

Managing capital procyclicality in African banks using contingent convertible bonds

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**TO THE MAN WHO WORKS IN SILENCE,
ON COLD AND DARK LONDON MORNINGS...
LIVES REALLY DO BREATHE EASIER BECAUSE YOU LIVE.
I KNOW YOU HAVE NO NEED TO BE PRAISED,
YET, YOU DESERVE EVERY WORD.
THESE TWO ARE FOR YOU.
THANK YOU.**

Preface

This thesis was completed in fulfilment of the requirements for the degree of *Philosophiae Doctor* in published article format at North-West University, Potchefstroom campus, under the supervision of Prof Gary van Vuuren and Prof André Heymans.

The work described in this thesis was carried out whilst in the employ of SmartFunder (PTY) Ltd. Theoretical and practical work was conducted in collaboration with Prof van Vuuren from the Department of Risk Management, School of Economics, North-West University (South Africa).

This study comprises three distinct studies and represents the original work of the author. These studies have not been submitted in any form to another university. Where use was made of the work of others, and where service providers supplied data, these have been duly acknowledged in the text.

Chapters 2, 3 and 4 present published research:

- Liebenberg, F., van Vuuren, G. and Heymans, A. 2016. Pricing contingent convertible bonds in African banks. *South African Journal of Economics and Management Sciences*, 19(3): 369 – 387.
- Liebenberg, F., van Vuuren, G. and Heymans, A. 2017. Contingent convertible bonds as counter-cyclical capital measures. *South African Journal of Economics and Management Sciences*, 20(1): 1 – 17.
- Liebenberg, F., van Vuuren, G. and Heymans, A. 2018. Exploring contingent convertible bond alternatives for African banks. *South African Journal of Economics and Management Sciences*, 21(1): 1 – 12.

The results obtained from these articles and the contributions they make to the existing body of knowledge are summarised in Chapter 5, which also sets out future research opportunities. These results aim to resolve unanswered questions relating to contingent capital in African banks, including its construction, assembly, measurement and design. This work aims to research in new ways the elements of this important financial problem.



FRANCOIS LIEBENBERG

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Abstract

In times of financial distress, banks struggle to source additional capital from reluctant private investors. Sovereign bailouts prevent disruptive insolvencies but distort bank incentives. Contingent convertible capital instruments (CoCos) – securities which possess a loss-absorbing mechanism in situations where the capital of the issuing bank reaches a level lower than a pre-defined level – offer a potential solution. Although gaining popularity in developed economies, CoCo issuance in Africa is still in its infancy, possibly due to pricing complexity and ambiguity about conversion triggers. In this thesis, the pricing of these instruments is investigated and the influence of local conditions (using data from three major African markets and an all-African index) on CoCo prices is explored. We find that the African milieu (high interest rates and equity volatility compared with developed markets) makes CoCos particularly attractive instruments for the simultaneous reduction of debt and enhancement of capital. If CoCo issuance becomes a viable bank recapitalisation tool in Africa, these details will be valuable to future investors and issuers.

The procyclical nature of capital models under the Basel II accord has been widely criticised for exacerbating lending in economic expansions and restricting lending during economic contractions. These criticisms have led regulators to employ countercyclical measures in subsequent Basel accords. One of these measures, the Countercyclical Capital Buffer, has been proposed as an effective countercyclical measure in expansionary periods as a deterrent to excessive lending through increased bank capital requirements. The effectiveness of this measure during contractions, however, is less obvious. CoCos – which are bond-like until triggered by a deterioration of a prescribed capital metric, at which point they convert into a form of equity – are explored as a supplementary countercyclical capital measure for such periods.

A variant of the CoCo, first proposed in 2011, is investigated: the Call Option Enhanced Reverse Convertible (COERC). Although issued as a bond, it converts to new shareholder's equity if a bank's market share of capital falls below a pre-specified trigger point. COERCs avoid the problems with market-based triggers (e.g. sell offs and death spirals) due to panic and market manipulation. Banks that issue COERCs have less incentive to choose investments which may be subject to large losses and disincentive problems associated with the replenishment of shareholder's equity after market declines (also known as debt overhang) are also avoided. Proposed amendments to the COERC structure are suggested for the African market.

Table of contents

Dedication	i
Preface	ii
Acknowledgements	iii
Abstract	iv
Table of contents	v
List of figures	viii
List of tables	x
List of abbreviations	xi
Chapter 1: Introduction	1
1.1: Background	1
1.2: Thesis Structure	2
1.3: Problem statement	2
1.4: Research question	3
1.5: Research objective	3
1.6: Research design	4
1.6.1: Literature review	5
1.6.2: Empirical study	5
1.6.3: Data	5
1.6.4: Research output	6
1.7: Conclusion	7
Chapter 2: Pricing contingent convertible bonds in African banks	8
2.1: Introduction	9
2.2: Literature Study	11
2.3: Contingent convertible (CoCo) bonds	13
2.3.1: CoCo trigger	15
2.3.2: Loss absorption mechanism	16

2.3.3: Pricing	18
2.4: Data and methodology	19
2.4.1: Equity derivative approach.....	21
2.4.2: Loss	22
2.4.3: Trigger intensity	23
2.4.4: CoCo delta.....	25
2.5: Results and discussion	26
2.5.1: Trigger probability	27
2.5.2: Credit spread.....	28
2.5.3: Trigger intensity	28
2.5.4: Total yield.....	29
2.6: Conclusions.....	31
References.....	32
Chapter 3: Contingent convertible bonds as countercyclical capital measures.....	35
3.1: Introduction.....	36
3.2: Literature Study	38
3.2.1: Procyclicality.....	38
3.2.2: The CCB.....	40
3.2.3: CoCos	44
3.3: Methodology and data	48
3.3.1: Hodrick Prescott Filter	48
3.3.2: The HP Filter applied to South African data	51
3.3.3: Equity Derivatives Approach CoCo Pricing Model.....	53
3.4: Results and discussion	55
3.5: Conclusion	59
References.....	60
Chapter 4: Exploring contingent convertible bond alternatives for African banks.....	64
4.1: Introduction.....	65

4.2: Literature Study	67
4.2.1: The credit crisis	68
4.2.2: Contingent convertible bonds.....	69
4.2.3: Call Option Enhanced Reverse Convertible bonds	72
4.3: Data and methodology	73
4.3.1: Data	73
4.3.2: Methodology	73
4.4: Results and discussion	75
4.5: Conclusions and suggestions for future work.....	83
References.....	85
Chapter 5: Conclusions and suggestions for future research	88
5.1: Summary and conclusions	88
5.1.1: Paper 1: Pricing contingent convertible bonds in African banks	89
5.1.2: Paper 2: Contingent convertible bonds as countercyclical capital measure	90
5.1.3: Paper 3: Exploring contingent convertible bond alternatives for African banks.....	91
5.2: Limitations	93
5.3: Suggestions for future research.....	93
Bibliography	95

List of figures

Chapter 2: Pricing contingent convertible bonds in African banks

Figure 2.1: South African GDP growth rate (1992 – 2014)	12
Figure 2.2: Main design features of CoCos.	18
Figure 2.3: Daily returns of the JSE ALSI and associated annual volatility.	20
Figure 2.4: Monthly returns of the Egyptian EGX 30 index and associated annual volatility.	20
Figure 2.5: Daily returns of the Nigerian ALSI and associated annual volatility (note different time scale).	21
Figure 2.6: Daily returns of the S&P all Africa index and associated annual volatility (note different time scale).	21
Figure 2.7: Accounting trigger and associated market trigger S^*	23
Figure 2.8: Probability p^* of hitting the trigger level S^* for different share prices.	26
Figure 2.9: Trigger probability at various share prices for (a) South Africa (b) Egypt, (c) Ni- geria and (d) all Africa.	27
Figure 2.10: Coco spread at various share prices for (a) South Africa (b) Egypt, (c) Nigeria and (d) all Africa.	28
Figure 2.11: Trigger intensity at various share prices for (a) South Africa (b) Egypt, (c) Nige- ria and (d) all Africa.	29
Figure 2.12: Total yield at various share prices for (a) South Africa (b) Egypt, (c) Nigeria and (d) all Africa.	30

Chapter 3: Contingent convertible bonds as countercyclical capital measures

Figure 3.1: The strengthening of the banking sector due to the capital conservation buffer...41	41
Figure 3.2: Proposed Basel III countercyclical rules.	42
Figure 3.3: The Basel III procyclical capital rules for various credit growth/GDP gap levels.	43
Figure 3.4: Total global CoCos issuance (to end 2015).....	45
Figure 3.5: CoCo CET1 ratios and associated AT1 yield.....	48
Figure 3.6: Credit/GDP and Credit/GDP Gap for the South African economy and capital charges associated with the CCB charge. The shaded area indicates the 2007 credit crisis period and illustrates how the CCB would have been at its peak during this pe- riod.	52

