The implementation of the Basel III Countercyclical Capital Buffer in Portugal

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Abstract

Basel II capital requirements are risk sensitive because they rely on the credit quality of borrowers, which means that in a downturn of the business cycle, when capital might be needed to absorb losses, capital requirements are also expected to be higher. This procyclicality may lead to excessive risk-taking during good times and to a credit crunch during bad times, amplifying the business cycle effects. Several approaches were proposed to address this problem.

The new Basel III framework directly addresses this issue, mainly through the implementation of the countercyclical capital buffer. This buffer aims to protect the banking system from periods of excessive credit growth, ensuring that the financial sector, as a whole, has enough capital to maintain the flow of credit into real economy in stress periods and that capital requirements do not constraint credit supply.

The objective of this thesis is to discuss the implementation in Portugal of the Basel III countercyclical capital buffer framework. The analysis was organized in two main parts, answering two different questions.

First, the historical performance of the common guide Credit-to-GDP gap, proposed by the Basel Committee on Banking Supervision (BCBS) to signal the built up of the countercyclical capital buffer, was tested. The results showed that the guide can signal the build up of the buffer complying with the objectives set. However, according to the results, some alterations to the methodology proposed may need to be considered, in order to improve the calibration for the Portuguese economy. For instance, a smoothing parameter of 1 600 instead of 400 000 to compute the trend using a recursive Hodrick-Prescott filter may provide better results, while changing the lower and upper thresholds might also be necessary.

The second objective was to assess if Portuguese banks would respond to an increase of capital requirements by constraining loan supply or by other means. To do so it was used an approach based on the previous work of Francis and Osborne (2012), which studied the effects of regulatory capital requirements on capital, lending and balance sheet management of UK banks. The results suggest that Portuguese banks tend to react to capital requirement increases by raising the levels of regulatory capital.

Acknowledgements

This thesis represented a challenge, not only because of its own difficulties, but also because it was accomplished while I was father of my second child, which was demanding, and I also had to maintain my professional obligations. Obtain the data needed was the most defying task, being responsible for a delay in the completion of the work.

The support of my family, especially my wife which was restless during this endeavor, was essentially.

I also would like to sincerely thank my advisor, Diana Bonfim, for her support and total availability during this process.

Contents

1 Introduction

Banking system regulators impose minimum capital ratios to banks, which depend on the coverage of risk weighted assets (RWA) by the level of own funds held by the institution. Basel II capital requirements, in place today, are risk sensitive because RWA depend on the credit quality of borrowers. This means that in a downturn of the business cycle, when overall credit quality decreases, RWA tend to be higher and in good times tend to be lower for the exact opposite reasons. This procyclicality gives a wrong incentive to banks that may lead to excessive risk-taking during good times and to a credit crunch during bad times, amplifying the business cycle effects.

This problem led to the necessity of presenting solutions to smooth the effects of procyclicality and, in consequence, several approaches were proposed. The new Basel III framework directly addresses this problem, mainly through the implementation of the countercyclical capital buffer, which aims to protect the banking system from periods of excessive credit growth, ensuring that the financial sector, as a whole, has enough capital to maintain the flow of credit into real economy in stress periods and that capital requirements do not constraint credit supply. To do so, this buffer should be imposed by national authorities if they believe to be in the presence of excessive credit growth that is contributing to the build up of system-wide risk (constraining it) and should be released in the presence of a crisis or when the risks identified subside. Although national authorities should apply proper judgment in buffer decisions, the variable Credit-to-GDP gap, explained afterwards, was proposed by the Basel Committee on Banking Supervision (BCBS) to be a common guide in signaling the build up of the countercyclical capital buffer.

The objective of this thesis is to discuss the implementation in Portugal of the Basel III countercyclical capital buffer framework. The analysis was organized in two main parts, answering two different questions.

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The rest of the document is organized as follows:

1. The second chapter will address the importance of capital and the evolution of international capital regulation. It will also address procyclicality in capital regulation and the role of the Basel III countercyclical capital buffer in mitigating it, while also reviewing some of the related literature;

2. The third chapter will explain how the common guide Credit-to-GDP will be implemented and assess its historical performance in Portugal;

3. The fourth chapter will analyze how Portuguese banks adjust their balance sheets to comply with changes in capital requirements;

4. Finally, conclusions are presented in the fifth chapter.

2 International capital regulation

2.1 Capital

It is common for financial institutions to incur in losses due to their activity and they must be prepared to absorb these losses in order to maintain themselves operating in the long run. The losses can be of different magnitude and probability, as shown in Figure 1, and should be dealt with in different ways. The expected loss, due to its high probability of occurring, should be covered by the regular activity with an adequate pricing of the products and provisioning, while the unexpected loss, which is not expected to be exceeded with some degree of confidence (usually 99% or 99.9%), should be absorbed by capital. This means that an adequate capital level prevents financial institutions from failure when extreme losses occur. The stress loss is the unexpected loss level which it is judged to be too expensive to hold capital against, meaning that this level of losses leads to insolvency.

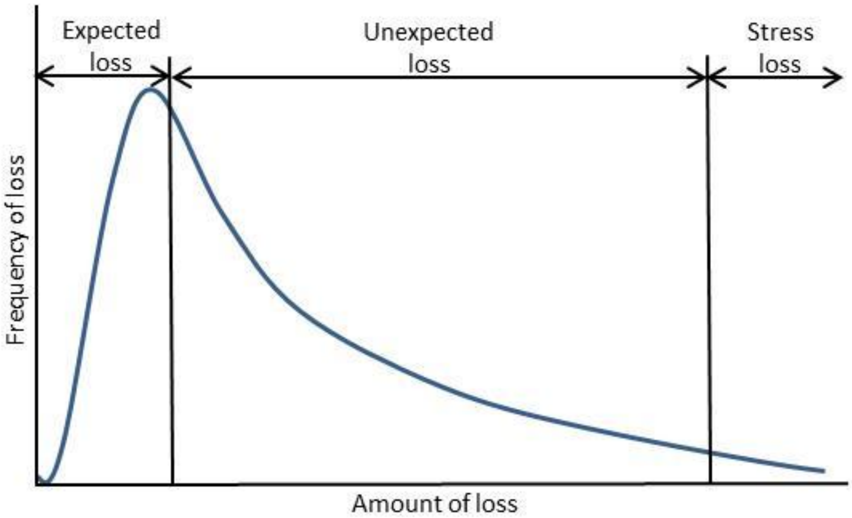

Figure 1 – The loss probability function

The failure of a financial institution may cause serious damage in the financial system where it is integrated and also in the real economy, due to the propagation of losses across banks, which in turn may lead to the default of other financial institutions (systemic risk) and to a reduction of the credit supplied to households and corporations, deteriorating the economy. In order to prevent these negative impacts on the financial system and economy, regulators must ensure that banks hold adequate levels of capital, preventing them from defaulting.

Before 1988, many regulators of different countries imposed minimum levels of capital coverage over total assets. However, the definitions of capital and minimum levels required were not homogeneous across jurisdictions, which lead to unequal conditions to banks competing worldwide, giving an edge to the ones with slack regulation. Additionally, due to the existence of new transactions accounted as off-balance sheet items (*e.g.* over-the-counter derivatives), the amount of capital required should not be based only on total assets, being required a better measure of the risks taken by banks.

2.2 Basel I

These constrains were behind the creation of the Basel Committee on Banking Supervision in 1974 and to the subsequent first approach to set international risk-based standards for capital adequacy ("The 1988 BIS Accord"). Despite of maintaining a minimum standard based on the ratio of capital to total assets, where banks were required to have a minimum multiple of 20, a new standard, based on the bank's total credit exposure, was introduced and became known as the Cooke ratio.

The Cooke ratio consisted on the coverage of risk-weighted assets (RWA), which include off-balance sheet items, by total capital and a minimum of 8% was set. Total capital was composed by Tier 1 Capital, with a better loss-absorbing quality and a minimum requirement of 4%, and by Tier 2 Capital, also known as Supplementary Capital.

To compute the risk-weighted assets, a risk-weight was applied to each exposure based on the asset category, as shown in Table 1 (example for on-balance sheet items). The exposure of off-balance sheets items consisted in a credit equivalent amount, which for non-derivatives derived from applying a credit conversion factor (CCF) to the principal amount and for derivatives resulted from adding to the exposure an add-on factor, to reflect the possibility of increasing the exposure in the future (the add-on factor is a percentage of the principal and depends on the residual maturity of the position and the type of underlying).

Risk weight (%)	Asset category
0	Cash, gold bullion, claims on OECD governments such as Treasury bonds or insured residential mortgages.
20	Claims on OECD banks and OECD public sector entities such as securities issued by US government agencies or claims on municipalities.
50	Uninsured residential mortgage loans.
100	All other claims, such as corporate bonds and less-developed country debt, claims on non-OECD banks, real estate, premises, plant, and equipment.

Table 1 – Risk weights for on-balance sheet items

In 1998, it was implemented the "1996 Amendment" to the original accord. This amendment introduced a capital requirement to cover exposures to market risks in addition to the existing capital requirement to cover exposures to credit risks. To calculate the market risk capital requirements, banks were allowed to use a standardized approach or an "internal model-based approach" (based on internal value-at-risk measurements), depending on the abilities of different banks in risk management. Most large banks preferred to use the latter model, because it led to lower capital requirements, due to diversification effects (Hull, 2010).

Despite the advantages brought by the 1988 BIS Accord in the improvement of the level of capital held by banks and consequently in the stability of the banking system, its simplicity did not allow to capture well credit risk, because the risk weight to be applied to a position only depended on the asset class, ignoring the creditworthiness of the counterparty. In 1999 a new set of rules was proposed by the BCBS and the final set of what has become known as Basel II was published in 2004 and implemented in 2007.

2.3 Basel II

Basel II is based on three "pillars", namely, (1) minimum capital requirements, (2) supervisory review and (3) market discipline. Concerning minimum capital requirements, two innovations relatively to the 1996 Amendment took place. First, the minimum capital requirement for credit risk reflects the credit rating of counterparties set by authorized External Credit Assessment Institutions (ECAI). Second, a new capital requirement for operational risk was established. This means that the total capital requirement under Basel II is

$$8\% \times (\text{Credit risk RWA} + \text{Market risk RWA} + \text{Operational risk RWA})$$

Equation 1 – Capital requirements under Basel II

For credit risk measurement, institutions are allowed to choose from one of three available options:

1. The standardized approach;
2. The foundation internal ratings based (IRB) approach;
3. The advanced IRB approach.

The standardized approach differs from Basel I in the additional risk sensitivity through the use of a wider range of risk weights linked to external ratings. As can be observed in Table 2, the risk weights depend not only on the counterparty class, but also on its rating.

