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CAPITAL REQUIREMENTS UNDER THE FUNDAMENTAL REVIEW OF THE TRADING BOOK
Impact of the revised approach to measure market risk

Inês Ramos Correia, 27232

A Project carried out on the Master Finance Program, under the supervision of:

Professor António Nogueira Leite

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Abstract

After the subprime crisis it became clear that a stronger regulatory framework was crucial to ensure a healthy banking system. Changes in banks' capital regulation and banking supervision standards have been the main focus of the policy discussions. The Fundamental Review of the Trading Book overhauls the market risk capital requirements, it aims to address shortcomings of the current Basel II.5 market risk capital framework and to increase the comparability of market risk weighted assets across banks in different jurisdictions. This dissertation seeks to assess the impact of the revised framework in the banking industry.

Keywords: Market Risk, Fundamental Review of the Trading Book, Basel Committee on Banking Supervision, Bank for International Settlements

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1. Background and rationale

A strong and resilient banking system is the foundation for sustainable economic growth, as banks are the main intermediaries in the credit process between savers and investors. Banking regulation originates from microeconomic concerns over the ability of bank creditors to monitor the risks originating on the lending side and from micro and macroeconomic concerns over the stability of the banking system in the case of a bank crisis. (Bonn, 2005) Since the first Basel accord, regulation has focused on capital, more capital should make banks more able to absorb losses with their own resources. Over the last years, regulatory capital requirements have been refined and broadened to cover various types of risks and to distinguish their treatment among different asset classes. In the process, the rules have become increasingly elaborate, reflecting the growing complexity of modern banking. (Demirgüç-Kunt, Detragiache and Merrouche, 2010)

The Fundamental Review of the Trading Book (FRTB) sets the standards for minimum capital requirement regarding market risk. FRTB will be gradually implemented until 2019 and will overhaul a major part of the current regulation. (BIS, 2017a) As of today, FRTB has no legal meaning and Basel II.5 is the current framework for market risk. Due to The Basel Committee on Banking Supervision (The Committee) decisions having an important impact on the financial institutions, this field becomes of interest. Especially FRTB, because amongst all the new incoming regulations, FRTB is expected to have one of the biggest impacts in the banking industry. Not only by increasing the capital requirements significantly but also by forcing banks to change their infrastructures. Furthermore, no previous regulation required banks to collect this wide-ranging type of data before. Thus, the required data and technology changes needed to comply with the new framework are definitely significant and interesting to further analyse in more detail.

2. Literature review

According to the Bank of International Settlements (BIS, 2014a), The Committee already made some refinements to the proposed market risk framework. More specifically, on three specific areas: on the treatments of Internal Risk Transfers (IRT's), on the Standardize Approach (SA) and on the concept of liquidity horizons. Regarding the treatment of IRT's, there were several responses to the second consultative paper (BIS, 2012) requesting clarification on external hedges that were recognized in the capital framework as risk reliefs. The Committee acknowledged the merits of allowing banks to efficiently hedge risks in their banking books. For example, the better monitoring of counterparty risk limits and the improvement of the overall risk management of the bank. At the same time, IRT's, if not properly constrained, can create incentives for capital arbitrage. The Committee is still developing a solution on this subject. Concerning the SA, the industry raised some concerns and The Committee agreed to a sensitivity-based approach as an alternative to the original cash flow-based calculations. This requires banks to use price and rate sensitivities that are more likely to be available in their systems as inputs already, reducing the implementation cost of this approach. Lastly, comments received on varying liquidity horizons pointed out potential implementation issues, such as the lack of comparability due to the complexity of the models and the fact that the approach provided small benefits in terms of precision compared with simplified modelling alternatives. The Committee adapted the framework according to the public comments.

The first portfolio exercise (BIS, 2014b) focused on the revised Internal Models-based Approach (IMA) and comprised 41 banks from 13 countries. This exercise concluded that, although banks have raised numerous concerns about the implementation of the approach to liquidity horizons, the majority of banks were able to implement it. As expected, the move from the sum of VaR and sVaR to ES typically increases the overall risk measure. Assuming the rho parameter is set at 0.5,

there would be a 62% mean increase. Moreover, only a small proportion of banks were able to properly compute the capital charges for Non Modelling Risk Factors (NMRF). Concerning trading desks, most banks indicated that they expect to have less than 100 regulatory trading desks, and most of the risk appears to be concentrated in the largest 10% of desks. Finally, on the stressed period selection, only six (out of 43) banks chose periods that did not include at least Q4 2008.

McKinsey (McKinsey & Company, 2015) states that banks' budgets for FRTB implementation range from \$10 million to \$20 million for medium-sized banks to \$50 million to \$100 million for large banks. It is expected that banks follow one of two potential strategic paths, depending on capital constraints and competitive dynamics. Capital-constrained banks, and those which lack competitive scale, will likely refocus their product portfolios. They will need to assess which products are core to their client base and, perhaps, exit from business lines which are not profitable. While banks that are less capital-constrained and operate at scale need to focus on where they can re-price to maintain profitability. This re-pricing will lead to some degree of volume reduction, particularly in more structured products where the capital charges are likely to be higher.

Results from the first Quantitative Impact Study (QIS) (BIS, 2015), based on a sample of 44 banks, showed that compared to the current market risk framework, the proposed market risk framework would result in a weighted average increase of 74% in aggregate market risk capital charges. When measured as a simple average, this increase in the total market risk capital requirement is 41%. For the median bank in the same sample, the capital increase is 18%. Concerning the IMA, when measured as a simple average, the capital requirement is 54% higher. For the median bank, the capital requirement under the revised IMA is 13% higher. Compared to the current SA for market risk, the capital requirement is 128% higher, measured as a simple average. For the median bank, the capital requirement under the revised SA is 51% higher.

3. Methodology

With the goal of assessing the impact of FRTB this dissertation uses figures concerning the Benchmarking Exercises made by The Committee.