Figure 3.7: Accounting trigger with the projected market trigger S^*	54
Figure 3.8: Share price of First National Bank (FNB) and ABSA with CET 1 capital ratios prior to- and after CoCo conversions.....	56
Figure 3.9: Share prices of Nedbank and Standard Bank with CET 1 ratios prior to- and after CoCo conversions.....	56
Figure 3.10: Coco yields for various South African bank share prices.	57
Figure 3.11: The conversion of proposed CoCo instruments of South African banks during an economic contraction. The shaded area represents the fall in the market due to the 2007 credit crisis and illustrates that the simulated CoCo triggers could have produced a CET1 capital injection during this period, for all four banks.....	58
Chapter 4: Exploring contingent convertible bond alternatives for African banks	
Figure 4.1: Global CoCo issuance (in USDbn).	66
Figure 4.2: Banco Santander 8.25% CoCo price (USD).	67
Figure 4.3: Principal benefits of COERCs. The left-hand side represents the naïve scenario, the right-hand side displays the more likely outcome of COERC share conversion.	74
Figure 4.4: Comparison of COERC and straight debt payoff profiles.	78
Figure 4.5: (a) Equity value, MV^E , (b) number of shares in issue and (c) fundamental share value, S_t as a function of underlying share price. All descriptive parameters as given in Table 3. $c_p = t_p = R5$	79
Figure 4.6: (a) Fully diluted share price and (b) gain to COERC investors as a function of the number of shares in issue and the COERC conversion rate.	80
Figure 4.6: (c) Fundamental stock value and (d) option exercise threshold as a function of the number of shares in issue and the COERC conversion rate.	80
Figure 4.6: (e) Implied conversion price, c_p , as a function of the number of shares in issue and the COERC conversion rate.....	81
Figure 4.7: Developed economy bond yields since 2008.	81
Figure 4.8: South African and Nigerian government bond yields since 2008.....	82

List of tables

Chapter 1: Introduction

Table 1.1: Data requirements, frequency and source.....	6
---	---

Table 1.2: Research output	6
----------------------------------	---

Chapter 2: Pricing contingent convertible bonds in African banks

Table 2.1: Calculation of credit spread	25
---	----

Table 2.2: Input parameters used in the CoCo pricing model	26
--	----

Chapter 3: Contingent convertible bonds as countercyclical capital measures

Table 3.1: Proposed Basel III countercyclical rules implemented in South Africa in 2014 (BCBS, 2015).	42
--	----

Table 3.2: Proposed Basel III countercyclical rules	43
---	----

Table 3.3: CoCos in issuance in Europe and Asia with additional information pertaining to their trigger mechanisms and yields	46
--	----

Table 3.4: Trigger share prices derived from Figure 3.7 and Figure 3.8 with market-related pricing model inputs	57
--	----

Chapter 4: Exploring contingent convertible bond alternatives for African banks

Table 4.1: Tier 1 Capital ratios for banks in the US for the first four quarters of 2008	71
--	----

Table 4.2: Summary and comparison of CoCo and COERC design features	72
---	----

Table 4.3: Potential criticisms of COERC issuance and measured responses.....	74
---	----

Table 4.4: Assumptions underlying a numerical CoCo example	75
--	----

Table 4.5: Assumptions underlying a numerical COERC example.	76
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List of abbreviations

ALSI	All Share Index	JIBAR	Johannesburg Interbank Agreed Rate
AT1	Additional Tier 1		
BCBS	Basel Committee on Banking Supervision	JSE	Johannesburg Securities Exchange
BIS	Bank for International Settlements	NCA	South African National Credit Act 34 of 2005
CET1	Common Equity Tier 1	PONV	Point of non-viability
CCB	Countercyclical Capital Buffer	PD	Probability of Default
CCR	Capital Conservation Ratio	PWD	Principal Write Down
CDS	Credit Default Swap	RWA	Risk Weighted Assets
CDO	Collateralised Debt Obligation	SARB	South African Reserve Bank
CoCo	Contingent Convertible Bond	SRB	Single Resolution Board
COERC	Call Option Enhanced Reverse Convertible Bond	TTC	Through-the-cycle
		T2	Tier 2
GDP	Gross Domestic Product	US	United States
HP	Hodrick-Prescott	USD	United States Dollar
IMF	International Monetary Fund	VaR	Value at Risk
IRB	Internal Ratings-Based	ZAR	South African Rand
IRS	Internal Revenue Service		

Chapter 1

Introduction

1.1 Background

The aftermath of the September 11 attacks in the United States (US) prompted central banks to lower interest rates in an effort to foster global economic growth. The low interest rate environment, which dominated developed and developing markets alike from about 2003, fuelled an asset price bubble (in many countries, this bubble occurred in residential house prices – particularly in the US and United Kingdom). The market for then fledgling securities like credit default swaps (CDSs) and securitised products inflated and new types of financial instruments, like collateralised debt obligations (CDOs), were rapidly devised to exploit this new milieu (Baily, Litan, & Johnson, 2008). Markets – perhaps naively – perceived these innovations to be adequately risk-managed, with appropriate tested techniques, policies and models implemented, stress-tested and back-tested. (Group of 20 (G20), 2009). In hindsight, it was these credulous assumptions that precipitated the credit crisis of 2008/9.

The regulatory response to the financial crisis was to adapt and augment the then new rules (Basel II – introduced in January 2008) to prevent future crises. The new rules transitioned through several phases before Basel III emerged (a supplement to, not a replacement of, Basel II). Basel III embraced five commendable aims: to introduce a leverage ratio into banks' Pillar 1 requirements; to address the issue of insufficient capital held for the trading book; to address the problem of market procyclicality, to introduce liquidity requirements, and to improve the quality and quantity of acceptable regulatory capital (BCBS, 2010a). To accomplish this final aim, Basel III focussed on increasing the *quantity* of banks' Tier 1 capital (and redefined what was to be considered *eligible* for Tier 1 capital status). Tier 1 capital was so named for its effectiveness in mitigating risk due to its loss-absorbing qualities.

Several proposals were mooted. Among these was the reduction in permitted Tier 2 and 3 capital levels, a tightening and refinement of the definition of qualifying Tier 1 capital, and the introduction of a contingent capital buffer to be activated in overheated economies and deactivated when markets returned to some level of normalcy (BCBS, 2010a). With their inherent risk mitigation properties to assist banks absorb losses in times of financial distress, Contingent Convertible Bonds (CoCos) were designed and implemented in developed economies to accomplish the goal of increasing banks' Tier 1 capital. CoCos are loss-absorbing debt instruments, issued as bonds, which convert into equity when a pre-determined

"credit events"¹ occur. CoCos have proved to be popular in developed economies, but the African market for CoCos remains in its infancy (KPMG, 2013).

1.2 Thesis structure

The remainder of this thesis is structured as follows: Chapter 2 presents a first attempt in the literature to investigate and adapt an existing CoCo pricing methodology to the African market. The consequences of introducing these hybrid instruments into the African banking market is also explored and the effect of local (African) economic conditions on the CoCo price.

Chapter 3 interrogates the literature regarding pro-cyclicality in the market, its origins and implications both globally and in South Africa. The countercyclical capital buffer - the Basel Committee on Banking Supervision's (BCBS) choice of pro-cyclical measure - is explored as a countercyclical capital measure in times of economic expansion.

CoCos also operate as countercyclical capital instruments because they convert in economic contractions (under suitably defined conditions, such as trigger mechanisms and conversion rates) into Tier 1 eligible capital. These details are discussed as well as specific examples then (2016) in issue. The Hodrick-Prescott (HP) filter is introduced and its relevance and applicability to financial data assessed. The HP filter is applied to historical South African data to identify economic downturns and establish capital levels required had the Countercyclical Capital Buffer (CCB) been implemented at those times. Simulation exercises of CoCo triggers in the 2008/9 financial crisis are presented along with the resultant increase in common equity Tier 1 (CET1) capital of the four main South African banks due to the conversions.

Chapter 4 reviews the regulatory response to the 2008/9 credit crisis and introduces existing CoCo pricing and valuation approaches. This chapter also examines proposed mechanisms to govern the behaviour of COERCs – convertible bond issues with added option features. Because the mathematics describing these derivatives is complex and explained elsewhere, numerical examples are provided for comparison. The results of calculations are analysed and presented as well as a discussion regarding the theoretical ramifications of COERC implementation in African banks.

Chapter 5 concludes the thesis by summarising the findings of the entire study and proposing suggestions for future research in this challenging field.

1.3 Problem statement

Since the credit crisis, developed market banks have designed and implemented an impressive array of instruments designed to prevent the procyclical nature of regulatory capital. Emerging African markets

¹ This refers to a default, bankruptcy, or other situation which is recognized as affecting the creditworthiness of a country or organization and which may trigger insurance payments as defined in a credit default swap.

differ from developed markets in several ways, yet they, too, must address the procyclicality problem. The design of African bank capital instruments which deal effectively with procyclicality is in its infancy. Such designs should take into account the unique features of the African milieu such as high interest and default rates, low credit ratings and small portfolio sizes.

1.4 Research questions

How are CoCos priced? What is the optimal Coco pricing model? How does the optimal pricing method function in uniquely African market environments? How does the pricing model behave under changing conditions and varying macroeconomic conditions?

What are the risks associated with CoCos? How is risk measured in CoCos? How will trigger mechanisms work with CoCos – what will trigger the conversion event? How will the introduction of CoCos impact African banks' capital? How will this impact differ from developed markets?

Will CoCos manage African bank capital procyclicality effectively? Which implications do countercyclical capital rules under Basel III accord pose to regulation in Africa? Will CoCos be sufficient to introduce robust capital countercyclicality in African banks?

1.5 Research objectives

Determine the feasibility of effective countercyclical capital measures for African banks.

