Württemberg	Germany	BFA Sociedad Tenedora Acciones	Spain
Landesbank Berlin Holding AG	Germany	CaixaBank	Spain
Landesbank Hessen-Thüringen	Germany	CatalunyaBanc	Spain
Landwirtschaftliche Rentenbank	Germany	Fundación Bancaria Ibercaja	Spain
L-Bank Baden-Württemberg	Germany	Grupo Cooperativo	Spain
Münchener Hypothekenbank	Germany	Kutxabank SA	Spain

NORD/LB	Germany	Liberbank SA	Spain
NRW.BANK	Germany	Unicaja Banco SA	Spain
Volkswagen Financial Svcs AG	Germany	National Bank of Greece	Greece
Westdeutsche Genossenschafts	Germany	Piraeus Bank	Greece
Wüstenrot Bank AG	Germany	Allied Irish Banks	Ireland
Wüstenrot Bausparkasse AG	Germany	Bank of Ireland	Ireland
Alpha Bank	Greece	Permanent TSB Group Hldgs Plc	Ireland
Eurobank Ergasias	Greece		