The Committee performs Quantitative Impact Studies (QIS) on a semi-annual basis with end-December and end-June reporting dates. The figures used concern the results for the last quarter of 2015 (2015Q4), second quarter of 2016 (2016Q2) and last quarter of 2016 (2016Q4). The participation in this exercise is voluntary and data is only reported on an aggregate basis, to guarantee the anonymity and confidentiality of the participating banks. To be part of the QIS all the banks are required to fill a template created by The Committee. The Committee then aggregates all the results using a weighted approach, hence the largest banks in the industry will have more impact in the final result than small banks.

The figures, provided by BNP Paribas, show the impact of multiple components compared with the current methodologies. The figures are computed for the aggregated bank, weighted average, as well as a simple average. Some additional statistics are also available. Namely, the 25th Percentile, the Median and the 75th Percentile. The data provided, since December 2015 until December 2016, allows to analyse the way banks are adjusting to the new regulation and to observe which components of the revised framework have more impact compared to the current framework.

4. Regulatory framework

4.1. The need for a dynamic financial regulation

The majority of people might think that the Subprime Crisis was caused by the lack of regulation and that the solution is to increase the regulatory framework. That would be an incorrect diagnosis. (ICMB and CEPR, 2009) By the time of 2008-2009 there were highly regulated institutions in regulated jurisdictions. Although in some cases there is, indeed, the need of an expansion in the regulatory framework, the solution is not as simple as an overall increase in regulation per se. What is required is a different type of regulation. A crisis should be used as a guide to what needs to be fixed, to discover what fundamental market failures were being ignored or improperly dealt with. Thus, the role of regulators should be to properly adapt the regulatory framework having in account the pace of the industry and paying close attention to gaps in the existing framework that frauds or financial distress situations may expose.

The crisis that began in 2008 revealed that in a context in which financial products and transactions become more complex it is necessary to introduce new regulations and resolution mechanisms. The crisis showed the need to include in the legislation the goal of financial stability as well as the supervision of institutions that were likely to spread their issues to the entire financial system. Besides bringing severe discredit on all the financial authorities the global financial crisis brought awareness for the lack of control on banks and moral hazard issues. (CEPR and SRC, 2015)

4.2. Regulatory entities

The Bank for International Settlements (BIS) was created in 1929-1930 aiming to act as a banker for central banks, and to promote world-wide financial and monetary collaboration. The Committee, was established by the central bank Governors of the G10 countries at the end of 1974. The main goal of The Committee was to exchange knowledge, seeking to improve banking

supervision globally and promote financial stability by improving the quality of banking supervision worldwide. (BIS,2016a) Nowadays, The Committee, headquartered in Basel, is responsible for closing gaps in international supervisory coverage so that all banking establishments are subject to supervision. Furthermore, The Committee is responsible to guarantee that supervision is adequate and consistent across member jurisdictions.

4.3. Previous legislation

4.3.1. Basel I

Basel I, also known as The Basel Capital Accord, was proposed in 1988. The 1988 Accord called for a minimum ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992 and suffered several adjustments in the next years. (BIS, 2016a) When the Capital Accord was implemented the financial world was a simple place, with simple financial transactions, which can explain the simplicity of the regulation. And, although the regulation appeared to be a basic effort in terms of regulation, it did show improvements since banks had to improve their capital ratios to comply with the regulation. And more important, it introduced the concept of a standardized definition of capital adequacy globally and made awareness for the need of effective capital management in the financial industry.

4.3.2 Basel II

Basel II, also known as New Capital Framework, was released in June 2004 seeking to replace the 1988 Capital Accord. This revised capital framework widened the focus on risk management and assessment by presenting a new approach, based on 3 pillars. Pillar 1, also known as Minimum Capital Requirements, stated that banks had to maintain a certain acceptable capital level. This approach has able to assess both Credit and Operational Risks. Pillar 2, known as Supervisory Review Process, asserted that banks had to assess their solvency according to their specific risk.

Furthermore, additional supervisory oversight was introduced regarding the way banks calculated their capital requirements, and regulators could intervene before the capital levels start to deteriorate. Pillar 3, regarding Market Discipline, enforced the levels of disclosure that the bank was subject to, aiming to strengthen market discipline and encourage good banking practices. (BIS, 2005)

4.3.3 Basel II.5

After the beginning of the crisis in 2008, The Committee felt the need to deal with the most present lacks in the existing regulation immediately. Thus, in July 2009 it introduced a set of revisions to the market risk framework, known as the Basel II.5.

Major improvements from Basel II were, the deviation from VaR to SVaR approach and the attempt to capture credit and default risk by introducing the Incremental Risk Charge (IRC). Also, the introduction of a new measure, the Comprehensive Risk Measure (CRM), that assess the risks arising from the correlation between trading positions. And finally, a set of new charges for securitization positions. According to BIS an important property of Basel II.5, is the reduction of pro-cyclicality of the minimum capital requirement for market risk. (BIS, 2011)

4.3.4 Basel III

Basel III can be considered the biggest regulatory change in the banking industry in the last years. Expected to be fully implemented until 2019, the new framework strengthens bank capital requirements and introduces new regulatory requirements on bank liquidity and leverage. (BIS, 2017a) After the subprime crisis, The Committee admitted that the crisis had its roots on the excessive leverage and in the inadequate liquidity buffers. These two factors combined with poor risk management, as well as inappropriate incentive structures, resulted in the mispricing of credit and liquidity risks, and excess of credit growth. (BIS, 2016a)

The new standards were issued in December 2010 (BIS, 2010), strengthening the 3 pillars introduced by Basel II and widening the previous framework with multiple innovations. Namely, a capital conservation buffer, that consists in an additional layer of common equity; an additional countercyclical capital buffer, that restricts the participation of banks in system-wide credit booms; the introduction of a leverage ratio, a non-risk based measure, that states the minimum amount of capital that the bank is obligated to have relative to all its assets and off-balance sheet exposure; and two new measures for liquidity requirements, the Liquidity Coverage Ratio (LCR) and The Net Stable Funding Ratio (NSFR). While the LCR intends to provide enough cash to meet the banks funding needs for short-term and long-term stressed periods, the NSFR intends to address the maturity mismatches present in the balance sheet. Additionally, The Committee created a proposal for systemically important banks (GSIBs) with supplementary capital requirements.