The major objectives of this study are as follows:

- To elucidate the weaknesses of countercyclical capital models used in Africa.
 - Provide a background on the *development of capital models*.
 - Provide a background on the development of *Basel regulations*, its objectives and main features to *gauge possible objectives initially set out by the accord* to determine capital adequacy levels.
 - Provide a *brief history of the build-up* and occurrence of the financial crisis of 2007-2010 along with the *most prominent contributing factors* to the crisis.
 - Relate the contributing factors back to procyclical capital models under the Basel II accord to identify its possible *weaknesses and/or deficiencies that were highlighted by the crisis*.
 - Perform a retrospective regression by using a countercyclical capital model and compare the results to the conventional procyclical capital model results.
- To evaluate whether global regulatory standards truly provide for adequate *countercyclical* capital provision in terms of credit risk in African markets;
 - Briefly explain the historical development of Basel regulation and the application in Africa.
 - Introduce and explain the functionality of CoCos and the various pricing methodologies.

- Explore whether these CoCos would have the desired effect on African bank regulatory capital.
- Compare the results of the calculations of simulations in different African countries and present findings and conclusions.
- Relate the results and findings of the two calculations to Basel requirements.
- Explore the construct of CoCos and determine if there are alternative structures available which would add unique new features to CoCos and in so doing, alter payoff profiles to the benefit of all stakeholders.
- Summary of the weaknesses of countercyclical capital models in African markets.
 - In the conclusion chapter, the potential weaknesses of Basel are summarised and implications and recommendations are presented.

1.6 Research design

The research design of this thesis follows in the outline below:

Pose research problem statement and question: A broad problem statement attempts to encompass procyclicality in its entirety as it is a phenomenon rooted in the entire financial system. Even before the credit crisis, gaps in risk management theory and practice were becoming increasingly obvious with regards to procyclicality and the treatment thereof. To achieve macroeconomic stability, the issue of procyclicality must be addressed through alternative capital structures like CoCos.

Critical literature review: Critical literature reviews are conducted in Chapters 2 through 4 by consulting and considering existing literature. Adjustments to existing risk management procedures, techniques and methodologies to solve problems are documented and highlighted in the literature studies. The existing literature for this particular research theme is copious. Where an entirely new approach to risk practices is required, the literature was less obliging, but this was not a constraint in this study, because popular, well-established mathematical techniques are almost always available for research endeavours and again, abundant literature exists to address and divulge these.

Theory building/adapting/testing: Adaptation of existing capital risk management tools and methods for practical implementation into capital construction and management usually enjoys rich precedent. In these cases, exploring alternative capital instruments (CoCos) allows the quality of capital of a bank to be improved upon as these instruments may be loss-absorbing. The issuance of the CCB in Basel III is a practical example of regulation changing to make the capital structure of banks more resilient towards market changes. Developing new types of securities such as CoCos and COERCs, however, require much back-testing, validation and endorsement from other practitioners. Ultimately, the bulk of

the results reported in this thesis were from empirical analyses of historical data derived using known risk metrics with slight innovations for some.

Data collection: Data used were from original sources where possible (e.g. website of the South African Reserve Bank for proprietary regulatory capital data) or 3rd-party, internet databases (e.g. McGregor BFA and Opendata for historic share prices). Adequate data were available for all chapters, so sample error was minimised.

Conceptual development: This research is intended to provide accurate, but highly practical, solutions for use by risk analysts and risk managers. As a direct result, the primary source of analytical work was Microsoft ExcelTM since this tool is used by most financial institutions. These spreadsheet-based models use visual basic programming language (a flexible, functional desktop tool available to all quantitative analysts and risk managers) to develop macros to replace onerous and repetitive computing tasks.

Illustrate and reason findings: Having analysed the data, obtained meaningful results and displayed these appropriately, the findings were written up into article-style reports for peer review and publication. Chapter 2 and Chapter 3 have already been published as detailed in Table 1.2.

Further work: To complement major findings of and ensure the continuation of much needed work not addressed in this thesis, future work regarding the many components of procyclicality is then proposed for risk theorists and practitioners.

1.6.1 Literature review

The literature reviews focus on the origin, development, history and applications of the issues identified through problem statements and research questions, in this case the prevalence of procyclicality in the South African banking and financial environment. These literature studies explain and clarify the problem of procyclicality and elucidate how previous studies have addressed these problems.

1.6.2 Empirical study

The empirical study comprises the practical implementation of the research method, using techniques and models developed in Microsoft Excel.TM

The variables used refer to data assembled from various historical time series. All these data are available in the public domain and were refreshed either monthly or daily. Some pricing data were simulated by the author for demonstration purposes.

1.6.3 Data

Data in this study comprised several published, historical time series, available from both proprietary (e.g. McGregor BFA) and non-proprietary sources (e.g. internet databases).

Table 1.1: Data requirements, frequency and source.

#	Topic	Data required	Frequency	Sources
1	Pricing contingent convertible bonds in African banks	Returns of the Johannesburg Securities Exchange (JSE), Nigerian ALSI and the S&P All Africa Index	Daily and monthly, spanning 15 years from January 2000 to March 2015	McGregor BFA and Opendata databases (McGregor, 2014; Opendata, 2014)
2	Contingent convertible bonds as countercyclical capital measure	Nominal GDP and credit extended by all South African monetary institutions to the domestic private sector	Monthly, spanning the period from January 1996 to January 2014	South African Reserve Bank
3	Exploring contingent convertible bond alternatives for African banks	Stylised values for a “standard” COERC	n/a	Simulated by authors

1.6.4 Research output

The research output is indicated in Table 1.2 below.

- Topic 1: Liebenberg, F., van Vuuren, G. and Heymans, A. 2016. Pricing contingent convertible bonds in African banks. *SA Journal of Economics and Management Sciences*, 19(3): 369 – 387.
- Topic 2: Liebenberg, F., van Vuuren, G. and Heymans, A. 2017. Contingent convertible bonds as countercyclical capital measures. *SA Journal of Economics and Management Sciences*, 20(1): 1 – 17.
- Topic 3: Liebenberg, F., van Vuuren, G. and Heymans, A. 2018. Exploring contingent convertible bond alternatives for African banks. *SA Journal of Economics and Management Sciences*, 21(1): 1 – 12.

Table 1.2: Research output.

#	Topic	Models required	Research methodology	Contribution
1	Pricing contingent convertible bonds in African banks	Black and Scholes	Equity derivatives approach used to price CoCos for various African Markets	This chapter contributes to the field by being the first attempt in literature to investigate and adapt an existing CoCo pricing methodology to the African market. Pricing models that could be used to value CoCos were investigated and the optimal approach to pricing CoCos, the equity derivative method, tested. How this pricing model behaves under changing conditions and varying macroeconomic conditions were explored, with chosen conditions closely representing African markets chosen as proxies for the African continent.
2	Contingent convertible bonds as	HP Filter,	HP filter used to establish long-run trend	The Countercyclical Capital Buffer, has been proposed as an effective <i>countercyclical</i> measure in expansionary periods as a deterrent to

	countercyclical capital measure	BCBS countercyclical buffer trigger model, Black and Scholes	BCBS regulatory capital calculator determines capital requirements Equity derivatives approach was used to price Co-Cos for various African banks	excessive lending through increased bank capital requirements. The effectiveness of this measure during contractions, however, is less obvious. Contingent Convertible (CoCo) bonds – which are bond-like until triggered by a deterioration of a prescribed capital metric, at which point they convert into a form of equity – are explored in this chapter as a supplementary countercyclical capital measure for such periods for the first time in African markets.
3	Exploring contingent convertible bond alternatives for African banks	Pennacchi, Vermaelen, & Wolff, (2011) and Pennacchi, Vermaelen, & Wolff, (2014) COERC pricing model	The Pennacchi <i>et al.</i> (2014) COERC pricing model used to simulate various COERC performances in African markets	This is the first work in the literature to investigate the optimal structure for CoCo bonds in the African Market. COERCs were suggested as the best structure as these bonds avoid the problems with market-based triggers (e.g. sell offs and death spirals) due to panic and market manipulation. Banks that issue COERCs have less incentive to choose investments which may be subject to large losses and disincentive problems as associated with the replenishment of shareholder's equity after market declines (also known as debt overhang) are also avoided. It was demonstrated that the distinctive features and advantages of COERCs would be particularly beneficial for developing economy banks – such as African banks. Additional features to COERCs such as floating coupon rates, would also benefit these banks.

This thesis contributes to the field via a series of mathematical models which calculate CoCo and COERC prices and which incorporate uncertainty dynamics, stochastic pricing, Ito calculus and the Black-Scholes methodology in a novel way. The models described and augmented here were adapted for high spread yields, low credit ratings and substantially illiquid markets – all characteristics of emerging markets, making them useful and practical in the African market. Methods of shoring up contingent capital in good economic periods and releasing it in bad are sorely needed both from a practical implementation point of view. In addition, there is a general lack of contemporary literature upon which to base decisions in the design process of contingent capital: this problem is not unique to developing-economy banks. This thesis should be viewed as seminal work in the pricing and construct of CoCo and COERC bonds as alternative sources of countercyclical capital for use by banks in African markets which have proved throughout the study to be viable additions to the regulatory regime currently employed in the banking world. Ultimately, this work points research in new directions regarding this important financial problem of inherent procyclicality in financial instruments.

1.7 Conclusion

The conclusions are summarised in Chapter 5 which also presents future research opportunities. These aim to resolve unanswered questions relating to African bank contingent capital, its construction and assembly, measurement and design.