<table>
<tr><th>Counterparty</th><th>Credit Assessment</th><th>AAA to AA-</th><th>A+ to A-</th><th>BBB+ to BBB-</th><th>BB+ to BB-</th><th>B+ to B-</th><th>Below B-</th><th>Unrated</th></tr>
<tr><td>Sovereigns</td><td>RW</td><td>0</td><td>20</td><td>50</td><td colspan="2">100</td><td>150</td><td>100</td></tr>
<tr><td>Banks – Option 1: Credit Assessment of the Sovereign</td><td>RW</td><td>20</td><td>50</td><td colspan="3">100</td><td>150</td><td>100</td></tr>
<tr><td rowspan="2">Banks – Option 2: Credit Assessment of the bank</td><td>RW (long-term)</td><td>20</td><td colspan="2">50</td><td colspan="2">100</td><td>150</td><td>100</td></tr>
<tr><td>RW (short-term)</td><td colspan="3">20</td><td colspan="2">50</td><td>150</td><td>100</td></tr>
<tr><td>Corporate</td><td>RW</td><td>20</td><td>50</td><td colspan="2">100</td><td colspan="2">150</td><td>100</td></tr>
</table>

Table 2 – Risk weights (as percentage of principal) under Basel II's standardized approach

Under the IRB approach, capital requirements depend on the Probability of default (PD), Loss given default (LGD), Exposure at default (EAD) and Maturity adjustment (MA). For corporate, sovereign and bank exposures, under the foundation IRB approach, banks compute PD and the remaining risk parameters are set by the regulator, while under the advanced IRB approach, banks compute their own estimates of PD, LGD, EAD and MA. Under both IRB approaches, for the calculation of capital requirements for retail exposures, banks provide their own estimates of PD, LGD and EAD (in this case there is no maturity adjustment).

2.4 Basel III

On June 2011, it was published the final version of the original December 2010 Basel III document entitled "Basel III: A global regulatory framework for more resilient banks and banking systems". This framework was designed to strengthen capital and liquidity rules in order to promote a more resilient banking sector, able to absorb shocks arising from financial and economic stress, and by doing so, reducing the risk of damaging the real economy.

These new rules also intend to reflect the lessons learned from the recent financial crisis, which began in 2007/2008. The main drivers of this crisis, according to the BCBS[1], were the build up of excessive on- and off-balance sheet leverage, a gradual erosion of the level and quality of the capital base and also the insufficient liquidity buffers held by some banks. The

[1] Basel III: A global regulatory framework for more resilient banks and banking systems (2011)

crisis was also amplified by the procyclical deleveraging process and the linkage between systemic institutions, through complex transactions.

In order to address these problems, the framework's main objectives are:

1. Raising the quality, consistency and transparency of the capital base;
2. Enhancing risk coverage;
3. Supplementing the risk-based capital requirement with a leverage ratio;
4. Reducing procyclicality and promoting countercyclical buffers;
5. Addressing systemic risk and interconnectedness;
6. Introducing a global liquidity standard.

The new minimum capital requirements, as can be observed in Table 3, are imposed not only to Tier 1 Capital and Total Capital as in Basel II, but introduce the concept of Common Equity Tier 1 and two additional Capital buffers (the Conservation buffer and the Countercyclical buffer).

	Common Equity Tier 1	**Tier 1 Capital**	**Total Capital**
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5
Countercyclical buffer range	0 – 2.5		

Table 3 - Capital requirements and buffers (all numbers in percent)

The introduction of the capital requirements for Common Equity Tier 1 serves the objective of raising the quality of the capital base as it is basically composed by common shares and retained earnings. The capital conservation buffer, comprised of Common Equity Tier 1, intends to ensure that banks build up and maintain an excess of high quality capital outside of periods of stress, through the retaining of earnings, which can be used to absorb future losses. The countercyclical buffer is designed with the purpose of reducing procyclicality. This will be discussed in more detail on the next sections (section 2.5 discusses procyclicality and section 2.6 addresses the Basel III countercyclical capital buffer).

The Basel III framework, which should be fully implemented in 1 January 2019, started its phase-in arrangements in 2013 as shown in Table 4.

Phase-in arrangements

(shading indicates transition periods - all dates are as of 1 January)

	2011	2012	2013	2014	2015	2016	2017	2018	As of 1 January 2019
Leverage Ratio	Supervisory monitoring		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015					Migration to Pillar 1	
Minimum Common Equity Capital Ratio			3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital Conservation Buffer						0.625%	1.25%	1.875%	2.50%
Minimum common equity plus capital conservation buffer			3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of deductions from CET1 (including amounts exceeding the limit for DTAs, MSRs and financials)				20%	40%	60%	80%	100%	100%
Minimum Tier 1 Capital			4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Capital			8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Capital plus conservation buffer			8.0%	8.0%	8.0%	8.625%	9.25%	9.875%	10.5%
Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital			Phased out over 10 year horizon beginning 2013						
Liquidity coverage ratio	Observation period begins				Introduce minimum standard				
Net stable funding ratio	Observation period begins							Introduce minimum standard	

Table 4 – Basel III phase-in arrangements

The CRD IV package transposes Basel III into the European Union legal framework and entered into force on 17 July 2013. Institutions are required to apply the new rules from the 1 January 2014, with full implementation on 1 January 2019 (European Commission).

2.5 Procyclicality

Basel II capital requirements are risk sensitive because they rely on the credit quality of borrowers, as mentioned before. Under the standard approach, the credit quality is reflected by the borrower's external rating, when available, and under the IRB approach on the borrower's probability of default. This means that in a downturn of the business cycle, when capital might be needed to absorb losses, capital requirements are also expected to be higher and, as shown in the work of Kashyap and Stein (2004), under the IRB approach this increase of the capital requirements might be substantial. This procyclicality may lead to excessive risk-taking during good times and to a credit crunch during bad times, amplifying the business cycle effects.

According to the BCBS[2], "*one of the most destabilizing elements of the crisis has been the procyclical amplification of financial shocks throughout the banking system, financial markets and the broader economy*". The BSBC also claims that "*losses incurred in the banking sector can be extremely large when a downturn is preceded by a period of excess credit growth. These losses can destabilise the banking sector and spark a vicious circle, whereby problems in the financial system can contribute to a downturn in the real economy that then feeds back on to the banking sector.*"

Although there is some agreement that the effect of procyclicality of the Basel II capital requirements should be mitigated and that it should be done without throwing out the risk-sensitiveness of capital regulation regime, different solutions were proposed by several authors.

Kashyap and Stein (2004) argue that having a single time-invariant "risk curve"—that maps credit-risk measures (such as the PD) into capital charges—is, in general, suboptimal. These authors propose the use of several point-in-time risk curves (several confidence levels), as displayed in Figure 2, with each curve corresponding to different macroeconomic conditions (for the same probability of default, the capital charge should be lower in bad times of the business cycle). The authors suggest two equivalent ways of accomplishing the shift between curves, either by reducing the minimum capital ratio required in a recession or by a reduction of the risk weights assigned to loans of varying risk profiles.

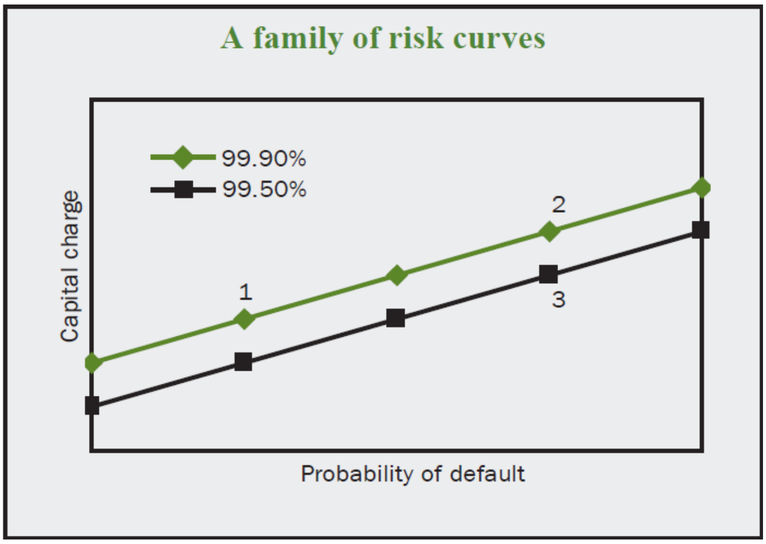

Figure 2 – Kashyap and Stein (2004) Family of risk curves

[2] Basel III: A global regulatory framework for more resilient banks and banking systems (2011)

Repullo, Saurina, & Trucharte (2010) also show that Basel II capital requirements move significantly along the business cycle (more than 50% from peak to trough). Using the Basel II formula to calculate capital requirements, their analysis was based on an estimation of *point-in-time* (PIT) PDs resulting from a logistic model of the one-year-ahead probabilities of default of Spanish firms during the period 1987-2008. They also tested two different solutions to mitigate the cyclicality of these requirements over the business cycle. The first procedure consisted in smoothing the input of the Basel II formula by using some *through-the-cycle* (TTC) adjustment of the PDs and the second in smoothing the output of the formula computed from the PIT PDs. For the latter they tested different adjustments based on aggregate information (the rate of growth of the Gross Domestic Product (GDP), the rate of growth of bank credit, and the return of the stock market) and on individual bank information (the rate of growth of banks' portfolios of commercial and industrial loans). The results showed that the best procedures are either to smooth the input of the Basel II formula by using TTC PDs or to smooth the output with a multiplier based on GDP growth. They also concluded that the latter solution is better in terms of simplicity, transparency, and consistency with banks' risk pricing and risk management systems.

Another approach to deal with the problem is through countercyclical bank capital buffers that mitigate bank procyclicality in credit supply. In Spain the build up of these buffers is accomplished by the use of dynamic provisions, which are not related to bank specific losses and are forward-looking provisions, allowing the build up of a buffer from retained profits in good times that can then be used to cover the realized losses in bad times (Jiménez, Ongena, Peydró, & Saurina, 2013). Dynamic provisions are formula based, being the total loan loss provisions for a period (flow) the sum of the *Specific* plus *General Provisions*. *General Provisions* are computed by the following formula:

$$General\ Provisions_t = \alpha \Delta Loans_t + \left(\beta - \frac{Specific\ Provisions_t}{Loans_t}\right) Loans_t$$

Equation 2 – General provisions simplification formula in Spain (Jiménez, Ongena, Peydró, & Saurina, 2013)

where $Loans_t$ is the stock of loans at the end of period t and $\Delta Loans_t$ its variation from the end of period $t-1$ to the end of period t (positive in a lending expansion, negative in a credit decline). α and β are parameters set by the *Banco de España* (α is an estimate of the percent latent loss in the loan portfolio, while β is the average along the cycle of specific provisions in relative terms.

Jiménez, Ongena, Peydró, & Saurina (2013) studied the effects of dynamic provisioning in Spain in the period between 1999 and 2010 and concluded that the buffering stemming from it reduces credit supply in good times (when more risk creeps into bank balance sheets) and supports bank lending in bad times, with less need for costly governmental bail-outs and/or expansive monetary policy.

2.6 Basel III Countercyclical Capital Buffer

The Basel III framework also addresses this problem by the implementation of the countercyclical buffer, which aims to protect the banking system from periods of excessive credit growth, ensuring that the financial sector, as a whole, has enough capital to maintain the flow of credit into real economy in stress periods and that capital requirements do not constraint credit supply.