4.3.5 “Basel IV”

While The Committee considers some latest reforms as the finalization of Basel III these new requirements are commonly referred to as “Basel IV”, which is the case of FRTB. FRTB belongs to the package of new standards issued by The Committee that is expected to overhaul most of the current regulatory framework, considered to be the biggest set of modifications in the history of banking regulation.

As discussed, Basel III focused on the numerator of the minimum regulatory capital ratio by covering both the quantity and quality of banks’ capital. Now, “Basel IV”, aims to make changes in the denominator of that same ratio. Making banks to use either Standardize or Internal Models approaches when calculating their capital charges regarding credit, market and operational risk exposures. With this framework The Committee wants to revisit transparency and consistency in risk measurements across approaches, banks and jurisdictions. Thus, most of this review focuses

on the use of standardized approaches in the calculation of risk measures, in order to better compare banks' risk exposures. It is expected a gradual implementation of "Basel IV" rules once the framework is finalized from 2022 until 2027, potential phase-in arrangements are still under discussion. (BIS, 2017b)

Some examples of the new regulatory requirements that banks will be subject to under the "Basel IV" framework are the risk data aggregation and IT requirements (BCBS 239); the revised interest rate risk in the banking book standards (IRRBB); and the introduction of IFRS 9 accounting standards. It is worth mentioning that this new regulatory environment will require banks to run large-scale implementation programs. Moreover, additional capital requirements imposed by supervisors, such as during the EU Supervisory Review and Evaluation Process (SREP), will likely increase banks capital charges even further. (McKinsey & Company, 2017)

4.4. Global Assessment

The regulatory framework in place by the time of the crisis, Basel II, proved to be inadequate and made the situation even more disastrous, as its capital calculations for credit risk were procyclical. Meaning that in a situation of financial distress the probability of a counterparty defaulting and the loss in case of default both increase, causing the regulatory capital requirements to rise as well. This reveals a gap in Pillar 2, since this type of situation should be dealt with capital additional buffers, but by the time of the crisis risks had been underestimated. Pillar 2 states that under a review process, supervisors can evaluate whether banks should hold more capital than the Pillar 1 minimum. In 2008 the minimum capital requirements under Pillar 1 were not sufficient to cover the losses caused by the default of most counterparties, and nor did the requirements under Pillar 2, meaning that not only the banks but supervisors alike underestimate the risks taken. Pillar 3 requirements, regarding market discipline and disclosures that had to be made by banks to the

market also proved to be inefficient, as most of the linkages in the market were unpredictable and doubtful. Overall, Basel II can be blameworthy of requiring levels of capital that were inadequate and to delegate the assessment of credit risk to inappropriate institutions. Furthermore, the international framework assumed that the internal models used by banks, would result in higher requirements to those that supervisors could have implemented.

After the crisis, The Committee, recognized the need to fix a certain number of structural flaws present in the previous framework, starting an overhaul of banking standards. Basel III framework, appears to solve some of the gaps in the legislation observed during the subprime crisis. While capital ratios are to be dramatically pushed forward, the introduction of capital buffers and liquidity ratios seems to address two of the major problems perceived in 2008. Without a doubt, the new framework makes it costlier for banks to have a riskier behaviour and to take unwanted risks. On the other hand, the package of additional requirements that follows Basel III, can have a considerable negative impact on the banking industry and be pointed out as quite complex. As it will overhauls all the current legislative framework, forcing banks to change their business models and infrastructures in order to adapt and be able to cope with all the new requirements. It can also be mentioned that Basel III impacts have not yet been analysed properly, since is only expected that the new framework is fully implemented in 2019. Thus the additional reforms do not have into account the pros and cons of Basel III framework. Although the implementation period of the additional requirement already suffered some changes, last one in December 2017 (BIS, 2017), the implementation period can be considered too short having in account the complexity of the revised framework. Taking into account that the new framework will overhaul most of the current legislation and will force banks to change their infrastructures and business strategies, a more detailed analysis on the impact of the new requirements should be made.

5. FRTB implementation

5.1. Qualitative aspects

5.1.1. Boundary between the Trading and Banking Book

In October 2013, The Committee issued a revised regulatory boundary between the Trading Book (TB) and Banking Book (BB), aiming to reduce arbitrage of regulatory capital between the two books. Concerning the TB the regulatory framework states that, “instruments presumed to be in the TB are so designated because they are held with the intention of short-term resale; held with expectations of profiting from short-term price movements or arbitrage profits; and/or to hedge risks resulting from such instrument types.” (BIS, 2013) In this new regulatory boundary, the definition of the TB is supplemented with a list of instruments presumed to be in this book – the Presumption List. No deviation from this list is allowed without explicit approval, a bank must receive explicit supervisory approval to be able to do so. Under the revised boundary all TB instruments must be fair-valued daily, and any valuation changes must be recognized in the profit and loss (P&L) account. Banks must also document and disclose their policies for the assignment of instruments between books and make available such documentation to supervisors. Bank-initiated decisions to switch instruments must be reported to the supervisor, receive approval, and be disclosed to the public. When an instrument is switched to another book, the bank will not be allowed to benefit from a lower regulatory capital requirement from this switch. If the capital charge on an instrument is reduced because of switching, the difference in charges is imposed on the bank as a fixed, as an additional Pillar 1 capital charge. (BIS, 2013)

5.2. Quantitative aspects

5.2.1 Internal Models Approach

The use of an IMA will require explicit approval of the bank’s supervisory authority. The process for determining the eligibility of trading activities for the IMA can be summarized in three steps –