Chapter 2

Pricing contingent convertible bonds in African banks

Pricing contingent convertible bonds in African banks

Francois Liebenberg,² Gary van Vuuren³ and André Heymans⁴

ABSTRACT

In times of financial distress, banks struggle to source additional capital from reluctant private investors. Sovereign bailouts prevent disruptive insolvencies, but distort bank incentives. Contingent convertible capital instruments (CoCos) – securities which possess a loss-absorbing mechanism in situations where the capital of the issuing bank reaches a level lower than a pre-defined level – offer a potential solution. Although gaining popularity in developed economies, CoCo issuance in Africa is still in its infancy, possibly due to pricing complexity and ambiguity about conversion triggers. In this paper, the pricing of these instruments is investigated and the influence of local conditions (using data from three major African markets and an all-African index) on CoCo prices is explored. We find that the African milieu (high interest rates and equity volatility compared with developed markets) makes CoCos particularly attractive instruments for the simultaneous reduction of debt and enhancement of capital. If CoCo issuance becomes a viable bank recapitalisation tool in Africa, these details will be valuable to future investors and issuers.

JEL Classification: C134, C16, C53

Key words: Contingent capital, pricing, core equity, capital ratio

2.1 Introduction

The financial crisis that has caused large scale disruption in global financial markets in late 2007 had its origins in the asset price bubble (particularly the American house price bubble) which contained new types of financial instruments that masked risk (Baily *et al.*, 2008). The perception in the broader economic markets was that these new innovations were matched in complexity by risk mitigation tools, techniques, policies and models (G20, 2009). History has however proven that this was not the case. In response to the financial crisis that ensued, the regulation which pertains to risk management in financial institutions, specifically referring to the Basel II (BCBS, 2006) legislature was revised and subsequently the Basel III accord was produced. The main aim of Basel III is for more quality, consistency and transparency of Tier 1 capital.

Basel III also aims to regulate the amount of capital required for the trading book as well as the revision of acceptable capital composition of the bank. To increase the capital ratio from 8.0% to 10.5% or even 13.0% if the procyclical buffer capital requirement is invoked, Basel III also introduced a leverage ratio together with capital buffers (BCBS, 2010a). The type of Tier 1 Capital required for banks to effectively mitigate risk is of considerable importance to banks and regulators due to their loss-absorbing qualities. CoCo instruments have been designed and implemented in developed economies to accomplish this with their inherent risk mitigation properties helping banks absorb losses in times of financial distress.

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CoCo instruments are loss-absorbing debt instruments issued as bonds which convert into equity when a pre-determined "credit event" occurs. Despite ever increasing popularity in developed economies, the African market for CoCos remains in its infancy (KPMG, 2013). This paper represents the first attempt in the literature, as far as the authors are aware, to investigate and adapt an existing CoCo pricing methodology and explore the consequences of introducing these hybrid instruments to the African market. The effect of local (African) economic conditions on the CoCo price is explored and evaluated.

The remainder of this paper then proceeds as follows: Section 2.2 discusses the literature on economic procyclicality; the focus of this discussion will be on the 2008-9 credit crisis, its origins and implications on a broad global scale. The history and design of CoCos are examined in Section 2.3. The issuance of Cocos has been popular in developed economies, with banks in the UK, the US and the Eurozone enjoying some success issuing these securities. In 2009, three banks issued securities which were considered to be CoCos. These instruments had triggers which were activated based on regulatory capital values. Lloyds Bank was the first to issue a CoCo in November 2009 in a successful subscription offer. The second recognised CoCo was issued by Rabobank in May 2010 and presented terms that dictated a 75% write-down on the principal value of the bond when the bank's regulatory capital ratio fell to less than 7% with the remaining 25% stake being paid out in cash. The Rabobank CoCo does not exhibit the classic features of a CoCo in the sense that there is no equity conversion. The third CoCo bond issued was the security issued by Credit Suisse which was open to subscription from the public and offered a 7.875% coupon rate (a large credit spread at the time⁵) and was heavily oversubscribed. This CoCo was also to be converted from a bond to equity with a conversion cap of \$20 set to the amount at which it could be converted into shares. As a result, these products have gained popularity in the developed world. It is however by no means conclusive that similar popularity will ensue as smaller, developing economies, such as those in Africa begin CoCo issuance. Banks and regulators in these countries face several issues, including the specific trigger mechanism of CoCos as well as how to price these hybrid instruments in a robust way.

Section 2.4 will therefore explore the various pricing methodologies currently available in the literature and assess their relevance and applicability to financial data. Pros and cons of these methodologies – in particular the equity derivatives approach – are also discussed in this section. The equity derivatives approach is then applied to South African, Nigerian and Egyptian data (as well as an all-African index) due to the large sizes of these economies, making them good proxies for African markets. The results obtained are analysed and presented in Section 2.5 and Section 2.6 concludes.

⁵ At the issue date, the 30-year Treasury yield was 4.16%, the AAA corporate bond yield was 5.26%, and the BBB (which was Fitch's rating of the CoCo) corporate bond yield was 6.14%.

2.2 Literature study

The hidden risks behind securities in financial markets provided for a test of risk management models world-wide, especially for financial markets exposed to the asset price bubble, particularly the US house price bubble (Merrouche & Nier, 2010). The increasing scale and complexity of these securities as well as the looming failure of the credit market was, in many ways, obvious to all parties involved either directly or indirectly with these instruments (Baily *et al.*, 2008). The mainstream view in the broader financial services industry was that increased complexity had been matched by the evolution of mathematically sophisticated and effective techniques for measuring and managing the resulting risks (Financial Services Authority, 2009). When Lehman Brothers filed for a Chapter 11 bankruptcy and the initial cracks in the global financial system started to appear, it led to an over-exaggerated reduction of bank lending, widespread panic amongst risk managers and an industry-wide avoidance of the securities and structured product markets as a whole. Many financial service providers struggled to survive, thus exerting pressure on the broader macro-economic environment in which they operated (de Haas & van Horen, 2012).

In 2010, the financial crisis precipitated the European sovereign solvency crisis. Greece received bailout money from the European Union, substantiating the view that current regulatory capital directives and credit ratings are ineffective measures of controlling risk (Sorkin, 2010). Although the Basel II accord was an improvement on previous regulations it still provides inconsistent and biased forecasts of impending risks, notably under-estimating the joint downside risk of many assets (Atik, 2010). This, together with the failure of regulatory capital models during the credit crisis, is viewed as a key risk management failure (Dowd, Hutchinson, Ashby, & Hinchcliffe, 2011). Counteractive measures employed in the financial sector received criticism for being *post hoc*, and "pouring water on an inferno instead of smothering the embers" (Wong, 2011:419).

In September 2009, the Group of Central Bank governors alongside the Heads of Supervision, chaired by the president of the European Central Bank, met at the headquarters of the Bank for International Settlements (BIS) (BIS, 2009) to discuss strengthening the capital requirement of global banks. The Basel Committee on Banking Supervision (BCBS) subsequently implemented the Basel III accord (BCBS, 2010a) designed as a supplementary framework to augment and improve the Basel II accord. The phased implementation of Basel III began in 2013 and is at this stage (2015) expected to be complete by 2019, with minimum capital requirements to be fully implemented by 2015 (BIS, 2013). The principal aim of Basel III is for better quality, consistency and transparency of Tier 1 capital (BCBS, 2010a).

Banks in South Africa are in the process of migrating to Basel III compliance (Price Waterhouse Coopers (PWC), 2015). Although South Africa was largely sheltered from the effects of the crisis because of prudent risk management, the country still slid into a recession (SARB, 2011). This recession was

also the first one in 17 years, as demonstrated in Figure 2.1, with economic growth falling to -1.53% (World Bank, 2014).⁶ Although the declining growth had negative implications for income, employment, investment and social programmes, all South African banks survived the crisis while many banks around the globe were bailed out. This earned the South African banking system the reputation for being well developed, well-regulated and sophisticated and therefore ranked among those of first world economies despite the fact that South Africa as a whole is viewed as a developing economy (SA National Treasury, 2011). The four largest banks, in particular, performed relatively well during and directly after the financial crisis as no banks went into default in the South African market.⁷ This performance was linked to sound profitability, the low leverage ratios, limited exposure to foreign assets and foreign funding as well as adequate levels of capital in times of crisis (Maredza & Ikhide, 2013).

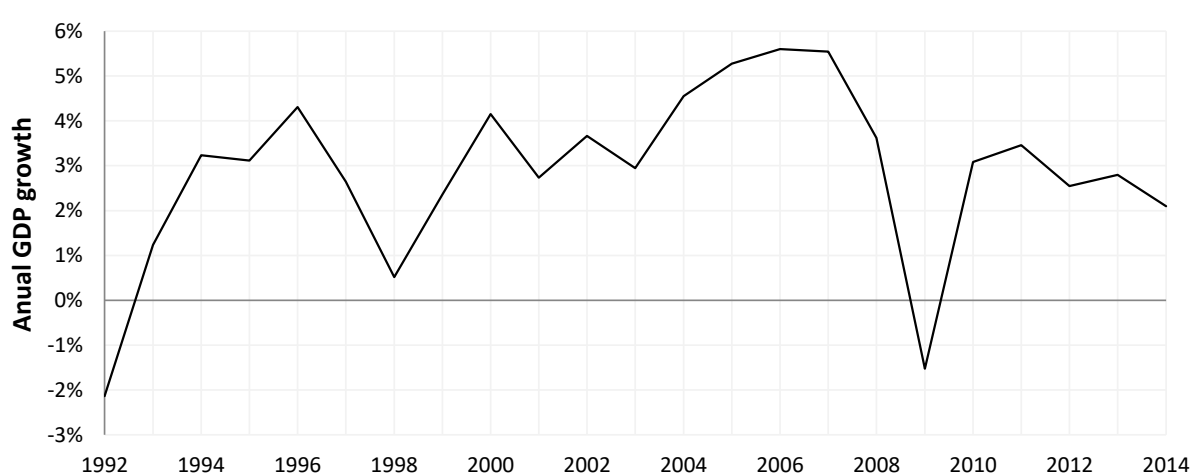


Figure 2.1: South African GDP growth rate (1992 – 2014).