The buffer, to be filled with Common Equity Tier[3], should be imposed by national authorities if they believe to be in the presence of excessive credit growth that is contributing to the build up of system-wide risk. It will assume values within the range of zero to 2.5% of risk weighted assets[4] and extends the magnitude of the conservation buffer, as presented in Table 5.

Common Equity Tier 1 Ratio (including other fully loss absorbing capital)	Minimum Capital Conservation Ratios (expressed as a percentage of earnings)
4.5% - 5.75% (within 1st quartile of buffer)	100%
>5.75% - 7.0% (within 2nd quartile of buffer)	80%
>7.0% - 8.25% (within 3th quartile of buffer)	60%
>8.25% - 9.5% (within 4th quartile of buffer)	40%
> 9.5% (Above top of buffer)	0%

Table 5 - Individual bank minimum capital conservation standards, when a bank is subject to a 2.5% countercyclical requirement

[3] For the moment only Common Equity Tier 1 should be used to meet the buffer. However, the Committee is reviewing the possibility of allowing other forms of capital.

[4] National authorities can implement a range of additional macroprudential tools, including a buffer in excess of 2.5% for banks in their jurisdiction, if this is deemed appropriate in their national context. However, the international reciprocity provisions set out in this regime treat the maximum countercyclical buffer as 2.5%.

The specific buffer requirement for each bank is based on a weighted average of the capital buffers determined by each jurisdiction where the bank has credit exposure (Basel Committee on Banking Supervision, 2010).

Increases in the countercyclical buffer will have to be announced at least a year earlier, in order to assure that banks have enough time to comply with the new capital requirements. On the contrary, decreases in the buffer may take effect immediately to mitigate the risk of credit crunches due to higher capital requirements imposed by regulators (Basel Committee on Banking Supervision, 2010).

It is expected for authorities to define an internationally common guide for the buffer that can be a starting point for decisions concerning the buffer. The Bank for International Settlements presents an extensive analysis of the properties of a broad range of indicator variables and the credit-to-GDP gap had the best performance. Another advantage of this indicator is being based on credit, as constraining excessive credit growth is also an objective of the countercyclical capital buffer. This guide does not always work well in every jurisdiction, and that is why judgment has an important role in this regime. In order to guide authorities in their judgment, the BCBS defined a set of principles included in the document *Guidance for national authorities operating the countercyclical capital buffer* (Basel Committee on Banking Supervision, 2010), as follows:

1. Objectives: "*Buffer decisions should be guided by the objectives to be achieved by the buffer, namely to protect the banking system against potential future losses when excess credit growth is associated with an increase in system-wide risk.*"

2. Common reference guide: "*The credit/GDP guide is a useful common reference point in taking buffer decisions. It does not need to play a dominant role in the information used by authorities to take and explain buffer decisions. Authorities should explain the information used, and how it is taken into account in formulating buffer decisions.*"

3. Risk of misleading signals: "*Assessments of the information contained in the credit/GDP guide and any other guides should be mindful of the behaviour of the factors that can lead them to give misleading signals.*"

4. Prompt release: "*Promptly releasing the buffer in times of stress can help to reduce the risk of the supply of credit being constrained by regulatory capital requirements.*"

5. Other macroprudential tools: "*The buffer is an important instrument in a suite of macroprudential tools at the disposal of the authorities.*"

With the objective of giving credibility to the buffer decisions, authorities should disclose the information used in the process. It is also important that capital buffer decisions should be updated frequently to mitigate the risk of the buffer not being in line with the credit cycle (the BCBS suggests reviews on a quarterly or more frequent basis (Basel Committee on Banking Supervision, 2010)).

3 Credit-to-GDP

In the document *Guidance for national authorities operating the countercyclical capital buffer* is presented a series of graphics for several countries which allows observing the past performance of the credit-to-GDP gap as a signaling variable for the buffer decisions and for most of the countries this indicator performed well. In this chapter will be presented some conclusions presented by several authors regarding the performance of the credit-to-GDP gap and its historical performance in Portugal will be assessed.

Repullo and Saurina (2011) argue that the Credit-to-GDP gap (deviation of Credit-to-GDP to its trend) is negatively correlated with GDP growth and an automatic application of the buffer regulation based on this variable would have an effect oposite to the intended, that is, the capital requirements woud increase in bad times and decrease in good times. The authors identify two reasons as the potencial sources of these problems, being the first the fact that credit usually lags business cycles and the second is that the use of credit-to-GDP ratio deviations from its trend intensifies the problem because time will pass before the ratio crosses the trend. They conclude that the credit-to-GDP should be abandoned as a common guide and propose to correct the procyclicality of risk-sensitive capital requirements with a business cycle multiplier, as proposed by Repullo, Saurina and Trucharte (2010), combined by a variety of the Spanish forward looking loan loss provisions, to assure that capital buffers and provisions increase in good times and can be used in bad times.

Drehmann, Borio and Tsatsaronis (2011) studied the performance of different variables in signaling the level of the countercyclical capital buffer (36 countries and about 40 crisis were analysed) and concluded that the credit-to-GDP gap had the best performance signaling the build up of the buffer and that other variables, as credit spreads, perform better in signaling the release phase (however, the performance of these variables for the release phase is not as good as the performance of the credit-to-GDP gap for the build up). This conclusion is in line with the previous work of Drehmann, Borio, Gambacorta, Jiménez and Trucharte (2010). They also denote the valuable side-benefit of this variable in restraining credit booms. Another conclusion obtained as a result of their work is that all indicators provide false signals and for that, there is no perfect mechanism based only in rules, being necessary some judgment in setting the buffer levels.

3.1 Historical performance in Portugal: methodology

To analyze the historical performance of the credit-to-GDP in Portugal it is used the methodology prescribed in the BCBS document "*Basel Committee (2010), Guidance for national authorities operating the countercyclical capital buffer*".

This methodology consists in three main steps:

1. Compute the credit-to-GDP ratio;
2. Compute the credit-to-GDP gap;
3. Transform the credit-to-GDP gap into the buffer add-on.

1. Compute the credit-to-GDP ratio

The credit-to-GDP ratio for the period t is calculated by the following formula:

$$Ratio_t = \frac{Credit_t}{GDP_t} \times 100\%$$

Equation 3 – credit-to-GDP ratio

where GDP_t is domestic GDP in period t and $Credit_t$ is the credit to the private sector in period t (both in nominal terms and on quarterly frequency).

2. Compute the credit-to-GDP gap

The credit-to-GDP gap is the deviation of the credit-to-GDP ratio from its long term trend. For period t the gap is given by the formula:

$$GAP_t = Ratio_t - Trend_t$$

Equation 4 – credit-to-GDP gap

where $Trend_t$ is calculated by the use of a one sided Hodrick-Prescott filter with a smoothing parameter (λ) set to 400 000[5].

3. Transform the credit-to-GDP gap into the buffer add-on

The size of the buffer add-on will depend on the credit-to-GDP gap compared to an upper and a lower threshold (BCBS suggests the values of 10 and 2 respectively). Specifically, the buffer add-on will be zero if the credit-to-GDP gap is below the lower threshold (2), will have its maximum value when the credit-to-GDP gap is higher than the upper threshold (10) and will vary linearly in between.

After obtaining the periods for the build up and maximum value of the buffer using the previous methodology, these will be compared to the crisis period that began in the third quarter of 2008 and find if the build up of the buffer would occur as expected (according to BCBS (2010), the build up phase should occur at least 2-3 years prior to a crisis and the buffer maximum value should be reached prior to a crisis).

3.2 Historical performance in Portugal: data

To perform the calculations, quarterly data of nominal broad credit to the private, non-financial sector and nominal GDP was used from the fourth quarter of 1979 to the fourth quarter of 2011. In both cases, the source of the information was the Bank of Portugal (the full series are presented in annex 6.1). The credit-to-GDP ratio considers the volume of credit of the period and the sum of the last four quarters of the quarterly GDP. Given that according to the document "Guidance for national authorities operating the countercyclical capital buffer", "*the indicator should breach the minimum at least 2-3 years prior to a crisis*" and that the crisis

[5] A smoothing parameter (λ) of 1 600 was also used. Literature suggests that lambda is set according to the expected duration of the average cycle and the frequency of observation and for the business cycle and quarterly observations a value of 1600 is suggested (Hodrick & Prescott, 1997). For cycles with longer durations, such as the credit cycle, a higher value is considered appropriate. The empirical analysis by Drehmann, Borio, Gambacorta, Jimenez and Trucharte (2010) reveals that trends calculated using a lambda of 400 000 perform well in picking up the long-term trend in private-sector indebtedness.

in Portugal began in 2008Q3, the period in analysis will be from 2002Q1 to 2011Q4. Following Drehmann, Borio and Tsatsaronis (2011), the one-sided Hodrick-Prescott filter was computed for 2002q1 only considering the credit-to-GDP ratio up to this quarter and then for the following quarters, one record of data was added, assuring that for each period only available information at that period is considered in computing the trend.

3.3 Historical performance in Portugal: results

Table 6 below, presents the results of the credit-to-GDP gap in the period of 2002q1 to 2011q3, using a one sided Hodrick-Prescott filter with a smoothing parameter (λ) set to 400 000 to compute the trend.

Time period (t)	Credit	GDP	Ratio	Trend	Gap
2002q1	182 025	34 681	134	103	30
2002q2	185 287	35 146	134	106	28
2002q3	188 540	35 359	135	108	27
2002q4	191 038	35 381	136	111	25
2003q1	193 210	35 426	137	114	23
2003q2	196 994	35 639	139	116	23
2003q3	195 298	35 989	137	118	19
2003q4	194 228	36 418	135	121	15
2004q1	197 833	36 743	137	123	14
2004q2	201 315	37 301	137	125	13
2004q3	203 250	37 499	137	127	11
2004q4	202 973	37 770	136	128	8
2005q1	204 081	37 997	136	130	5
2005q2	209 906	38 638	138	132	6
2005q3	212 776	38 627	139	133	6
2005q4	217 076	39 007	141	135	6
2006q1	225 878	39 573	145	137	8
2006q2	234 820	40 025	149	139	10
2006q3	238 400	40 364	150	141	9
2006q4	244 273	40 893	152	143	9
2007q1	249 495	41 936	153	145	8
2007q2	259 042	42 168	157	147	10
2007q3	265 853	42 302	159	149	10
2007q4	275 138	42 914	162	151	11
2008q1	282 079	43 072	165	153	12
2008q2	292 955	43 144	171	156	15
2008q3	296 051	43 137	172	158	14
2008q4	298 718	42 631	174	160	13
2009q1	303 807	41 862	178	163	15
2009q2	307 964	41 908	182	165	16
2009q3	309 277	42 272	183	168	15
2009q4	314 781	42 462	187	171	16

2010q1	314 107	43 030	185	173	12
2010q2	319 077	42 874	187	175	12
2010q3	323 988	43 494	189	178	11
2010q4	329 618	43 273	191	180	11
2011q1	336 548	43 220	195	183	12
2011q2	335 303	42 761	194	185	9
2011q3	332 996	42 799	194	187	7

Table 6 – Credit-to-GDP gap (one-sided HP; Lambda 400 000)

Observing the results, we can see that the gap was above the lower threshold of 2 for all periods and also that the maximum value did not occur in the 2 to 3 years' time period preceding the crisis (see Figure 3). For these reasons, the conclusion should be that the credit-to-GDP gap using a one sided Hodrick-Prescott filter with a smoothing parameter set to 400 000 to compute the trend, did not performed as expected. One possible explanation may be the important vulnerabilities built up in the Portuguese economy in the late 90s/early 00s (*e.g.* strong credit growth, house prices growth, current account imbalances). Very likely, the gap was always above 2 because these vulnerabilities were never corrected, until recently.