Appendix 1. In the first step, the definition and structure of all trading desks is evaluated, as well as the bank's organizational infrastructure and its internal risk capital model. The failure of this test means that the bank has to apply the SA in the entire TB. In the second step banks must nominate which trading desks are in-scope for model approval and which trading desks are out-of-scope. Desks that are out-of-scope will have their capital charges calculated according to the SA. For the desks that the bank considers to be in-scope for the IMA model approval is required. Each trading desk must satisfy P&L attribution and back testing requirements on an ongoing basis. Step three is a risk factor analysis that will determine which risk factors are eligible to be used in the internal models. (BIS, 2013)

The use of the IMA requires a model approval process, meaning that trading desks will have to show that their models are adequate, approval is based on a P&L Attribution and Back-testing tests. The P&L attribution test aims to assess whether the P&L based on risk factors included in the trading desk's risk management model captures the material drivers of actual P&L. (BIS, 2013)

The inputs of this test are the Hypothetical P&L and the Risk-based P&L, being the first one the daily desk-level P&L excluding the impact of new transactions and the second the model based P&L. The P&L Attribution requirements are based on two daily tests – Appendix 2 - that compare the unexplained P&L with the hypothetical P&L at a trading desk level. To succeed these tests a trading desk cannot have more than four breaches over the prior 12 months.

Back-testing requirements seek to determine how well the risks are captured. The inputs for this assessment are the 1-day VaR (at 99% and 97.5%) and the Actual P&L. The test is based on the comparison of the VaR measures with the actual P&L outcomes. The back-testing assessment will be run daily at trading desk and bank level. To succeed these tests a trading desk cannot have more

than a maximum number of breaches over the prior 12 months, in case of VaR at 97.5% this number is 30 breaches, and for VaR at 99% the value is 12 breaches.

Under this new framework it is important to distinguish between modellable and non-modellable risk factors. For a risk factor to be classified as modellable by a bank there must be continuously available “real prices” for a sufficient set of representative transactions. “Real price” is defined as a price (i) at which the institution has conducted a transaction; (ii) that is verifiable for an actual transaction between other arms-length parties; (iii) or that is obtained from a committed quote. Additionally, if the price is obtained from a third-party, the transaction has to be processed through that party and the party must agree to provide evidence of the transaction to supervisors upon request. Also, an additional requirement needs to be fulfilled: a risk factor must have at least 24 observations per year, with a maximum period of one month between two consecutive observations. The previous criteria must be assessed monthly. (BIS, 2013)

Risk factors that do not meet these conditions are deemed to be non-modellable and must be capitalized individually using a separate stressed capital add-on. Modellable risk factors are capitalized under the Expected Shortfall (ES), ES must be computed daily at a bank and trading desk level, with a 97.5th percentile. ES loss distribution must also have into account the liquidity characteristics of the risk factor. Liquidity horizon is defined as “the time required to exit or hedge a risk position without materially affecting market prices in stressed market conditions”. (BIS, 2016b) The ES measure must be calibrated to the most severe 12-month period of stress available over the observation horizon, Stressed ES (sES). The revised approach uses a supervisory aggregation scheme to restrict correlations across risk factor categories and hedging benefits. Hence, the final ES figure is calculated as an equal-weighted average of an “unconstrained” bank-wide ES charge with diversification benefit recognized across all risk classes and a set of

“constrained” partial ES charges, for asset class, with no cross-risk class diversification benefit recognized. NMRF are capitalized individually using a stress scenario that is calibrated to be at least as conservative as the ES calibration used for the bank’s internal model. The final value is calculated by the sum of all stand-alone charges without any diversification benefits.

Furthermore, the revised framework replaces the IRC with a Default Risk Charge (DRC) measure. Default risk is the risk of direct loss due to an obligor’s default as well as indirect losses that may arise from a default event. The DRC model will capture default risk exclusively and also limit the types of risk factors and correlations that can be used within the model. This default risk is measured using a VaR model, at a 1-year time horizon and 99.9% confidence interval.

The total charge for market risk under the IMA will be equal to the capital requirements for eligible trading desks, both modellable risk factors and NMRF, plus the Default Risk charge plus the standardized capital charge for ineligible trading desks.

5.2.2 Standardized Approach

The new SA has three main objectives. First, the approach must fit banks with a level of trading activity that do not require sophisticated measurement of market risk. Second, it has to provide a fall back if a bank fails to be apt to use the IMA. Finally, the approach should facilitate consistency and comparability on the reporting of market risk across banks and jurisdictions. The revised SA will also capture the risks from securitization exposures in the TB, which are fully removed from the IMA for market risk. This approach must be calculated by all banks and reported to their supervisor monthly, even if a bank is authorized to use the IMA.

The major change is that the approach is now based on risk sensitivities across asset classes: there is a set of buckets and risk factors that are prescribed by the regulator to which instruments can

then be mapped to. The underlying principle for bucketing was to group instruments deemed to be sufficiently homogenous from a risk perspective. (BIS, 2013) To make a link between the SA and IMA some improvements from the IMA were embedded into the revised SA. Namely, the “bucket” risk weights within each risk class under the SA have been calibrated to stressed market conditions using an ES methodology. The concept of varying liquidity horizons is used as well in the calibration of the standardized risk weights. The SA capital requirement is the sum of three components: the risk charges under the Sensitivities based method (SBM), the DRC, and the residual risk add-on (RRAO).

The risk charge under the SBM must be calculated by aggregating three risk sensitivities: “delta”, “vega” and “curvature”. Instruments are mapped to a set of regulatory prescribed risk factors to which shocks are applied to calculate a capital charge for the individual risk factors. Then, the risk-weighted sensitivities are aggregated within each bucket, using regulator-prescribed aggregation formula and correlations. The total capital charge is the sum of each risk-class level capital charge. This method is calculated for three different correlation scenarios (medium, low and high), the final capital charge is the maximum of the overall scenario capital charge. (BIS, 2015b)

The DRC captures the jump-to-default risk, using the same calculation method as the IMA. The standardized DRC allows for some limited hedging recognition within each bucket category, but not across different bucket categories.