Source: *Statistics South Africa*.

The South African Reserve Bank's (SARB) institution of the National Credit Act (NCA 35 of 2005) proved to be decisive and proactive in dampening the effects of the financial crisis on the South African economy (Kumbirai & Webb, 2010). The NCA is part of a comprehensive legislation overhaul designed to protect the concerns of banks and consumers and is concerned with legislation regarding reckless lending, interest rate capping and reasonability of credit, among others, and has laid down a clear set of rules for the way credit may be extended between financial institutions and borrowers (South African (SA) Government, 2005).

A novel regulatory requirement, introduced by Basel III, is the countercyclical capital buffer which aims to reduce bank capital procyclicality by increasing capital requirements in favourable economic

⁶ The last time South Africa was in a recession was in 1992, with a -2.14% growth rate (World Bank, 2014).

⁷ The banking sector consists of 17 domestically governed banks, 11 branches of multi-national banks, one co-operative bank, two mutual banks, and 43 representative offices. However, the South African banking sector is dominated by four major banking institutions the so-called Big Four namely the Amalgamated Bank of South Africa (ABSA), FirstRand Bank, Nedbank, and Standard Bank (SARB, 2012).

conditions and releasing this capital in unfavourable conditions (BCBS, 2010b). Countercyclical capital buffers were suggested as a measure which would guard to protect the financial system from systemic risk due to periods of increased credit growth, which have been associated with financial sector procyclicality (BIS, 2009). The way in which the credit-to-GDP ratio moves away from its historic trend, to the extent that it indicates the presence of imminent crises in the banking sector, is also indicative as a proxy of financial sector weaknesses.⁸ The BCBS has subsequently proposed in its guidance notes (BCBS, 2010b) that this credit-to-GDP gap and the way it moves away from its historic trend should be employed as a guideline when issuing Basel III countercyclical capital buffers. Every Basel Committee member is expected to use the countercyclical buffer as suggested by Basel III.⁹

Another of the methods proposed, and currently under investigation by the BCBS to manage the problem of insufficient capital in stressed economic milieus, is the introduction of CoCos (BCBS, 2011a:7).

2.3 Contingent convertible (CoCo) bonds

Contingent capital is not a new concept: the US banking system was built on an unfunded contingent capital commitment system of double liability. From 1850 to 1933, banks' risk management was shared through this system (De Spiegeleer & Schoutens, 2011). Under double liability, bank shareholders were required by law, in the event of financial distress, to pay a down payment equivalent to the issued par value of all shares held. Shareholders could thus be called upon for a sudden down payment of another \$100, assuming the initial investment in the bank was \$100.

Recently (post the 2008 credit crisis) contingent capital has been generated in the form CoCos. CoCos are securities with both an underlying equity and fixed income component that absorb losses by converting from a bond into equity when certain conditions – usually heightened systemic risk – are met (BCBS, 2010a). CoCos are similar to convertible bonds, with a few fundamental differences. A callable and convertible bond can be converted into a predetermined number of the common shares of the issuing entity at the bondholder's decision, while the bond is also callable by the issuer, i.e. the bondholder can be called upon to surrender the bond to the issuing entity for a predetermined price (Huang, 2009). Thus, it is the choice of the bondholder and/or the bond issuer when the contractual agreement of the bond will cease. A convertible bond usually offers a higher yield than a standard non-convertible bond because of the uncertainty associated with the conversion property of the bond. In addition, income-specific investors may have a mandate to invest exclusively in securities that generate interest or coupon payments. Convertible bonds may be converted to equity and, in some cases, this feature will prevent such income-specific investors from purchasing a convertible bond, even if the yield offered is more than that of other bonds (Huang, 2009).

⁸ There is strong evidence for this when studying the South African market. The credit-to-GDP guide issued a strong warning signal for a buffer add-on for the 2006–2010 period (SARB, 2011).

⁹ The countercyclical capital buffer was introduced to the South African market in January 2016 (SARB, 2012).

CoCos made a modest entry into finance when the Lloyds banking group offered the holders of some of its hybrid debt a swap where their bonds will be traded for a new bond which carried a possible conversion into shares in November, 2009 (De Spiegeleer & Schoutens, 2011). Credit Suisse soon followed suite, managing to raise \$2bn in new capital using this new asset class. This type of security could either convert from debt into either equity, cash, or be written down (De Vries & Brehm, 2011).

CoCos have an array of appealing properties. They are issued as bonds with fixed interest coupons and unlike other hybrid capital instruments, CoCos have a trigger (threshold for the issuing bank's capital ratio) which, if reached, results in automatic conversion of the CoCo into equity (the nominal value is written off). The trigger may also be activated by the relevant regulatory authority if the bank's viability is believed to be threatened (for example, when the bank still has sufficient capital but is struggling with reduced liquidity). CoCos are thus loss-absorbing, increasing a bank's capital when the bank is weakened and when it is most difficult for the bank to issue new equity. By automatically restructuring the capital of a bank, CoCos reduce the "debt overhang" problem, i.e. the failure of a bank to successfully acquire funds to finance additional loans because their return partially accrues to existing debt holders (Chen, Glasserman, Nouri & Pelger, 2013).¹⁰ It is this attribute that would have saved numerous banks during the financial crisis when they were required to issue new equity (Prescott, 2011). Second, CoCos automatically restructure bank capital before bankruptcy, when the bank is a 'going concern' and not a 'gone concern', thereby reducing the chance of being put into resolution or bankruptcy. The Lehman's bankruptcy provides a robust example of the value of perception in influencing the financial system: knowledge of pre-bankruptcy reorganisation of financial institutions (especially a systemically important one) is valuable. Lastly, when a CoCo is correctly structured, bondholders, regulators and issuing banks can potentially all be in a better position post-conversion, as opposed to one party suffering a loss (Pennacchi *et al.*, 2011:16).

CoCos may not necessarily convert into equity as the conversion mechanism could be cash, or in some instances, the bond may suffer a write down (either partially or completely). An investor can easily make the mistake of assuming that the returns from a callable convertible bond and a CoCo are comparable. On the contrary, however, the potential for profit of a CoCo is limited and the full downside may come into play for an investor once the bond is converted to shares (De Spiegeleer & Schoutens, 2011:8). One of the main differences between a normal convertible bond and a CoCo is the composition of the trigger mechanism, which is an event that must occur in order for the bond to be converted into the loss absorption mechanism.

¹⁰ Although the conversion of debt to equity raises the book value of equity, it fails to raise new cash for the bank like a new issuance of equity would (Prescott, 2012).

2.3.1 CoCo trigger

The trigger is documented in the prospectus of the bond and lays down a setting from where banks will most likely move into financial pressure (De Spiegeleer & Schoutens, 2011). Pioneering work by Flannery (2005) suggests a single trigger mechanism. A CoCo can, however, have one or more triggers as recent academics have proposed, with CoCos becoming an important topic post financial crisis (see, Flannery, 2009; Huertas, 2009; Albul, Jaffee & Tchistyi, 2010; Plosser, 2010; McDonald, 2010; Pennacchi, 2011 and Pennacchi *et al.*, 2011). In the case of a CoCo with more than one trigger, the loss conversion to equity (or write-down) will occur when any or a combination of trigger/s is/are breached. Triggers are either modelled on a mechanical rule or on the authority which may be executed by regulators. In the former case, also known as book-value triggers or accounting-value triggers, the trigger mechanism is typically set contractually as the ratio of Common Equity Tier 1 to risk-weighted assets, the CET1/RWA ratio. The loss absorption mechanism is activated should the CET1/RWA ratio of the issuing bank fall below a level which was pre-defined with the CoCo issuance. A good example of this type of CoCo is the one issued by Lloyds Banking Group in 2009.¹¹ This specific CoCo pays a 15% semi-annual coupon rate and will convert at £0.59 per share if the core Tier 1 ratio of Lloyds Banking Group falls below 5%. Under Basel III, the minimum CET1/RWA ratio for a CoCo to qualify as Additional Tier 1 capital is 5.125% according to current Basel regulations. Interestingly, since 2011, issuing banks have set their trigger at exactly that level (Avdjiev, Kartasheva, & Bogdanova, 2013).

Book-value triggers have been criticised for being a lagging indicator of capital issues and depend heavily on the frequency that the banks publish their financial results publicly and raises questions as to the similarity of internal risk models which differ across banks (Culp, 2009, Flannery, 2009). As a result of this delay in reporting, book-value triggers may not be activated as quickly as capital requires. Bear Stearns, Lehman Brothers, Wachovia and Merrill Lynch all reported regulatory capital well above the minimum level of 8% when they went bankrupt (De Spiegeleer & Schoutens, 2011).