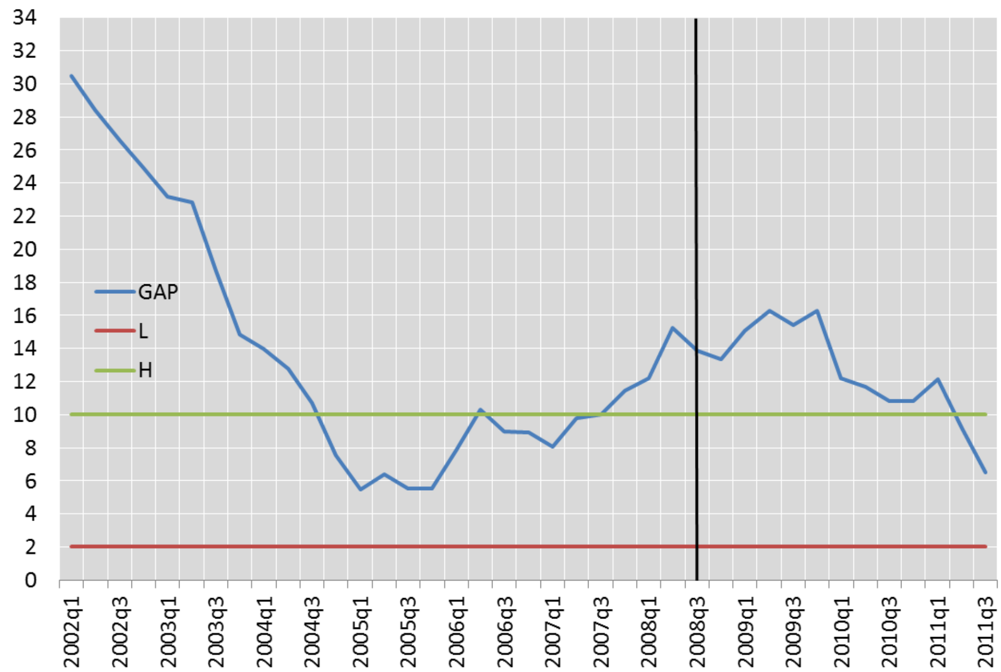

Figure 3 – Credit-to-GDP gap (one-sided HP; Lambda 400 000)

As mentioned before, the same methodology was applied using a one sided Hodrick-Prescott filter with a smoothing parameter set to 1 600 to compute the trend, as suggested by Hodrick and Prescott (1997) for quarterly data. The results are shown in the following table and figure.

Time period (t)	Credit	GDP	Ratio	Trend	Gap
2002q1	182 025	34 681	134	138	-5
2002q2	185 287	35 146	134	140	-6
2002q3	188 540	35 359	135	142	-7

2002q4	191 038	35 381	136	143	-7
2003q1	193 210	35 426	137	144	-7
2003q2	196 994	35 639	139	145	-6
2003q3	195 298	35 989	137	145	-8
2003q4	194 228	36 418	135	145	-10
2004q1	197 833	36 743	137	145	-8
2004q2	201 315	37 301	137	145	-7
2004q3	203 250	37 499	137	145	-7
2004q4	202 973	37 770	136	144	-8
2005q1	204 081	37 997	136	143	-7
2005q2	209 906	38 638	138	143	-5
2005q3	212 776	38 627	139	143	-4
2005q4	217 076	39 007	141	143	-2
2006q1	225 878	39 573	145	144	1
2006q2	234 820	40 025	149	145	4
2006q3	238 400	40 364	150	147	3
2006q4	244 273	40 893	152	148	3
2007q1	249 495	41 936	153	150	3
2007q2	259 042	42 168	157	152	4
2007q3	265 853	42 302	159	154	4
2007q4	275 138	42 914	162	157	5
2008q1	282 079	43 072	165	160	6
2008q2	292 955	43 144	171	163	8
2008q3	296 051	43 137	172	166	5
2008q4	298 718	42 631	174	169	4
2009q1	303 807	41 862	178	173	5
2009q2	307 964	41 908	182	176	5
2009q3	309 277	42 272	183	180	4
2009q4	314 781	42 462	187	183	4
2010q1	314 107	43 030	185	185	0
2010q2	319 077	42 874	187	188	-1
2010q3	323 988	43 494	189	190	-1
2010q4	329 618	43 273	191	192	-1
2011q1	336 548	43 220	195	195	0
2011q2	335 303	42 761	194	196	-2
2011q3	332 996	42 799	194	198	-4

Table 7 – Credit-to-GDP gap (one-sided HP; Lambda 1 600)

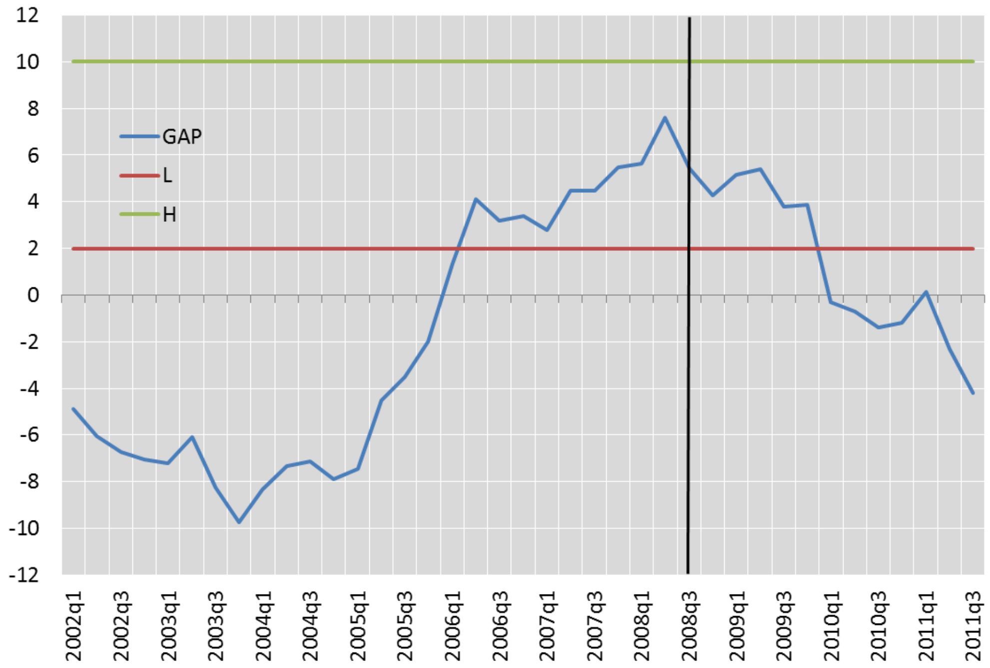

Figure 4 – Credit-to-GDP gap (one-sided HP; Lambda 1 600)

These results suggest that with a smoothing parameter set to 1 600 to compute the trend, the lower threshold is reached in 2006q2, which is on the period of 2 to 3 years prior to the crisis (Basel Committee on Banking Supervision, 2010). However the maximum buffer would not be reached prior to the crisis, suggesting that other thresholds should be used. Figure 5 shows an example for the lower and higher thresholds of 1 and 7, respectively.

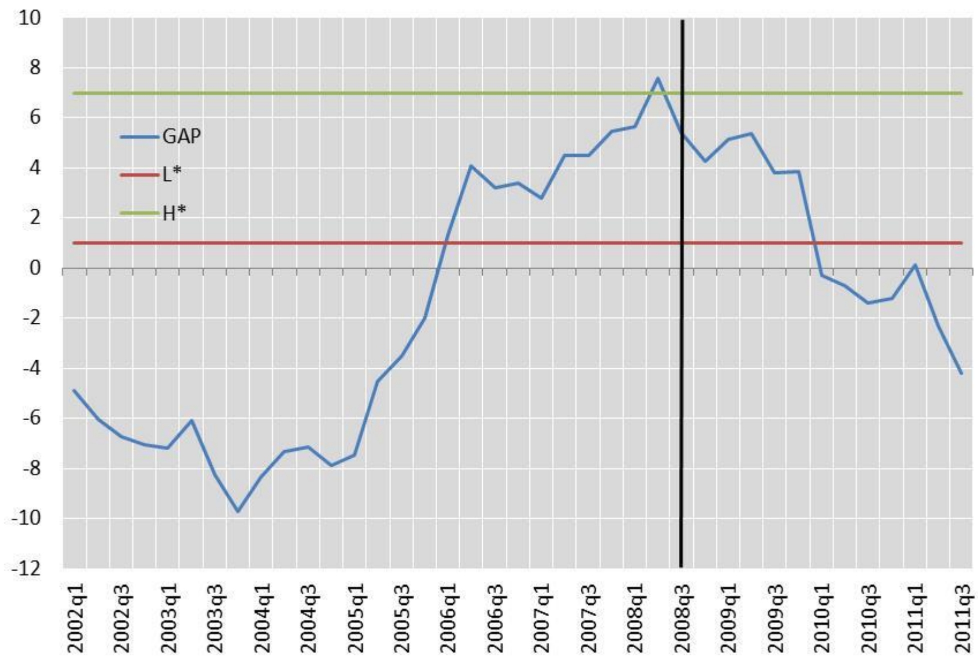

Figure 5 – Credit-to-GDP gap (one-sided HP; Lambda 1 600; Lower threshold = 1; Higher threshold = 7)

In conclusion, the gap based on the trend computed with a Hodrick-Prescott filter with a smoothing parameter set to 400 000 did not perform as expected and so it does not prove to be a perfect guide for Portugal. On the other side, the gap based on the trend computed with a Hodrick-Prescott filter with a smoothing parameter set to 1 600 delivered good results, although new thresholds may be required. For example, setting these parameters to 1 and 7 would allow the buffer to start the build up in 2006q1 and reach its maximum in 2008q2, complying with both the objectives of reaching the lower threshold at least 2 to 3 prior to the crisis and also reach the maximum buffer prior to a crisis.

4 Capital requirements: How do banks adjust?

After verifying the historical performance of the common guide credit-to-GDP, another question has to be answered in order to judge the effectiveness of the countercyclical capital buffer in Portugal: will higher capital requirements constrain credit growth?