A residual risk add-on is introduced to ensure sufficient coverage of all market risks. It provides a simple and conservative capital treatment for more complex instruments. The RRAO is the sum of gross notional amounts of the instruments bearing residual risks, multiplied by a risk weight factor of 1% or 0.1% depending on the complexity of the instrument. (BIS, 2015b)

6. Data and empirical results

Using data from 2015Q4, 2016Q2 and 2016Q4 - Appendix: Graph 1. -, FRTB represents an increase of 51%, 64% and 47%, respectively, when compared to the current framework and computed as a weighted average. If considering a simple average this value is higher than the previous one: 52%, 94% and 57% for 2015Q4, 2016Q2 and 2016Q4, respectively. By analysing the 25th percentile one can see that even banks in this part of the distribution registered an increase in capital charges of 18% in the last quarter of 2016. The values concerning the 75th percentile can be quite worrisome, showing that some banks registered an increase around 200% on their current capital charges. The previous figures were computed having in account both the desks falling under IMA and under the SA. To better understand both approaches and what components have a bigger impact one has to take a closer look to each approach on a stand-alone basis.

When comparing the SA with the current total capital charge, only for non-securitisations - Appendix: Graph 2. -, in the last quarter of 2016, is possible to observe that the revised approach represents a 159% increase, computed as a simple average and a 146% increase if computed as weighted average. Under this new approach the median bank registered a 151% increase in its capital charges. Banks in the 25th percentile registered a 94% increase in their charges. Looking at the 75th percentile, having all the desks under SA, would mean an increase of 192% in the capital costs. Breaking down the components of the SA - Appendix: Graph 3. -, using data from 2015Q4 and 2016Q2, is possible to observe that the SBM component has by far the biggest impact. Looking closer on SBM statistics for 2016Q2, for the aggregated bank this component represents 70% of the SA, is also possible to observe that the aggregated bank is in 25th percentile. Analysing the banks standing on the 75th percentile, these institutions registered 85% of their capital charges arising from the SBM component.

Although with a smaller impact than the SA, observing 2016Q4 results for the - Appendix: Graph 4. -, is possible to observe that FRTB represent as 48% increase compared with the current IMA, for the aggregated bank. When computed as a simple average the increase is 55% and 46% for the median bank. Banks standing in the 25th percentile saw their capital charges increased by 3%, while banks in the 75th percentile had an increase of 111%. Breaking down IMA components - Appendix: Graph 5. -, since 2015Q4 until 2016Q4, all components seem to be balanced and none of them has a major impact as seen previously with SBM under the SA.

When comparing both approaches - Appendix: Graph 6. -, using 2016Q4 data, SA represents an increase of 128% in capital charges compared to the IMA, considering the aggregated bank. If the analysis does not include residuals components (RRAO and NMRF) this value stands for 179%. Showing that NMRF under IMA has a higher impact than RRAO on SA. As seen before, SBM under SA is the component that creates a bigger increase and ES under IMA is likely to create an increase as well for the majority of banks. The last component to be compared is the DRC under both approaches, using data only for modellable desks, the DRC under SA represents a 127% additional capital charge compared with the DRC under IMA. Using 2014Q4 data, comparing the new DRC measure with the previous IRC - Appendix: Graph 7. -, under the IMA is possible to observe that the aggregated bank registered an increase of 164%, which can be explained, in part, by the new requirement for equity default risk to be under this component. When comparing the DRC under SA with the IRC, the aggregated bank registered a 40% decrease, this value can be explained by the fact that it does not consider securitisations impact. Under FRTB, securitisations will always be computed under the SA. Taking a closer look on securitisations components - Appendix: Graph 8. -, using data from 2016Q2, is possible to see that the major impact for securitisations will be the DRC, representing 70% of all the total charge for the aggregated bank.

7. Impacts and future research

The implementation of FRTB represents a major challenge for the banking industry in several areas. Namely, the need for increasing technological skills and computational power, the strengthening of the existing market risk infrastructure and the planning of changes in the business strategy and overall infrastructure. Banks also need to prepare to adjust their risk calculations and data sourcing to be able to run their models at desk level and to adhere to a desk structure that complies with the rules the regulatory have set, adjusting their strategies accordingly. Setting a clear strategic path to implement FRTB will be a big challenge. In terms of costs, banks can expect not only significant increases in market risk capital charges but also increases in their business-as-usual costs due to the new computation requirements. Thus, banks will need to assign a considerable sizeable budget to be able to deal with the revised framework. The implementation of FRTB will also require a clear understanding of the regulation and its impact. Banks will also have an increase in costs due to hiring new people and giving additional training to their current staff to deliver the complex program of work that supervisors are expecting.

The major problems for banks will arise from data management, data sourcing and operational issues. There are some quantitative challenges when implementing FRTB, which are fundamentally a data challenge. First, banks need to understand the incremental data requirements compared with the existing data calculation models. Compared with previous regulatory frameworks banks will need to manage a lot more data, and the rules for the calculations are a lot more prescriptive. Under FRTB there will be much more data to be produced, while in the current frameworks banks aggregate data at a higher level, at bank level, the new framework requires data do be aggregated at a trade desk level. Other issue for banks will arise from the restrictions concerning risk factors to be eligible for inclusion in IMA calculations. Banks will have to find a

good data source for risk models, which will be particularly challenging in the case of complex derivative products where the bank might not have enough data and market data sources lack as well.

Specifically under the IMA, the revised framework will impose a greater computational burden, some examples are the management of historical market data, calibration of stress periods and scenario generation across multiple trading desks. Banks need to gather data at raw level, clean the information, compute it and aggregate the results to present to their regulator. It will force banks to completely change the way they gather and organize data. P&L Attribution tests also represent a significant challenge, as they will require the finance and risk functions to become more align. Although this can vary from bank to bank, in most institutions there is a gap between these two departments.