Market-value triggers are proposed as an alternative, to address the shortcoming of inconsistent accounting valuations (Pennacchi *et al.*, 2011, Sundarsen & Wang, 2011, and Calomiris & Herring, 2012). These triggers are formulated in a way that the bond will convert to the loss-absorbing mechanism at a certain ratio of the bank's stock market capitalisation and/or Credit Default Swap (CDS) spread to its assets (Flannery 2005, 2009). This will decrease the risk that the balance sheet is manipulated and hopefully prevent regulatory forbearance (Avdjiev *et al.*, 2013). A potential problem though, is that market-value triggers could be difficult to price, are susceptible to stock price manipulation and can exhibit a multiple equilibria problem (Sundarsen & Wang, 2011). To elaborate on the problem of multiple equilibria CoCos need to be priced in conjunction with equity. Thus, a conversion rate which is

¹¹ Specifically, CoCo ISIN XS0459089255.

dilutive may bring forth a scenario where there are multiple pairs of prices for equity and CoCos for any given combination of the asset values of a bank and the amount of debt with CoCos excluded.

Lastly, discretionary triggers (also referred to as point of non-viability (PONV) triggers) will be triggered through the discretion applied by regulators looking at the financial position that a bank is in (Albul *et al.*, 2012). Such CoCos will afford a pre-defined regulator (usually a central bank) the authority to trigger the conversion mechanism of a CoCo if and when they view the action as necessary to save the bank. The use of PONV triggers offer a solution to the time-lag factor of book-value triggers. However, such a trigger may send the wrong message to the market and create a systemic panic in the financial system. De Spiegeleer and Schoutens (2011) suggest the following guidelines for the design of the trigger namely:

- *Clarity* - the trigger must portray a universal message regardless of jurisdiction;
- *Objectiveness* – the exact process to be followed if the loss-absorption mechanism is triggered should be known at the issue date;
- *Transparency* – a trigger defined as an event whereby the share price drops below a pre-defined barrier fits the test of transparency;
- *Fixed* – a trigger must be constant and unchangeable throughout the period in which the instrument is active; and
- *Public* - a trigger event or the data driving a possible conversion should be public information.

In general, the lower the share price or capital level of a trigger, the lower the yield and vice versa (Wilkens & Bethke, 2014). The level at which the trigger will activate is overwhelmingly driven through the view regulators hold on whether it is sufficiently high enough to be viewed as loss-absorbing and low enough for the bank to be profitable. CoCos which do not have high enough triggers have less loss-absorbing ability, as banks may already be at a point of non-viability if the trigger is set too low. Due to this fact they are usually less expensive to issue, but may not qualify as additional Tier 1 capital in banks. CoCos with lower triggers afford banks the opportunity to bolster their Tier 2 capital in a manner that makes business sense. The mechanism through which losses are absorbed is another important characteristic of any CoCo (Flannery, 2005).

2.3.2 Loss absorption mechanism

Upon breaching the pre-defined trigger, the loss absorption mechanism is activated. The first type of loss absorption mechanism is the Principal Write-down (PWD). This CoCo will be written down completely i.e. the bondholder would lose the nominal amount paid for the CoCo. A second form of loss absorption is a partial write-down. This form of CoCo will be partially written down, so the bondholder would sacrifice a pre-determined percentage of the nominal amount paid for the CoCo and receive the remaining amount in cash or equity. To illustrate this example, consider the CoCo issued by Rabobank

in March 2010. Upon investigation it is clear that holders of Rabobank CoCos could suffer a 75% loss of face value and be remunerated only by the remainder of the value, 25%, in cash (Wilkens & Bethke, 2014). A negative aspect of this specific trigger situation is that the issuer would be held liable for a cash pay-out while in distress. Thus, the most popular form of trigger mechanism is equity conversion, as is evident in the majority of CoCos issued to date featuring this mechanism (Avdjiev *et al.*, 2013). This type of CoCo will be converted into equity at a pre-defined rate.

The conversion price indicates the amount of shares an investor will obtain if a conversion occurs. As an example, a CoCo holder with a par value of R100 will receive 10 shares if the conversion price after the trigger price is R10 ($R100/R10$). The CoCo holder will, however receive 20 shares if the conversion price is R5 ($R100/R5$). Thus, CoCo investor benefits when the conversion price is low, as this leads to a high number of shares received upon conversion, with the inverse being true for current shareholders of a bank who are likely to favour a higher conversion price which will lead to their equity being less diluted post-conversion. It is however important to bear in mind that the conversion price is relative to how much or how little shares might be worth at the point of conversion and by how much their price may have fallen already. The conversion price could be any of the following:

1. a fixed value, for example, the share price on the day the CoCo is issued. Some CoCos have a clause specifying the amount of shares which are to be issued at conversion, instead of the price at the conversion, which is fundamentally the same as specifying a conversion price;
2. the price of the share at conversion
3. the share price with a floor, at conversion;
4. the share price at conversion including a premium or in some cases a discount; or
5. the average of daily stock prices at a pre-determined interval before the conversion (Sundaresan & Wang, 2011 and Prescott, 2012).

Figure 2.2 illustrates the main design features of a CoCo:

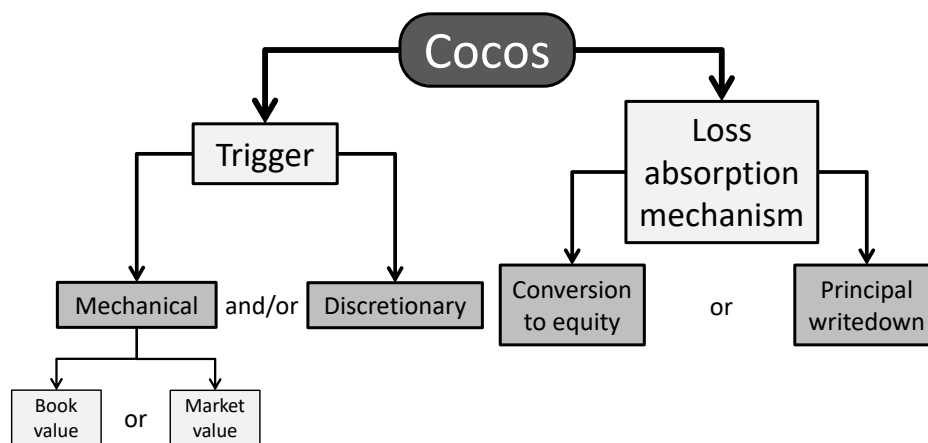


Figure 2.2: Main design features of CoCos.

Source: *Author*.

CoCo issuance to date (2015) is attributed mainly to their potential to satisfy regulatory capital requirements, although they can be actively traded in the secondary market after their issuance under Basel III, CoCos may be classified as additional Tier 1 (AT1) or Tier 2 (T2) capital (BCBS, 2011a). The majority of demand for CoCos stems from individuals who are often classified as “smaller” investors, while institutional investors have been held back by their mandates to date (2015), largely because CoCos are a relatively new type of security and disagreements continues about the correct accounting methodology for CoCos.¹²

CoCo credit spreads compared to other forms of subordinated debt largely depends on the way in which they are designed and is highly dependent on the trigger level as well as the loss absorption mechanism. The spreads offered by CoCos are generally more in line with returns offered by subordinated debt than with CDS spreads and equity prices (Avdjiev *et al.*, 2013). An important question to investors and academics is: how are CoCos priced in the secondary market, i.e. what is a CoCo worth if purchased from another investor?

2.3.3 Pricing

Various ways to price CoCos are explored in this paper, and the technique suggested by the majority of scholars was selected. Although the Black-Scholes assumptions have been shown to be empirically unreasonable for pricing CoCos as the implied market trigger of a CoCo is time dependent and volatile (Jung, 2012),¹³ the Black-Scholes model proved nevertheless to be a suitable candidate for pricing CoCos, due to the derivative nature of the underlying instruments.

¹² The debate stems from the hybrid nature of CoCos, with the majority of academics arguing they be treated as debt, but with others noting that they could also be treated as plain equity (Avdjiev *et al.*, 2013). The way in which CoCos are accounted for impacts the tax associated with the coupon payments made. For a detailed discussion on the tax treatment of CoCos see Mc Donald (2010).

¹³ We use the probability calculation from Black & Scholes (Equation 6 on page 24), which simply assesses the possibility of the threshold being breached during the life of the CoCo,

CoCo pricing has its roots in fixed income mathematics and equity derivative pricing, and may be grouped broadly into three model types, structural models (Pennacchi, 2011; Albul *et al.* 2010), credit derivatives models (De Spiegeleer & Schoutens, 2011; Serjantov, 2011) and equity derivatives models (De Spiegeleer & Schoutens, 2011). The fact that CoCos are (in their classic form) hybrid instruments, sitting between pure equity and pure debt, provides a particular challenge when selecting a suitable pricing model.

Structural models view CoCos as deleveraging tools, explicitly capturing the trigger event. Credit derivatives models acknowledge that CoCos carry credit risk as an inherent characteristic, paying coupons until maturity or conversion through the trigger. Equity derivative models on the other hand rely on the share price as an indicator of the underlying financial position of the bank as well as the value to be transferred at conversion. The majority of academics favour equity derivative models for pricing CoCos, as these seem to closely reflect the fair value of current CoCos in the market (De Spiegeleer & Schoutens, 2011 and Wilkens & Bethke, 2014). This method has thus been chosen as the basis for this paper.

2.4 Data and methodology

The data chosen were daily returns of the Johannesburg Securities Exchange (JSE) All Share Index (ALSI) (Figure 2.3), the Nigerian ALSI (Figure 2.5) and the S&P All Africa Index (Figure 2.6) spanning 15 years from January 2000 to March 2015. Monthly data from the Egyptian EGX 30 Index, spanning the same time period, were also used (Figure 2.4). Interest rate data were obtained from the relevant central bank from each country.