In this chapter the aim is to address this question, using a methodology based on the previous work of Francis and Osborne (2012), which studied the effects of regulatory capital requirements on capital, lending and balance sheet management of UK banks. They concluded that raising capital requirements may be less effective in the objective of constraining credit growth if banks can comply with them by using capital of lower quality and cost.

Francis and Osborne (2012) use on the analysis capital requirements available at the UK supervisor, which include bank-specific and time-varying add-ons set in an approach similar to the one adopted by many countries under Pillar 2 of Basel II. Pillar 2, concerned with the supervisory review process, goes beyond the minimum capital requirements (Pillar 1) and allow regulators in different countries some discretion in how rules are applied, taking into account local conditions and identified deficiencies. In Portugal this data is not available and there is no evidence, based on banks' annual reports, that Pillar 2 is actively used. To replicate, to some extent, Francis and Osborne (2012) the recent changes in capital requirements for the Portuguese banking system were explored.

4.1 Capital requirements: How do banks adjust? – Methodology

As mentioned before, the methodology used to find the impact of capital requirements in the balance sheet management of Portuguese banks is based on the previous work of Francis and Osborne (2012), which relies on three main steps:

1) Establish the target capital ratios of each bank;
2) Measure surplus or deficit of capital ratio to target capital ratio (capitalization index);
3) Use the capitalization index as an explanatory variable in regressions of bank balance sheet components.

Below, are the details of each step:

1) Establish the target capital ratios of each bank

These target capital ratios depend on characteristics of each bank for the observed periods and idiosyncratic factors affecting the bank choices, and is modeled by the following formula:

$$k_{i,t}^{*} = \eta_i + \sum_{n=1}^{N} \theta_n X_{n,i,t}$$

Equation 5 – Target capital ratio

where, $k_{i,t}^{*}$ is the target capital ratio of bank i in period t, $X_{n,i,t}$ are the characteristics of bank i in period t and η_i is a fixed effect representing the idiosyncratic factors affecting bank i.

The choice of the variables representing the characteristics of banks was also based on the work of Francis and Osborne (2012). The chosen variables were:

a) (CR) Capital requirements

   As mentioned before, unlike the UK where capital requirements are bank-specific and time-varying, the minimum solvency ratio in Portugal remains unchanged and equal for all banks during the observation period. However, the minimum core tier 1 ratio was set to a minimum of 9% in 2011 and 10% from 2012 and beyond (Notice 3/2011 of Bank of Portugal). In practice, setting the minimum core tier 1 ratio above the minimum solvency ratio implies that banks must have higher solvency ratios and so, this variable assumes the value of 8% for all periods except for 2011 and 2012, where it assumes the values of 9% and 10%, respectively.

b) (RISK) RWA/Total Assets

This variable intends to represent the regulatory risk profile of the bank. As mentioned before, risk weighted assets are the bank's assets and off-balance sheet exposures, weighted according to risk. The risk weight applied to each exposure must comply with the regulation set by national authorities.

c) (PROVISIONS) Provisions/Total Assets

This variable intends to represent the risk profile of the bank according to its own estimate. The economic value of each asset is its gross amount corrected by provisions that should represent the expected loss associated to the asset. Bank's use their own models to determine this expected loss, which can be seen as proxy for risk incurred (higher levels of provision reflect a higher perception of risk).

d) (SIZE) Demeaned value of the log of total assets

This variable measures the relative size of each bank on the sample, because according to Francis and Osborne (2012), "*larger banks may be better able to diversify risks, access funding and adjust capital compared with smaller institutions*."

Francis and Osborne (2012) also included another two variables, not included in my analysis. The first was the tier 1 ratio over total capital, representing the weight of high quality capital on total capital. Because, in Portugal, the minimum core tier 1 ratio is higher than the total capital ratio this variable is not meaningful in the context.

The second variable was the ratio of trading book to total balance sheet assets, to control for several business models in institutions with great trading activity. In the case of Portuguese banks, the trading book does not have materiality compared to the banking book, so this variable was excluded.

Assuming that banks take time to adjust their capital towards the target, and again following Francis and Osborne (2012), it was considered a partial adjustment model, where the variation of the capital ratio in each period depends on the target capital ratio ($k_{i,t}^{*}$) and the real capital ratio of the previous period ($k_{i,t}$). The equation is as follows:

$$k_{i,t} - k_{i,t-1} = \lambda\left(k_{i,t-1}^{*} - k_{i,t-1}\right) + \varepsilon_{i,t}$$

Equation 6 – Partial adjustment model of target capital ratio

where, $k_{i,t}$ and $k_{i,t-1}$ are the actual capital ratios of bank i in the periods t and $t-1$, respectively, $k^*_{i,t-1}$ is the target capital ratio of bank i in period $t-1$, and $\varepsilon_{i,t}$ is the error term.

Substituting Equation 5 into Equation 6 and rearranging gives the first equation of estimation:

$$k_{i,t} = (1-\lambda)k_{i,t-1} + \lambda\left(\eta_i + \sum_{n=1}^{N} \theta_n X_{n,i,t}\right) + \varepsilon_{i,t}$$

Equation 7 – Equation of estimation of capital ratio

Because Equation 7 was in fact estimated using one lag of the dependent variable and one lag of the explanatory variables, the equation is actually:

$$k_{i,t} = a_0 + a_1 k_{i,t-1} + \sum_{n=1}^{N} b_1 X_{n,i,t-1} + \varepsilon_{i,t}$$

Equation 8 – Equation of estimation of capital ratio using one lag of dependent and explanatory variables

where $a_0 = \lambda\eta_i$ in Equation 7, $a_1 = (1-\lambda)$ in Equation 7 and $b_1 = \lambda\theta_n$ in Equation 7.

2) Measure surplus or deficit of capital ratio to target capital ratio (capitalization index)

After estimating the coefficients in Equation 8, the target capital ratio is computed according to Equation 5, being the long run effect of each explanatory variable X_n given by:

$$\theta_n = \frac{b_{n,1}}{1-a_1}$$

Equation 9 – Long run effect of each explanatory variable

The computed target capital ratio is then used to calculate a measure of surplus or deficit of capital ratio to target capital ratio (capitalization index), according to the formula:

$$Z_{i,t} = 100\left(\frac{k_{i,t}}{k^*_{i,t}} - 1\right)$$

Equation 10 – Capitalization index

where, $Z_{i,t}$ is the capitalization index of bank i in period t, $k_{i,t}$ is the actual capital ratio of bank i in period t and $k^*_{i,t}$ is the target capital ratio of bank i in period t.

3) Use the capitalization index as an explanatory variable in regressions of bank balance sheet components.

In order to pursue its target capital ratios, banks may take measures that affect the numerator of the ratio, as raising or lowering the own funds levels or they can take measures that affect the denominator of the ratio, as changing the volume of loans, leveraging or de-leveraging and by changing the risk profile of the assets.

To assess how banks in Portugal manage their balance sheets to move towards the desired capital ratio, the capitalization index (which depends on capital requirements) is used as an explanatory variable in regressions of some balance sheet and regulatory items. Following Francis and Osborne (2012), the dependent variables analyzed are the annual growth rate of loans, total assets, RWA and regulatory capital. Other explanatory variables also used in the regressions to control for other factors that may affect the dependent variables are:

a. (DProvision) Change in the ratio of provisions to assets at period t
   This variable is intended to control for general credit conditions (*e.g*. an increase of provisions represent a deterioration of the credit quality of borrowers).

b. (NPL) Ratio of non-performing loans to assets at period t
   This variable is intended to control for general credit conditions (*e.g*. an increase of non-performing loans represent a deterioration of the credit quality of borrowers).

c. (VarGDP) Annual growth of GDP
   This variable is intended to control for general macroeconomic conditions.

d. (VarECBR) Annual growth of European Central Bank (ECB) *refi* rate
   This variable is intended to control for general monetary conditions.

e. (VarCPI) Annual growth of Portuguese Consumer Price Index (CPI)
   This variable is intended to control for general price conditions.

The next four equations reflect some of the options available to banks for responding to capital regulation and achieving their internal capital targets. Three focus on how banks adjust through altering the denominator of their capital ratios, through changing total assets (TA), risk-weighted assets (RWA), or loans (LOANS). One assesses how banks revise capital ratios by altering the numerator directly through regulatory capital (REGK).

$$\Delta lnLOANS_{i,t} = \alpha_i + \beta_Z Z_{i,t-1} + \delta_1 \Delta GDP_{t-1} + \delta_2 \Delta ECBR_{t-1} + \delta_3 \Delta CPI_{t-1} + \delta_4 \mathrm{DProvision}_{i,t} + \delta_5 \mathrm{NPL}_{i,t} + \varepsilon_{i,t}$$

Equation 11 – Loans regression

$$\Delta lnTA_{i,t} = \alpha_i + \beta_Z Z_{i,t-1} + \delta_1 \Delta GDP_{t-1} + \delta_2 \Delta ECBR_{t-1} + \delta_3 \Delta CPI_{t-1} + \delta_4 \mathrm{DProvision}_{i,t} + \delta_5 \mathrm{NPL}_{i,t} + \varepsilon_{i,t}$$

Equation 12 – Total assets regression

$$\Delta lnRWA_{i,t} = \alpha_i + \beta_Z Z_{i,t-1} + \delta_1 \Delta GDP_{t-1} + \delta_2 \Delta ECBR_{t-1} + \delta_3 \Delta CPI_{t-1} + \delta_4 \mathrm{DProvision}_{i,t} + \delta_5 \mathrm{NPL}_{i,t} + \varepsilon_{i,t}$$

Equation 13 – RWA regression

$$\Delta lnREGK_{i,t} = \alpha_i + \beta_Z Z_{i,t-1} + \delta_1 \Delta GDP_{t-1} + \delta_2 \Delta ECBR_{t-1} + \delta_3 \Delta CPI_{t-1} + \delta_4 \mathrm{DProvision}_{i,t} + \delta_5 \mathrm{NPL}_{i,t} + \varepsilon_{i,t}$$

Equation 14 – Regulatory capital regression

where, $\Delta lnLOANS_{i,t}$ is the annual growth rate of Loans of bank i in period t, calculated as $100(\ln(LOANS_{i,t}) - \ln(LOANS_{i,t-1}))$, $\Delta lnTA_{i,t}$ is the annual growth rate of Total assets of bank i in period t, calculated as $100(\ln(TA_{i,t}) - \ln(TA_{i,t-1}))$, $\Delta lnRWA_{i,t}$ is the annual growth rate of RWA of bank i in period t, calculated as $100(\ln(RWA_{i,t}) - \ln(RWA_{i,t-1}))$, $\Delta lnREGK_{i,t}$ is the annual growth rate of Regulatory capital of bank i in period t, calculated as $100(\ln(REGK_{i,t}) - \ln(REGK_{i,t-1}))$, $Z_{i,t-1}$ is the capitalization index of bank i in period $t-1$, ΔGDP_{t-1} is annual growth of GDP in period $t-1$, $\Delta ECBR_{t-1}$ is annual growth of ECB *refi* rate in period $t-1$, ΔCPI_{t-1} is annual growth of CPI in period $t-1$, $\mathrm{DProvision}_{i,t}$ is the change in the ratio of provisions to assets of bank i in period t, $\mathrm{NPL}_{i,t}$ is the ratio of non-performing loans to assets of bank i in period t and $\varepsilon_{i,t}$ is the error term.