Besides FRTB, in the next years banks will also be subject to additional regulatory requirements under the “Basel IV” framework. What is common between all these new frameworks is that they all require banks to deal with increasingly detailed data. It would be interesting to further explore what changes in the current technological systems and perhaps what new systems banks can use to be able to manage the new amount of data. Also, what type of advantages can banks that are leading the technology field and are more innovative in technology solutions can have when adapting to new regulation. Additionally, how are new requirements for more and more detailed data affecting banks in terms of becoming more inventive and aware of new solutions, embracing a more technological mind-set. Furthermore, it would be useful to study synergies between regulations, like Markets in Financial Instruments Directive II (MiFID II), that require banks to declare data regarding prices, which may be helpful in the treatment of the NMRF, a component that showed to be problematic for banks in terms of charges calculations and can have a significant impact.

8. Conclusions

In order to assess the impact of the revised framework to measure market risk this dissertation started by analysing previous regulatory frameworks, concluding that although the new framework is able to solve most of the lacks in the previous legislation, it appears to be a lot more complex than the ones presented before. To show the complexity of the implementation, the major challenges of the process were presented, both for the qualitative and quantitative aspects of the new framework. When analysing the previous QIS figures it is possible to conclude that FRTB will likely have an impact of 50% increase in the banking industry. Also, by looking at the difference between the weighted average and the simple average is possible to observe that, in relative terms, small banks will be more impacted than bigger banks when comparing the total charges under FRTB with their current capital charges. Although, on the other hand, big banks will have more costs implementing the new framework, since they require more sophisticated approaches concerning data management. Also, the difference is probably arising from the fact that bigger banks have already higher capital charges than small banks.

Under the SA the component that creates more capital charges is the SBM, also one of the components that arises more issues in terms of data management, computation and production of figures. Is also worth mentioning that even if a bank is allowed to use the IMA for some of its desks the SA capital charges figures have to be deliver to the regulator as well.

Under the IMA all components seem to be balanced. However, this approach requires the approval of the P&L Attribution and Back-testing tests, also a significant challenge. The P&L Attribution test will require the Finance and Risk department to work more closely with each other. The approval in the P&L test depends on the similarity between the Unexpected P&L and the Hypothetical P&L at desk level, calculated by Risk and Finance departments, respectively. For a

desk to be able to have its capital charges calculated under the IMA these two functions will have to become more align in terms of data models. Other issue under the IMA is the requirements for a risk factor to be considered modellable. If a risk factor is considerable a NMRF, in case there is no data concerning the price, that will represent an increase in the capital charge, compared with the computation of ES and sES. Thus, the availability of public data is a matter of concerning, mostly on complex derivatives products. If a desk trades a specific asset class or product that has a cyclical nature, that desk might be more profitable under the SA even if its apt to fall under the IMA. Because if a product is only traded in specific times, there will be lack of pricing data for more than one month apart, hence the instrument will be considered as a NMRF registering a higher capital charge. For products traded in the US there is data for prices available in the central reporting depository, the Trade Reporting and Compliance Engine. For Europe, MiFID II, to be implemented in January 2018, will require banks to disclose and make available more data on prices. Concerning APAC, there is few public data available and there is no reporting depository nor legislation that appears to minimize the probability of a product to be considered as NMRF.

Since the bank has to declare its SA charges to the regulators under any circumstances, at a certain point, if the computation process becomes too complex and it is not possible for the bank to produce such amount of data in the required timeframes, the bank can, purposely, have some of its desks that would be allowed to use the IMA under the SA. The same can happen if the bank happens to have most of its desks under the SA and the marginal increment in the capital charge under SA is lower than the capital charge under IMA, having in account all the additional calculations. The function of the Resources Management team is then to evaluate not only the impact of the future regulation but as well analyse all the possible outcomes and ways to minimize the final impact of the new framework in the bank's capital charges.

9. References

Bank for International Settlements. 2005. “International Convergence of Capital Measurement and Capital Standards: A Revised Framework”. Accessed November 2, 2017. <https://www.bis.org/publ/bcbs118.pdf>

Bank for International Settlements. 2010. “Basel III: A global regulatory framework for more resilient banks and banking systems”. Accessed November 3, 2017. <https://www.bis.org/publ/bcbs189.pdf>

Bank for International Settlements. 2011. “Revisions to the Basel II market risk framework”. Accessed November 2, 2017. <https://www.bis.org/publ/bcbs193.pdf>

Bank for International Settlements. 2012. “Fundamental review of the trading book: Consultative Document”. Accessed October 28, 2017. Available at: <https://www.bis.org/publ/bcbs219.pdf>

Bank for International Settlements. 2013. “Fundamental review of the trading book: A revised market risk framework: A Revised Framework”. Accessed November 3, 2017. <https://www.bis.org/publ/bcbs265.pdf>

Bank for International Settlements. 2014a. “Fundamental review of the trading book: outstanding issues”. Accessed October 28, 2017. <https://www.bis.org/bcbs/publ/d305.pdf>

Bank for International Settlements. 2014b. “Analysis of the trading book hypothetical portfolio exercise”. Accessed October 29, 2017. <https://www.bis.org/publ/bcbs288.pdf>

Bank for International Settlements. 2015a. “Fundamental review of the trading book – interim impact analysis”. Accessed November 4, 2017. <https://www.bis.org/bcbs/publ/d346.pdf>

Bank for International Settlements. 2015b. “Minimum capital requirements for market risk: Standards”. Accessed November 2, 2017. <https://www.bis.org/bcbs/publ/d352.pdf>

Bank for International Settlements. 2016a. “History of the Basel Committee”. Accessed November 17, 2017. <https://www.bis.org/bcbs/history.htm>

Bank for International Settlements. 2016b. “Explanatory note on the revised minimum capital requirements for market risk”. Accessed October 29, 2017. https://www.bis.org/bcbs/publ/d352_note.pdf