South Africa and Nigeria constitute the largest two economies in Africa. The data were sourced from the McGregor BFA and Opendata databases (McGregor, 2014; Opendata, 2014). The specific data were chosen as they reflect a reasonable proxy of African financial markets. Furthermore, the date ranges from pre- financial crisis to post- financial crisis to gain a good sample of volatilities and returns spanning extreme volatility values, not just periods of low or high volatility, as indicated by the Figures 2.3 through 2.6.

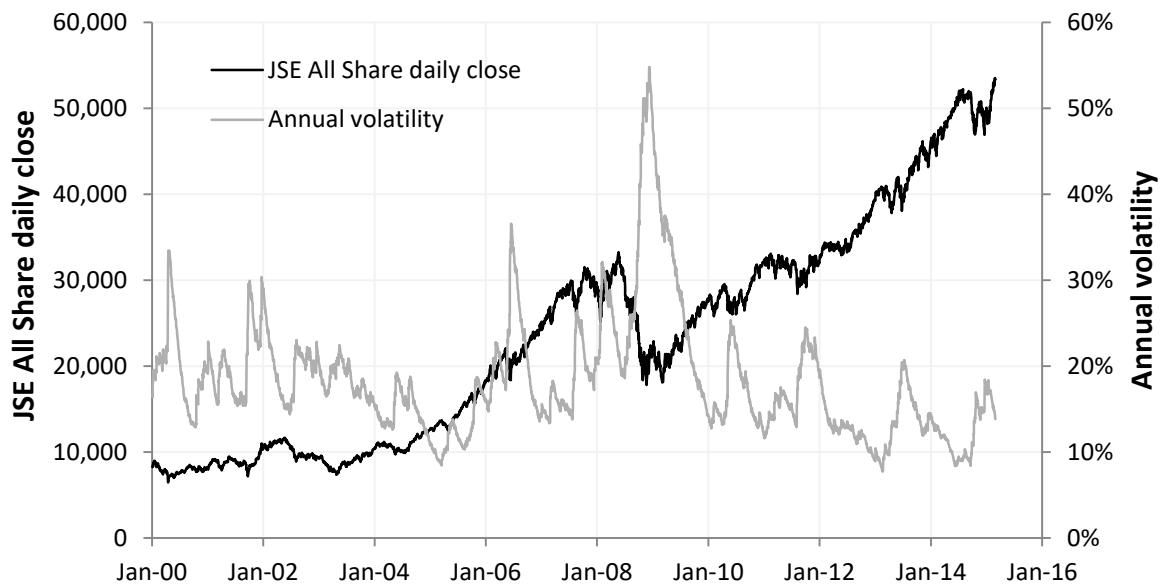


Figure 2.3: Daily returns of the JSE ALSI and associated annual volatility.

Source: *Datastream and author calculations.*

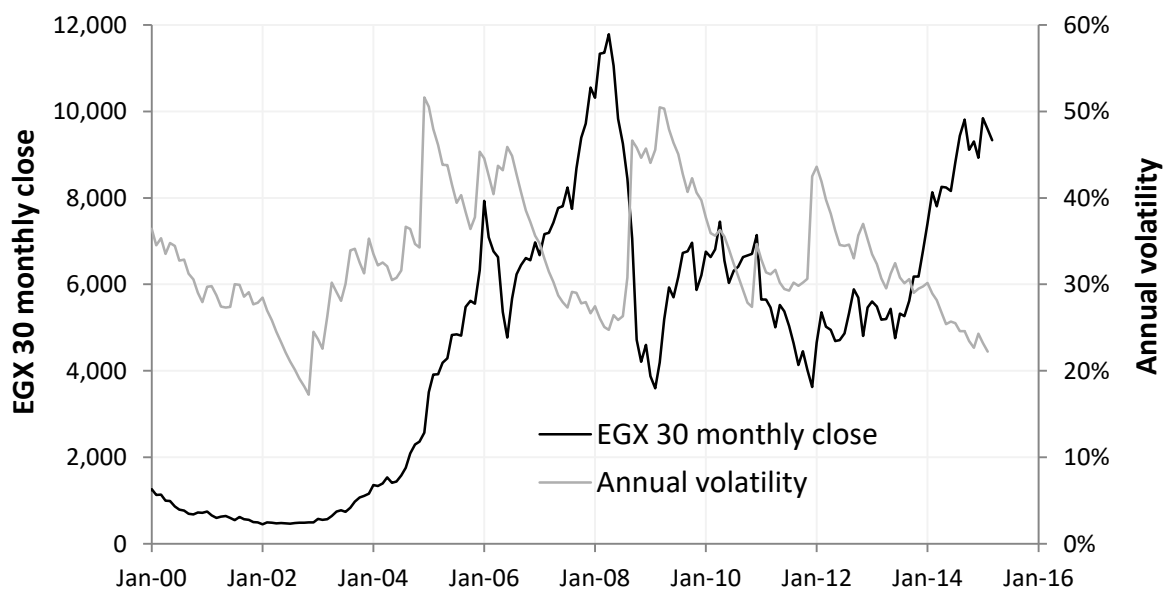


Figure 2.4: Monthly returns of the Egyptian EGX 30 index and associated annual volatility.

Source: *Datastream and author calculations.*

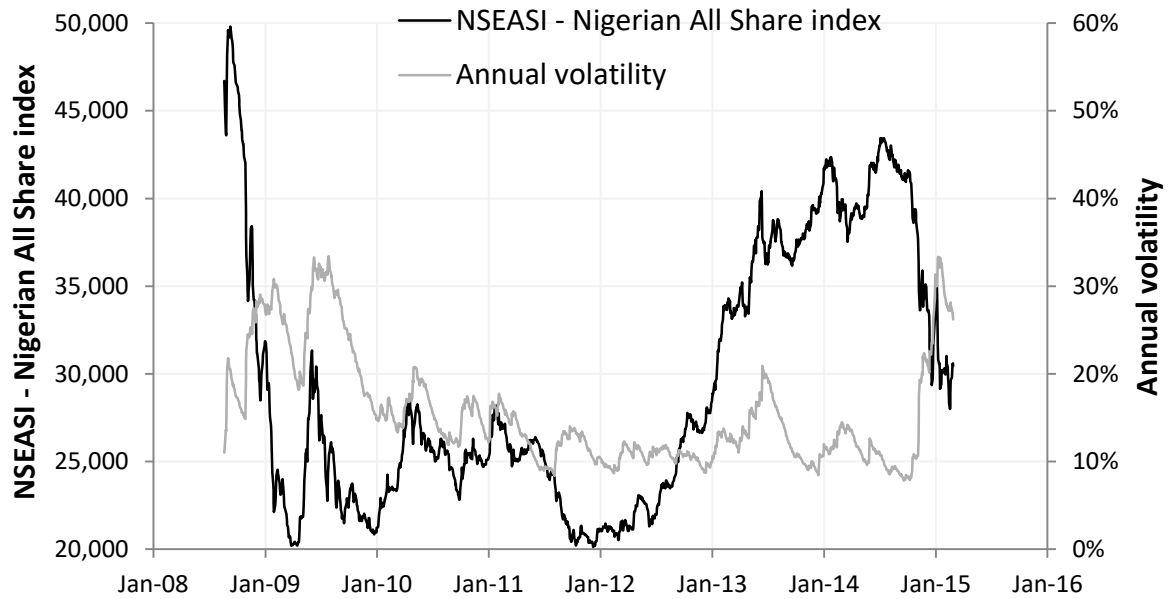


Figure 2.5: Daily returns of the Nigerian ALSI and associated annual volatility (note different time scale).

Source: *Datastream and author calculations.*

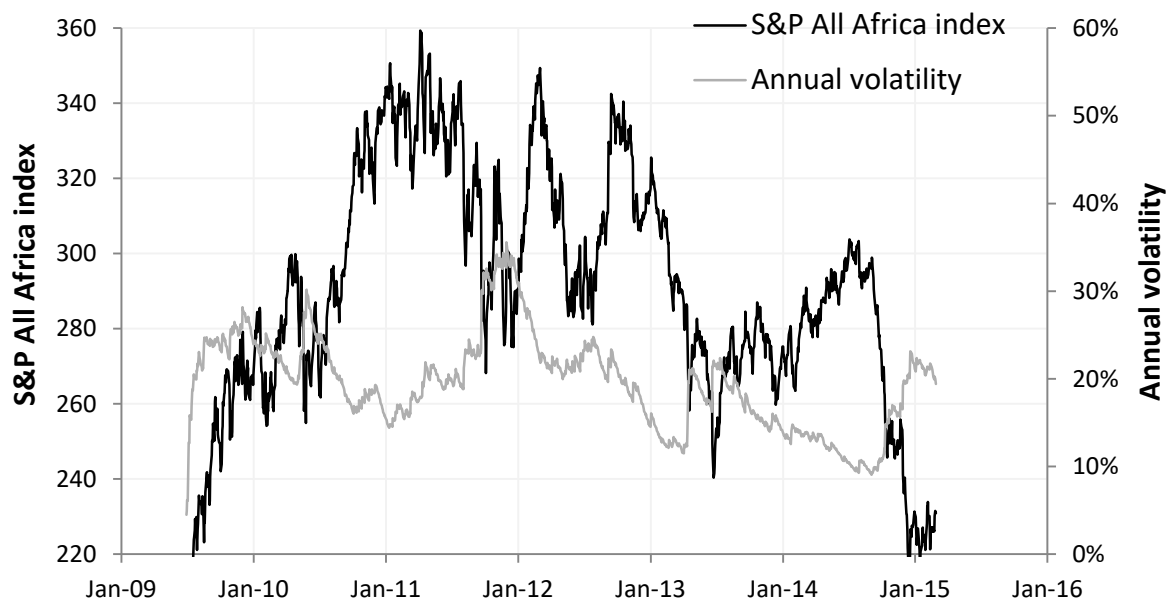


Figure 2.6: Daily returns of the S&P all Africa index and associated annual volatility (note different time scale).