4.2 Capital requirements: How do banks adjust? – Data

On this analysis, it was used yearly data from 2000 to 2012. A long dataset is necessary given the dynamic structure of the model and the nature of the issue analyzed (balance sheet adjustments). The macroeconomic variables were obtained from Bloomberg (CPI and ECB *refi* rate) and Bank of Portugal (GDP). The banking data was significantly harder to obtain and constituted the biggest challenge of the entire work and was also responsible for a considerable delay on its conclusion. The objective at the beginning was to obtain quarterly data from a single source for the majority of Portuguese banks and for that objective many sources were attempted, such as SNL (could not get access), Bloomberg (does not have sufficiently long series), Bankscope (does not have sufficiently long series), Banks Almanac (only has data starting in 2007), Bank of Portugal (the publicly and available data consists only on banks annual reports since 2006), Coface (does not have banking data), InformaD&B (does not have banking data), banks' web sites (do not contain annual reports for all periods and some of the required variables are not always available). Given the constraints, the only feasible solution was to collect annual data (consolidated level) from three different sources for the six biggest banks in the Portuguese banking system, excluding Caixa Geral de Depósitos (being a public bank, capital management does not necessarily pursue the same objectives of the remaining banking sector), which gives a sample size of 78 observations.

The three sources sorted by the priority given for collecting data were Bankscope, Bloomberg and bank's annual reports.

Table 8 presents descriptive statistics of the variables used in Equation 8 of the first step (to establish the target capital ratios of each bank). As can be observed, banks have always held capital ratios above the minimum required, although the average gap is not considerable (about 2.7%).

Variable	Observations	Mean	Standard deviation	Min	Max	Unit
CR	78	8.2308	0.5794	8.0000	10.0000	Percentage
K	78	10.9554	1.3795	8.0200	15.0000	Percentage
RISK	78	0.6856	0.0943	0.4700	0.8500	Ratio
PROVISIONS	78	0.0061	0.0048	0.0005	0.0294	Ratio
SIZE	78	0.0000	0.3260	-0.6078	0.5225	Ratio

Table 8 – Descriptive statistics of step 1 variables

Table 9 presents the correlation matrix of the variables used in Equation 8 of the first step and the results are as expected. Being a function of RWA, RISK has a negative correlation with K, and for higher capital requirements (CR) the risk taken decreases, possibly reflecting the cost of capital. RISK has a positive correlation with PROVISIONS and SIZE, meaning that more risk is associated with higher levels of provisions and that bigger banks take more risks. CR is positively correlated with K, as it should be, and banks' own perception of the risk taken (PROVISIONS) is correlated with higher capital ratios. The results also suggest that bigger banks tend to have higher capital ratios and lower levels of provisions.

	K	RISK	CR	PROVISIONS	SIZE
K	1.0000				
RISK	-0.1588	1.0000			
CR	0.2453	-0.2309	1.0000		
PROVISIONS	0.0706	0.0081	0.5553	1.0000	
SIZE	0.1757	0.0257	0.0000	-0.2472	1.0000

Table 9 – Correlation matrix of step 1 variables

Table 10, below, shows some descriptive statistics of the variables used in the regressions of the step three. The capitalization index (Z) is on average negative, which means that banks held, on average, less capital compared to the target. Z has also a disperse distribution, ranging from a minimum of -50.82% to a maximum of 38.04% and with a standard deviation of 19.94. Apart from the ECB *refi* rate, that on average decreased along the observation period, the rest of the variables presented a positive variation on average.

Variable	Observations	Mean	Standard deviation	Min	Max	Unit
Z	72	-8.1161	19.9428	-50.8200	38.0400	Percentage
VarGDP	72	0.0233	0.0280	-0.0300	0.0600	Percentage
VarECBR	72	-0.3333	0.8307	-1.5000	1.2500	Percentage
VarCPI	72	0.0258	0.0120	0.0000	0.0400	Percentage
Dprovision	72	0.0005	0.0034	-0.0121	0.0148	Ratio
NPL	72	0.0182	0.0124	0.0023	0.0569	Ratio
VarlnLOANS	72	6.3022	8.0768	-13.9700	24.9800	Percentage
VarlnTA	72	6.3494	7.8773	-13.8600	24.1600	Percentage
VarlnRWA	72	5.2468	9.6547	-13.6700	35.3600	Percentage
VarlnREGK	72	7.0186	15.3359	-30.1400	48.6300	Percentage

Table 10 – Descriptive statistics of step 3 variables

The complete series used in the regressions of step one and two are presented in Annexes 6.2 and 6.3.

4.3 Capital requirements: How do banks adjust? – Results

The results of the regression using Equation 8 are shown in Table 11, below. As can be observed, not all variables are statistically significant at the 10% level. RISK has a p-value of 0.19 and PROVISIONS has a p-value of 0.12, slightly above the threshold of 0.10. The most statistically significant variables were K with a p-value of 0.01 and CR with 0.03. It is important for the analysis the significance of CR and the coefficient estimated, which means that capital requirements are an important driver for capital ratios.

Variable	Coefficient
K_{t-1}	0.335**
	(0.127)
CR_{t-1}	1.735**
	(0.760)
$RISK_{t-1}$	3.679
	(2.805)
$PROVISIONS_{t-1}$	72.75
	(46.38)
$SIZE_{t-1}$	-8.447*
	(5.041)
η_1	-0.024
	(0.446)
η_2	2.792
	(1.744)
η_3	1.650*
	(0.963)
η_4	0.0244
	(0.446)
η_5	-6.229**
	(3.088)
η_6	-3.188
	(2.064)
Constant	-8.741
	(6.445)
Observations	72
R-squared	0.411

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

Table 11 – Results of the regression using Equation 8 (dependent variable: k_t)

As explained before, in the second step Z is computed using Equation 5, Equation 9 and Equation 10. Because some of the bank variables did not present statistically significance at the 10% level (Table 11),they were excluded from the calculation of the target capital ratio (*e.g.* RISK and PROVISIONS).

The results presented in Table 12 were obtained using the computed Z as an input for the regressions using Equations 11 to 14 and also the rest of the explanatory variables already mentioned (VarGDP, VarECBR, VarCPI, DProvision and NPL). Although there is a positive association between the capitalization index (Z) and the variation of Loans, Total assets and RWA, the results do not present the necessary significance to take liable conclusions. On the other side there is a significantly negative association between the level of capitalization (Z) and regulatory capital, which seems to suggest that Portuguese banks tend to react to the raising of capital requirements by changing the numerator of the ratio. These finding are consistent with the capital increases that most banks did on the recent past (some of them with funds stemming from the Portuguese government). However, it is important to remember that capital requirements increased in Portugal during a crisis period, and further, the objective was not to act countercyclically, as clearly there was not a credit boom building up.

Another negative and statistically significant association is observed between the variation of provisions and the variation of Loans, Total assets and RWA, suggesting that an increase in provisions (risk taken assessed by the bank) is associated with de-leveraging and the lowering of the risk profile. In fact, de-leveraging in the Portuguese economy is being driven by the increase in credit risk in the economy, which is forcing the banks to record more provisions and is thereby exerting strong pressure on profitability.

In sum, tighter capital requirements seem to be addressed by banks through increases in capital rather than through de-leveraging. Although these results might imply that imposing an additional capital buffer will lead to additional capital increases, the fact that in Portugal capital requirements were increased pro-cyclically indicates that these results cannot be generalized and does not allow to conclude that increases of capital requirements during a credit boom due to the build up of the countercyclical buffer will necessarily lead to the same adjustment by banks. Nevertheless, given the lack of empirical evidence on this very important issue, I hope that these results help to shed some light on the possible adjustments made by banks following an increase in capital requirements.

Variable	VarLnLoans	VarLnTA	VarLnRWA	VarLnRegK
Z	0.0232	0.0618	0.0649	-0.666**
	(0.0386)	(0.0615)	(0.116)	(0.249)
VarGDP	48.73	27.81	107.6	138.3
	(37.16)	(23.82)	(59.22)	(77.68)
VarEcbR	1.707***	1.767**	2.250	-2.248
	(0.416)	(0.574)	(1.474)	(1.267)
DProvision	-1,032***	-715.6***	-1,085***	-1,828**
	(140.3)	(138.1)	(268.2)	(540.3)
NPL	-157.0	-101.4	-66.55	-310.2
	(82.86)	(99.31)	(130.0)	(339.8)
Constant	8.723***	8.323**	5.018	4.627
	(2.163)	(2.233)	(3.197)	(7.277)
Observations	66	66	66	66
R-squared	0.454	0.315	0.447	0.299
Number of ID	6	6	6	6

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

Table 12 – Results of the regressions using Equations 11 to 14

5 Conclusions

The main objective of this thesis is to assess if the implementation in Portugal of the countercyclical capital buffer present on the Basel III framework will have the desired effect of constraining excessive credit growth in good periods of the business cycle and allow to build the necessary capital buffers to be released in crisis, thus mitigating the possibility of credit crunches.

The main objective was in practice divided in two smaller ones. The first one was to verify the historical performance of the common guide Credit-to-GDP gap proposed by the BCBS to signal the build up of the countercyclical capital buffer. The results showed that the guide can signal the build up of the buffer complying with the objectives of reaching the lower threshold at least 2 to 3 years prior to a crisis and also reach the maximum buffer prior to a crisis. However, some alterations to the methodology proposed may allow to improve the results. For instance, using a smoothing parameter set to 1 600 instead of 400 000 to compute the trend using a Hodrick-Prescott filter and changing the lower and upper thresholds to 1 and 7 may provide more useful signals to policy makers.

The second objective was to assess if Portuguese banks would respond to an increase of capital requirements by contracting loan supply or by other means. To do so, it was used an approach based on the previous work of Francis and Osborne (2012), which studied the effects of regulatory capital requirements on capital, lending and balance sheet management of UK banks. The results suggest that Portuguese banks tend to react to capital requirement increases by raising the levels of regulatory capital. However, it should be borne in mind that capital requirements were increased during a crisis period (*i.e.* not with countercyclical objectives). As such, though this analysis hopefully provides unique evidence on how banks adjust capital, the results could only be fully generalized if more changes in capital requirements were observed. Nevertheless, given the lack of international evidence on the effects of macroprudential measures (and of the countercyclical capital buffer in particular), with this thesis I hope to provide important insights to bankers and policy-makers.