Bank for International Settlements. 2017a. “Basel III: Monitoring Report”. Accessed December 22, 2017. <https://www.bis.org/bcbs/publ/d397.pdf>

Bank for International Settlements. 2017b. “Basel III: Finalising post-crisis reforms”. Accessed December 23, 2017. <https://www.bis.org/bcbs/publ/d424.pdf>

Bonn. 2005. “An increasing role for competition in the regulation of banks”. Accessed September 22, 2017 <http://www.internationalcompetitionnetwork.org/uploads/library/doc382.pdf>

Centre for Economic Policy Research & Systemic Risk Centre. 2009. “Post-Crisis Banking Regulation Evolution of economic thinking as it happened on Vox”. Accessed December 2, 2017. http://voxeu.org/sites/default/files/file/Post_Crisis_Banking_Regulation_VoxEU.pdf

Demirgüç-Kunt, Asli; Detragiache, Enrica; Merrouche, Ouarda. 2010. “Bank Capital: Lessons from the Financial Crisis. IMF Working Paper.” Accessed September 22, 2017 <https://openknowledge.worldbank.org/bitstream/handle/10986/3955/WPS5473.pdf?sequence=1>

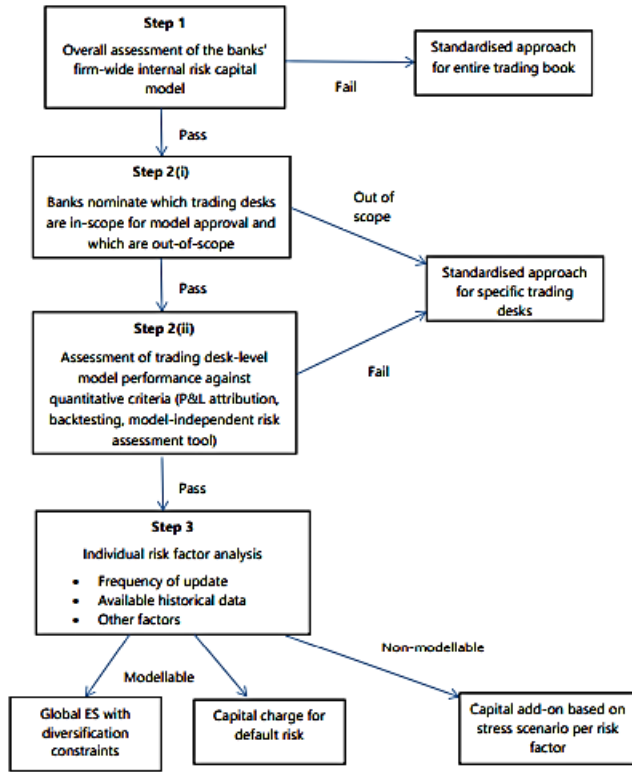
International Center for Monetary and Banking Studies & Centre for Economic Policy Research. 2009. “The Fundamental Principles of Financial Regulation. Geneva Reports on the World Economy”. Accessed December 2, 2017. <https://www.princeton.edu/~markus/research/papers/Geneva11.pdf>

McKinsey & Company. 2015. “The Fundamental Review of the Trading Book: Implications and Actions for Banks. Report”. Accessed November 25, 2017. <https://www.mckinsey.com/industries/financial-services/our-insights/the-fundamental-review-of-the-trading-book>

McKinsey & Company. 2017. “Basel “IV”: What’s next for banks? Implications of intermediate results of new regulatory rules for European banks. Global Risk Practice”. Accessed September 29, 2017. <https://www.mckinsey.com/business-functions/risk/our-insights/basel-iv-whats-next-for-european-banks>

10. Appendices

Appendix 1. Eligibility for IMA Process



Source: BIS, 2013

Appendix 2. Model Approval Tests

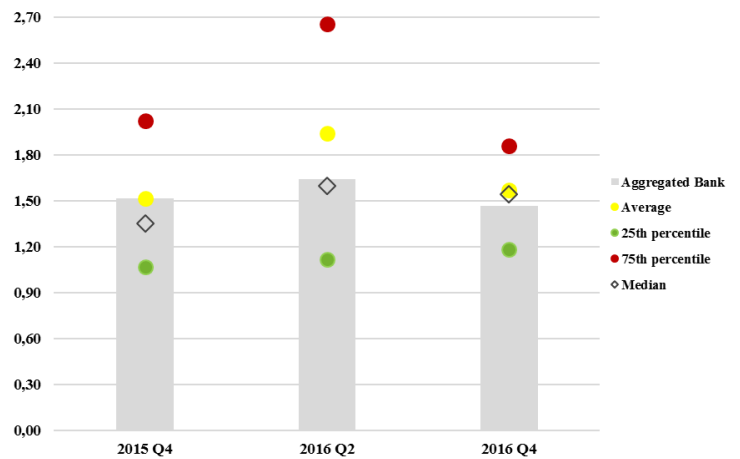
Test 1 (Mean ratio over the last month):

$$\frac{Mean(daily\ unexplained\ P\&L)}{StdDev(daily\ hypothetical\ P\&L)} < 10\%$$