6 Annexes

6.1 Quarterly data of nominal credit and nominal GDP (values in m€)

Time period (t)	Credit	GDP	Ratio
1979q4	4 240	1 780	-
1980q1	4 520	1 867	-
1980q2	4 722	1 996	-
1980q3	4 929	2 076	64
1980q4	5 386	2 149	67
1981q1	5 749	2 298	67
1981q2	6 125	2 324	69
1981q3	6 408	2 520	69
1981q4	6 792	2 644	69
1982q1	7 128	2 749	70
1982q2	7 513	2 855	70
1982q3	7 937	3 022	70
1982q4	8 535	3 195	72
1983q1	8 891	3 454	71
1983q2	9 369	3 667	70
1983q3	9 835	3 906	69
1983q4	10 743	4 115	71
1984q1	11 058	4 264	69
1984q2	11 634	4 550	69
1984q3	12 316	4 791	70
1984q4	13 045	5 032	70
1985q1	13 277	5 320	67
1985q2	13 727	5 591	66
1985q3	13 906	5 810	64
1985q4	14 406	6 057	63
1986q1	14 607	6 329	61
1986q2	14 959	6 789	60
1986q3	15 383	7 078	59
1986q4	16 206	7 336	59
1987q1	16 627	7 574	58
1987q2	16 863	7 976	56
1987q3	17 135	8 203	55
1987q4	17 687	8 522	55
1988q1	18 347	9 111	54
1988q2	18 857	9 430	53
1988q3	19 452	9 831	53
1988q4	20 294	10 444	52
1989q1	20 191	10 680	50
1989q2	20 691	11 158	49
1989q3	21 330	11 678	49
1989q4	22 758	12287	50
1990q1	23 183	12 737	48

1990q2	24 580	13 611	49
1990q3	24 420	13 947	46
1990q4	26 119	14 400	48
1991q1	27 738	14856	49
1991q2	29 476	15 523	50
1991q3	30 694	16 030	50
1991q4	33 189	16 520	53
1992q1	33 477	17 224	51
1992q2	35 326	17 814	52
1992q3	36 954	18 047	53
1992q4	39 516	18 283	55
1993q1	40 223	18 063	56
1993q2	42 114	18 415	58
1993q3	42 563	18 809	58
1993q4	44 433	19 126	60
1994q1	44 814	19 592	59
1994q2	45 982	20 141	59
1994q3	46 261	20 361	58
1994q4	49 356	20 842	61
1995q1	52 473	21 545	63
1995q2	54 833	21 899	65
1995q3	55 702	22 071	65
1995q4	58 088	22 326	66
1996q1	58 479	22 634	66
1996q2	61 561	23 100	68
1996q3	63 545	23 704	69
1996q4	67 996	23 778	73
1997q1	70 210	24 473	74
1997q2	74 056	25 114	76
1997q3	77 652	25 626	78
1997q4	82 168	25 934	81
1998q1	84 678	26 590	82
1998q2	90 923	27 395	86
1998q3	95 373	27 978	88
1998q4	102 736	28 414	93
1999q1	108 309	28 969	96
1999q2	115 140	29 403	100
1999q3	122 117	29 931	105
1999q4	129 577	30 358	109
2000q1	136 601	31 069	113
2000q2	147 115	31 369	120
2000q3	155 686	32 295	124
2000q4	160783	32 584	126
2001q1	167 915	32 815	130
2001q2	173 421	33 393	132
2001q3	177 305	33 768	134
2001q4	179 401	34 496	133
2002q1	182 025	34 681	134

2002q2	185 287	35 146	134
2002q3	188 540	35 359	135
2002q4	191 038	35 381	136
2003q1	193 210	35 426	137
2003q2	196 994	35 639	139
2003q3	195 298	35 989	137
2003q4	194 228	36 418	135
2004q1	197 833	36 743	137
2004q2	201 315	37 301	137
2004q3	203 250	37 499	137
2004q4	202 973	37 770	136
2005q1	204 081	37 997	136
2005q2	209 906	38 638	138
2005q3	212 776	38 627	139
2005q4	217 076	39 007	141
2006q1	225 878	39 573	145
2006q2	234 820	40 025	149
2006q3	238 400	40 364	150
2006q4	244 273	40 893	152
2007q1	249 495	41 936	153
2007q2	259 042	42 168	157
2007q3	265 853	42 302	159
2007q4	275 138	42 914	162
2008q1	282 079	43 072	165
2008q2	292 955	43 144	171
2008q3	296 051	43 137	172
2008q4	298 718	42 631	174
2009q1	303 807	41 862	178
2009q2	307 964	41 908	182
2009q3	309 277	42 272	183
2009q4	314 781	42 462	187
2010q1	314 107	43 030	185
2010q2	319 077	42 874	187
2010q3	323 988	43 494	189
2010q4	329 618	43 273	191
2011q1	336 548	43 220	195
2011q2	335 303	42 761	194
2011q3	332 996	42 799	194

6.2 Complete series used in the regression of the first step

YEAR	ID	CR	K	RISK	PROVISIONS	SIZE
2000	1	8	9.8000	0.7100	0.0036	0.0717
2001	1	8	9.2000	0.7100	0.0032	0.0646
2002	1	8	11.4000	0.6500	0.0025	0.0619
2003	1	8	11.1000	0.6900	0.0029	0.0537
2004	1	8	9.8000	0.6900	0.0029	0.0258
2005	1	8	11.5100	0.6000	0.0016	0.0329
2006	1	8	9.4500	0.6000	0.0009	0.0660
2007	1	8	9.9100	0.6400	0.0020	0.0704
2008	1	8	11.3200	0.6100	0.0028	0.0627
2009	1	8	11.0000	0.5500	0.0032	0.0716
2010	1	8	11.1000	0.5700	0.0023	0.0440
2011	1	9	9.3000	0.5900	0.0045	0.0258
2012	1	10	15.0000	0.5500	0.0060	0.0493
2000	2	8	9.2000	0.7900	0.0028	0.5225
2001	2	8	9.4000	0.7500	0.0033	0.4693
2002	2	8	10.8000	0.7600	0.0051	0.4439
2003	2	8	11.8000	0.7500	0.0070	0.4664
2004	2	8	11.9000	0.7400	0.0019	0.4681
2005	2	8	12.9000	0.7000	0.0015	0.4392
2006	2	8	11.0500	0.7000	0.0016	0.4140
2007	2	8	9.5600	0.7000	0.0030	0.4078
2008	2	8	10.5000	0.7100	0.0057	0.4043
2009	2	8	11.4700	0.6900	0.0057	0.3756
2010	2	8	10.3000	0.6000	0.0073	0.3781
2011	2	9	9.5000	0.5900	0.0142	0.3635
2012	2	10	12.7000	0.5900	0.0188	0.3533
2000	3	8	9.2900	0.7900	0.0075	0.2609
2001	3	8	10.7500	0.7900	0.0048	0.2560
2002	3	8	12.6400	0.8000	0.0067	0.2678
2003	3	8	13.1300	0.7500	0.0085	0.2723
2004	3	8	12.6600	0.8100	0.0070	0.2489
2005	3	8	12.3000	0.7600	0.0044	0.2544
2006	3	8	13.1000	0.7600	0.0031	0.2868
2007	3	8	11.5000	0.7700	0.0031	0.2972
2008	3	8	10.5000	0.7900	0.0036	0.3054
2009	3	8	11.1400	0.7900	0.0066	0.3107
2010	3	8	11.3000	0.8300	0.0042	0.3037
2011	3	9	10.7000	0.8100	0.0075	0.2972
2012	3	10	11.3000	0.7400	0.0104	0.3230
2000	4	8	12.8000	0.6000	0.0160	0.0960
2001	4	8	13.3000	0.5900	0.0039	0.1075
2002	4	8	12.5000	0.6900	0.0043	0.0818
2003	4	8	11.0000	0.6800	0.0044	0.0957
2004	4	8	11.2000	0.6500	0.0039	0.0716

2005	4	8	10.8000	0.6000	0.0020	0.0781
2006	4	8	10.9000	0.6200	0.0005	0.0406
2007	4	8	10.0000	0.6400	0.0030	0.0399
2008	4	8	10.3000	0.6200	0.0012	0.0328
2009	4	8	10.7000	0.5300	0.0021	0.0551
2010	4	8	10.1000	0.4800	0.0034	0.0479
2011	4	9	10.3000	0.5200	0.0057	-0.0039
2012	4	10	11.4000	0.4700	0.0121	-0.0139
2000	5	8	10.3000	0.6000	0.0093	-0.6078
2001	5	8	9.2000	0.5300	0.0074	-0.5730
2002	5	8	9.4000	0.7100	0.0080	-0.5645
2003	5	8	9.7000	0.8300	0.0072	-0.6073
2004	5	8	13.4000	0.7600	0.0061	-0.5234
2005	5	8	8.8400	0.7400	0.0028	-0.5246
2006	5	8	11.3000	0.8100	0.0028	-0.5236
2007	5	8	10.3800	0.8500	0.0025	-0.5057
2008	5	8	9.2200	0.8500	0.0042	-0.4610
2009	5	8	10.0300	0.8500	0.0075	-0.4450
2010	5	8	9.2400	0.8100	0.0064	-0.4194
2011	5	9	8.0200	0.7500	0.0212	-0.4079
2012	5	10	11.5100	0.7700	0.0294	-0.4538
2000	6	8	9.7000	0.7500	0.0076	-0.3434
2001	6	8	10.2600	0.7400	0.0103	-0.3243
2002	6	8	10.6800	0.7000	0.0108	-0.2910
2003	6	8	11.4000	0.6400	0.0121	-0.2807
2004	6	8	11.4000	0.6400	0.0147	-0.2910
2005	6	8	10.6800	0.6700	0.0052	-0.2800
2006	6	8	9.8300	0.6600	0.0047	-0.2837
2007	6	8	8.9500	0.7000	0.0050	-0.3097
2008	6	8	11.4400	0.6200	0.0055	-0.3441
2009	6	8	13.2500	0.5800	0.0084	-0.3680
2010	6	8	12.7400	0.5600	0.0061	-0.3543
2011	6	9	13.4900	0.6300	0.0067	-0.2748
2012	6	10	13.5800	0.6200	0.0078	-0.2578

6.3 Complete series used in the regression of the third step

Year	Id	VarLnLoans	VarLnTA	VarLnRWA	VarLnRegK	Z	VarGDP	VarEcbR	VarCPI	DProvision	NPL
2001	1	13,6700	12,3700	11,8300	5.5143	-18,5000	0,0600	-1,5000	0,0400	-0,0004	0,0070
2002	1	7,1400	3,4700	-4,0600	17.3789	0,6900	0,0500	-0,5000	0,0400	-0,0007	0,0099
2003	1	6,7900	1,9300	7,0600	4.3953	-2,8600	0,0200	-0,7500	0,0200	0,0004	0,0091
2004	1	8,1400	-1,5800	-1,3000	-13.7557	-16,8200	0,0400	0,0000	0,0200	0,0001	0,0086
2005	1	9,7700	15,7800	1,9500	18.0323	-1,5500	0,0300	0,2500	0,0300	-0,0014	0,0098
2006	1	15,9200	16,4900	16,0500	-3.6686	-16,1600	0,0400	1,2500	0,0300	-0,0006	0,0078
2007	1	10,1400	13,1100	19,6900	24.4394	-11,6300	0,0500	0,5000	0,0300	0,0011	0,0073
2008	1	7,4000	5,8800	1,0200	14.3273	0,0700	0,0200	-1,5000	0,0100	0,0008	0,0107
2009	1	2,5300	9,8400	-0,5000	-3.3721	-1,7800	-0,0200	-1,5000	0,0000	0,0004	0,0118
2010	1	0,4000	-3,8400	-0,0800	0.8240	-21,6100	0,0300	0,0000	0,0300	-0,0009	0,0129
2011	1	-5,4200	-6,1000	-3,4600	-21.1573	-45,2900	-0,0100	0,0000	0,0400	0,0022	0,0160
2012	1	-2,8900	3,6800	-2,5800	45.2253	-10,1900	-0,0300	-0,2500	0,0200	0,0016	0,0200
2001	2	4,5600	1,7700	-3,0500	-0.8963	4,8800	0,0600	-1,5000	0,0400	0,0005	0,0115
2002	2	5,4700	-1,7600	-0,8000	13.0850	16,3200	0,0500	-0,5000	0,0400	0,0018	0,0108
2003	2	8,3400	9,0200	7,7800	16.6318	31,1300	0,0200	-0,7500	0,0200	0,0019	0,0136
2004	2	4,4700	5,2300	3,7800	4.6265	32,5500	0,0400	0,0000	0,0200	-0,0051	0,0066
2005	2	3,9600	7,4700	2,7300	10.8010	38,0400	0,0300	0,2500	0,0300	-0,0004	0,0066
2006	2	6,5300	3,0900	2,4100	-13.0677	14,3300	0,0400	1,2500	0,0300	0,0000	0,0063
2007	2	14,3900	10,6500	10,5800	-3.9029	-1,8900	0,0500	0,5000	0,0300	0,0014	0,0063
2008	2	13,6400	6,8600	8,9000	18.2739	7,2700	0,0200	-1,5000	0,0100	0,0028	0,0090
2009	2	0,9100	1,1900	-2,4900	6.3478	12,9700	-0,0200	-1,5000	0,0000	0,0000	0,0213
2010	2	-1,2200	3,0900	-9,9100	-20.6688	-19,0900	0,0300	0,0000	0,0300	0,0015	0,0232
2011	2	-6,6000	-5,2800	-7,1500	-15.2314	-38,8100	-0,0100	0,0000	0,0400	0,0070	0,0342
2012	2	-6,7500	-4,0800	-4,0200	25.0112	-18,8700	-0,0300	-0,2500	0,0200	0,0045	0,0465
2001	3	12,0100	12,8900	12,9900	27.5873	2,0800	0,0600	-1,5000	0,0400	-0,0027	0,0117
2002	3	4,8700	6,8000	8,2400	24.4392	21,7600	0,0500	-0,5000	0,0400	0,0019	0,0133
2003	3	0,9500	4,8500	-0,9500	2.8557	27,1700	0,0200	-0,7500	0,0200	0,0018	0,0127
2004	3	8,9800	-0,5400	6,2100	2.5630	19,1900	0,0400	0,0000	0,0200	-0,0016	0,0128
2005	3	10,5600	15,4000	9,0500	6.1653	16,5700	0,0300	0,2500	0,0300	-0,0026	0,0097
2006	3	12,1500	16,3400	16,2000	22.5040	29,1900	0,0400	1,2500	0,0300	-0,0013	0,0080
2007	3	18,8300	14,4800	16,6700	3.6483	14,9200	0,0500	0,5000	0,0300	0,0000	0,0074
2008	3	11,0400	9,5300	12,1900	3.0973	6,0200	0,0200	-1,5000	0,0100	0,0005	0,0085
2009	3	4,7300	9,0400	8,7100	14.6220	13,2600	-0,0200	-1,5000	0,0000	0,0029	0,0109
2010	3	4,0200	0,8800	5,4700	6.8924	-9,8500	0,0300	0,0000	0,0300	-0,0023	0,0316
2011	3	-2,6900	-3,4200	-5,0900	-10.5499	-29,7300	-0,0100	0,0000	0,0400	0,0032	0,0421
2012	3	-1,6000	4,2100	-5,8700	-0.4098	-24,1500	-0,0300	-0,2500	0,0200	0,0029	0,0569
2001	4	15,2000	16,6600	15,7700	19.5987	23,2400	0,0600	-1,5000	0,0400	-0,0121	0,0142
2002	4	6,8000	-1,8500	13,1200	6.9166	12,4200	0,0500	-0,5000	0,0400	0,0004	0,0140
2003	4	-13,9700	7,0400	5,7900	-6.9894	0,5300	0,0200	-0,7500	0,0200	0,0001	0,0126
2004	4	23,0500	-0,7000	-4,5400	-2.7353	-0,4300	0,0400	0,0000	0,0200	-0,0005	0,0104
2005	4	7,7400	15,6200	6,5500	2.9085	-3,2800	0,0300	0,2500	0,0300	-0,0019	0,0056
2006	4	9,9900	0,2500	4,0300	4.9510	-6,3800	0,0400	1,2500	0,0300	-0,0015	0,0035
2007	4	4,0200	11,9400	15,4900	6.8744	-14,1700	0,0500	0,5000	0,0300	0,0025	0,0023
2008	4	7,0300	6,0100	3,0200	5.9783	-12,2800	0,0200	-1,5000	0,0100	-0,0018	0,0040

2009	4	-1,3700	12,9300	-3,6000	0.2118	-6,6200	-0,0200	-1,5000	0,0000	0,0009	0,0057
2010	4	0,8600	0,8700	-7,9600	-13.7308	-28,6600	0,0300	0,0000	0,0300	0,0013	0,0073
2011	4	-4,1400	-13,8600	-6,7400	-4.7789	-40,8900	-0,0100	0,0000	0,0400	0,0023	0,0134
2012	4	-3,8600	-4,0400	-13,6700	-3.5263	-35,0600	-0,0300	-0,2500	0,0200	0,0064	0,0231
2001	5	17,1400	22,0400	9,0500	-2.2475	-30,2300	0,0600	-1,5000	0,0400	-0,0018	0,0130
2002	5	13,7500	6,0500	35,3600	37.5102	-28,1200	0,0500	-0,5000	0,0400	0,0006	0,0146
2003	5	-0,4000	-6,0300	8,8300	11.9726	-28,7900	0,0200	-0,7500	0,0200	-0,0009	0,0170
2004	5	24,9800	24,1600	16,3200	48.6298	6,7300	0,0400	0,0000	0,0200	-0,0011	0,0127
2005	5	10,6200	13,8700	11,4600	-30.1385	-29,6700	0,0300	0,2500	0,0300	-0,0033	0,0123
2006	5	13,6400	9,1100	17,1400	41.6925	-10,0200	0,0400	1,2500	0,0300	0,0000	0,0196
2007	5	20,1100	16,2100	21,4800	12.9917	-15,8200	0,0500	0,5000	0,0300	-0,0002	0,0227
2008	5	18,3400	17,9500	18,0300	6.1794	-21,6100	0,0200	-1,5000	0,0100	0,0016	0,0256
2009	5	12,5400	11,4700	11,3000	19.7242	-13,2300	-0,0200	-1,5000	0,0000	0,0033	0,0470
2010	5	6,4200	8,4200	3,6500	-4.5538	-33,2500	0,0300	0,0000	0,0300	-0,0010	0,0245
2011	5	-6,8900	0,7100	-7,1100	-21.2727	-50,8200	-0,0100	0,0000	0,0400	0,0148	0,0316
2012	5	-9,0600	-12,3000	-9,8500	26.2751	-31,8500	-0,0300	-0,2500	0,0200	0,0081	0,0457
2001	6	18,7200	18,4100	16,3300	21.9434	-21,4800	0,0600	-1,5000	0,0400	0,0026	0,0284
2002	6	6,2100	11,7400	6,4400	10.4547	-15,5300	0,0500	-0,5000	0,0400	0,0006	0,0301
2003	6	1,7000	6,2000	-2,1600	4.3610	-8,8900	0,0200	-0,7500	0,0200	0,0013	0,0369
2004	6	4,9300	2,4800	2,5900	2.5915	-9,8300	0,0400	0,0000	0,0200	0,0026	0,0282
2005	6	18,2400	16,6700	19,9400	13.4195	-14,5800	0,0300	0,2500	0,0300	-0,0095	0,0226
2006	6	8,7700	8,0300	7,6300	-0.6672	-21,6800	0,0400	1,2500	0,0300	-0,0005	0,0186
2007	6	6,5600	6,1000	10,8800	1.5037	-30,5200	0,0500	0,5000	0,0300	0,0003	0,0193
2008	6	3,2400	-0,2800	-11,2000	13.3419	-14,1100	0,0200	-1,5000	0,0100	0,0005	0,0254
2009	6	-1,4200	2,3100	-4,6000	10.0904	-2,7300	-0,0200	-1,5000	0,0000	0,0028	0,0337
2010	6	-0,6600	5,6600	2,6600	-1.2678	-20,6600	0,0300	0,0000	0,0300	-0,0023	0,0316
2011	6	15,0400	16,3700	27,0600	32.7819	-23,6000	-0,0100	0,0000	0,0400	0,0006	0,0383
2012	6	-5,2500	2,2000	1,0800	1.7652	-22,1200	-0,0300	-0,2500	0,0200	0,0011	0,0425

References

Bank of Portugal. (2011). *Notice 3/2011.*

Basel Committee on Banking Supervision. (2010). *Guidance for national authorities operating the countercyclical capital buffer.* Bank for International Settlements.

Basel Committee on Banking Supervision. (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems.* Bank for International Settlements.

Drehmann, M., Borio, C., & Tsatsaronis, K. (2011). *Anchoring countercyclical capital buffers: the role of credit aggregates.* Bank for International Settlements.

Drehmann, M., Borio, C., Gambacorta, L., Jiménez, G., & Trucharte, C. (2010). *Countercyclical capital buffers: exploring options.* Bank for International Settlements.

European Commission. (n.d.). *Capital Requirements Directive: Legislation in force*. Retrieved 09 05, 2013, from European Commission: http://ec.europa.eu/internal_market/bank/regcapital/legislation_in_force_en.htm

Francis, W. B., & Osborne, M. (2012). Capital requirements and bank behavior in the UK: Are there lessons for international capital standards? *Journal of Banking & Finance*, 803-816.

Hodrick, R. J., & Prescott, E. C. (1997, 02). Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking, Vol. 29, No. 1*, pp. 1-16.

Hull, J. C. (2010). *Risk Management and Financial Institutions.* Prentice Hall.

Jiménez, G., Ongena, S., Peydró, J.-L., & Saurina, J. (2013). *Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments.* Tilburg University, European Banking Center Research .

Kashyap, A. K., & Stein, J. C. (2004, 03 22). Cyclical implications of the Basel II capital standards. *Economic Perspectives*, pp. 18-31.

Repullo, R., & Saurina, J. (2011). *The countercyclical capital buffer of Basel III, a critical assessment.* Centre for Economic Policy Research (CEPR).

Repullo, R., Saurina, J., & Trucharte, C. (2010). *Mitigating the procyclicality of Basel II.* Madrid: Banco de España.