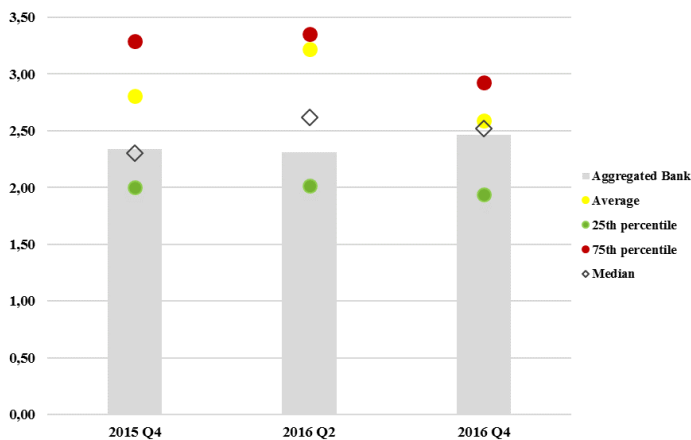
Test 2 (Variance ratio over the last month):

$$\frac{VAR(daily\ unexplained\ P\&L)}{VAR(daily\ hypothetical\ P\&L)} < 20$$

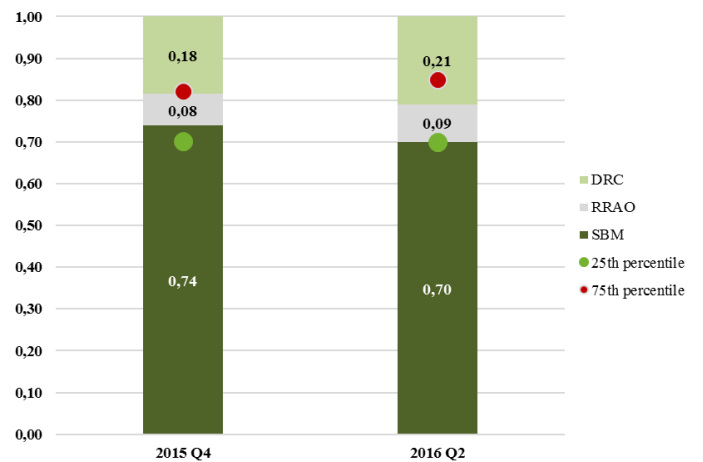
Graph 1. FRTB Capital vs Current Capital



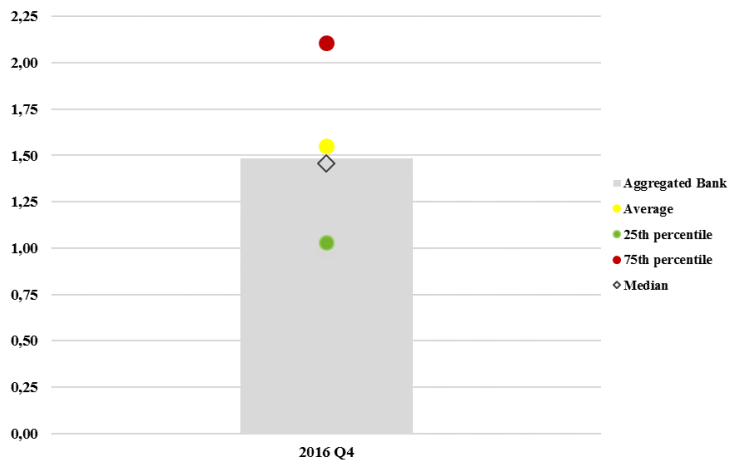
Graph 2. SA Capital vs Current Capital



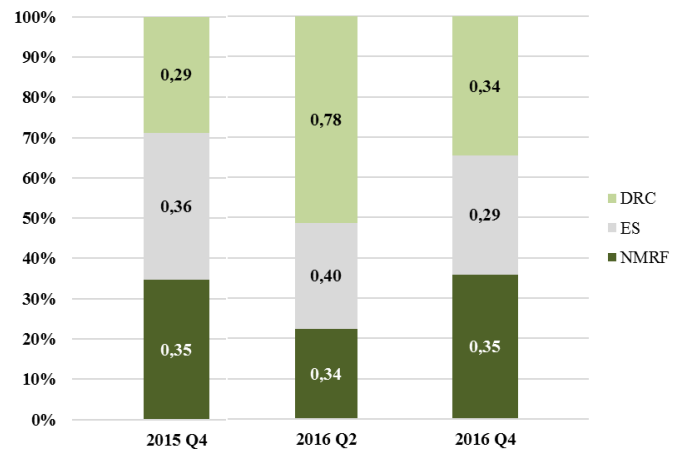
Graph 3. Components of SA/ SBM statistics



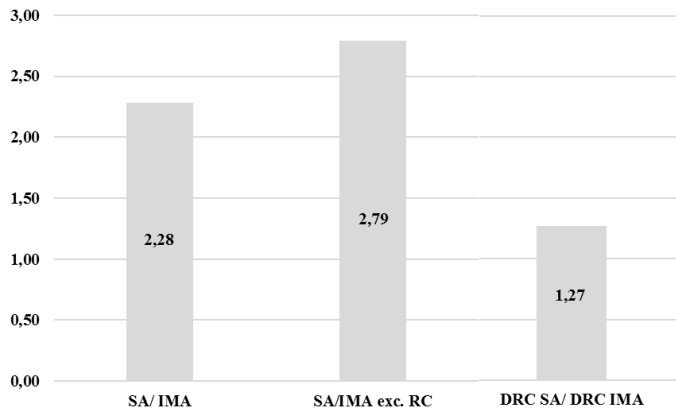
Graph 4. FRTB IMA vs Current IMA



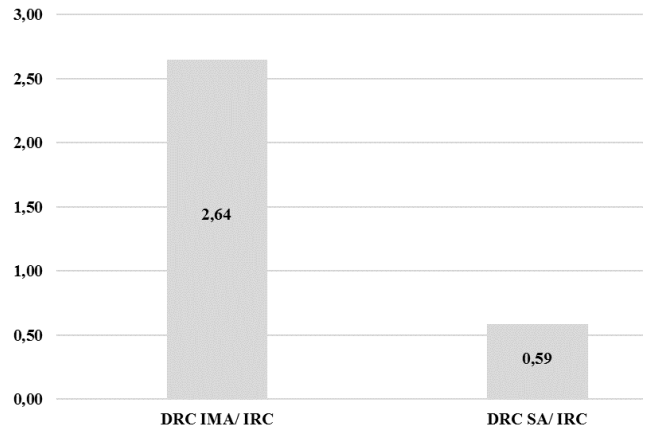
Graph 5. Components of IMA



Graph 6. IMA vs SA



Graph 7. DRC vs IRC



Graph 8. Securitisations