Source: *Datastream and author calculations.*

2.4.1 Equity Derivatives Approach

In this approach the default-intensity parameter, denoted as λ , is employed to model default in the reduced form (De Spiegeleer & Schoutens, 2011). The value λdt can be expressed as the probability that

the issuing bank of a CoCo defaults within the time interval $[t + dt]$ while staying solvent up to time t . Hence, the probability, p_s , that the CoCo survives the next T years, is given by $\exp(-\lambda T)$. The default probability over the same time period is thus $1 - \exp(-\lambda T)$. This technique is the precursor to the reduced form approach (De Spiegeleer & Schoutens, 2011). Given any value of λ the survival probabilities of CoCos may be calculated and their prices determined. If a default occurs the bondholder should want to recover at least part of the face value N of the bond, otherwise referred to as the recovery rate, R . Upon a default occurring an investor's total loss is equal to $(1 - R) \times N$.

Equation 1 explains the correlation of the credit spread, cs , recovery rate, R , and default intensity, λ :

$$cs = (1 - R) \times \lambda. \quad (1)$$

This credit spread is a combination of the percentage loss $(1 - R)$ and the probability of the loss occurring, λ . In order to measure the trigger event where the loss-absorption mechanism is triggered one has to employ a strategy similar to the way a default is statistically modelled in credit models. A CoCo trigger occurring would be modelled as a form of "default" event. The default intensity λ will accordingly be substituted by trigger intensity $\lambda_{trigger}$. The probability of a CoCo being triggered is higher than the probability that a bank will default on its outstanding corporate bonds. The CoCo will in all likelihood trigger before default takes place. Thus:

$$\lambda_{trigger} > \lambda. \quad (2)$$

From Equation 1, the credit spread value on CoCos may be determined:

$$cs_{CoCo} = (1 - R_{CoCo}) \times \lambda_{trigger}. \quad (3)$$

2.4.2 Loss

The conversion type and price drives the loss suffered by the holder of a CoCo when it is triggered.

$$Loss_{CoCo} = N - C_r S^* = N \left(1 - \frac{S^*}{C_p} \right) = N(1 - R_{CoCo}). \quad (4)$$

The share price momentarily after conversion of the CoCo is S^* . The recovery rate of the CoCo holder after a trigger is thus represented by the ratio of the converted share price S^* and the conversion price C_p :

$$R_{CoCo} = \frac{S^*}{C_p}. \quad (5)$$

This illustrates the correlation between the conversion share price and the valuation of the CoCo. Should a conversion price S^* be equal to the share price of the bank at the instance of the trigger, there is no loss for the investor. Thus, an investor becomes a shareholder when the CoCo is triggered with total value of the shares being equal to the face value N .

2.4.3 Trigger Intensity ($\lambda_{trigger}$)

The probability that a trigger occurs in the time interval $[t, t + dt]$, while not being triggered up to t is given by $\lambda_{trigger}dt$. To save a financial institution from default the CoCo-conversion has to occur before the default time t . This implies that the intensity parameter of conversion ($\lambda_{trigger}$) must be greater than the default intensity parameter, i.e. $\lambda_{trigger} \geq \lambda$ (Brandt & Hermansson, 2013). This implies that the CoCo-trigger event t^* always occurs before the default time t (so $p(t^* < t) = 1$). This should hold true as it is to no use for the bank should the bank default before the CoCo is triggered. A trigger could be an accounting based, market based or dependent upon a mechanical rule.

As an example of an accounting based trigger, a CoCo can be triggered when the bank announces it has insufficient Core Tier 1 capital. Modelling regulatory behaviour is however, as pointed out by De Spiegeleer & Schoutens (2011), an impossible task, and the same difficult challenge holds when trying to engineer a stochastic model for an accounting measure based on capital ratios. Instead of building a model which directly models an accounting or a regulatory trigger, we could associate a corresponding market trigger as a proxy indicator for these events. Thus, an accounting trigger where a Core Tier 1 ratio falls to below a minimum level, could be substituted with a similar event which would cause the share price to drop below a barrier S^* , given that the accounting trigger was likely to have triggered in any case for the given level of S^* (De Spiegeleer & Schoutens, 2011). The way in which a market trigger S^* is connected to an accounting trigger is illustrated in Figure 2.7, assuming an accounting trigger of 6% Core Tier 1 capital with a corresponding trigger share price of 160.

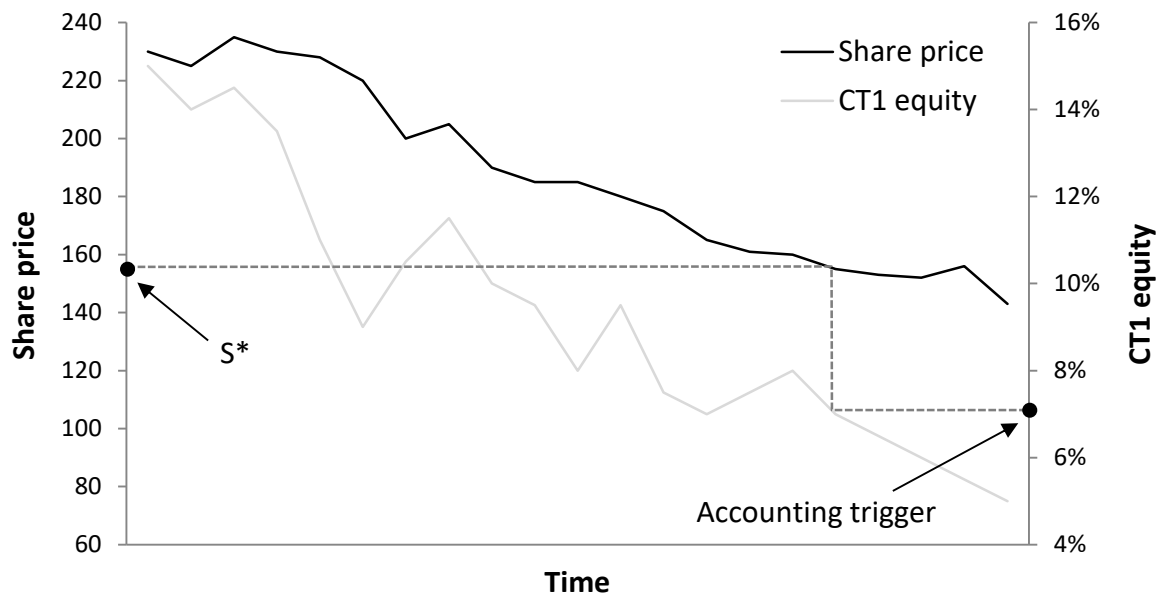


Figure 2.7: Accounting trigger and associated market trigger S^* .

Source: *Author calculations.*

Borrowing from the Black and Scholes equity derivative pricing formula, the probability p^* of the level being breached during the life T of the CoCo is as follows (Lujing & Rieger, 2009):

$$p^* = N\left(\frac{\log\left(\frac{S^*}{S}\right) - \mu T}{\sigma\sqrt{T}}\right) + \left(\frac{S^*}{S}\right)^{\frac{2\mu}{\sigma^2}} \cdot N\left(\frac{\log\left(\frac{S^*}{S}\right) + \mu T}{\sigma\sqrt{T}}\right), \quad (6)$$

where:

- $\mu = r - q - \frac{\sigma^2}{2}$ is the drift rate;
- q is the continuous dividend yield;
- r is the continuous interest rate;
- σ is the volatility;
- T is the maturity of the CoCo; and
- S is the current share price.

This is similar to the first exit time equation which is used in barrier option pricing under Black- Scholes and is used to derive the probability that a stock price S may touch the level S^* before the expiration of the bond T years from now. $N(x)$ denotes the probability of a random variable X , which is following a standard normal distribution, taking a value smaller than x :

$$N(x) = Pr(X \leq x). \quad (7)$$

In Equation 6, p^* quantifies the probability of the trigger occurring.

From p^* , $\lambda_{trigger}$ may be calculated:

$$\lambda_{Trigger} = -\frac{\log(1 - p^*)}{T}. \quad (8)$$

This gives the CoCo spread (cs_{CoCo}):¹⁴

$$cs_{CoCo} = -\frac{\log(1 - p^*)}{T} \times \left(1 - \frac{S^*}{C_p}\right). \quad (9)$$

To illustrate the spread calculation, consider a CoCo in the primary market, with a single regulatory trigger and a 10-year maturity. It is assumed that the continuous interest rate (r) is 4%, the underlying share price is R150, the share has an annual volatility (σ) of 30% and does not pay any dividends ($q = 0$). An assumption is made that the activation of the trigger accompanies a share price equal to half the current share price $S^* = R75$. The three steps in Table 1 indicate the process of calculating the credit spread under this assumption.

¹⁴ This credit spread is a continuous interest rate which needs to be scaled back to the yield and day count convention on the bond (De Spiegeleer & Schoutens, 2011).

Table 2.1: Calculation of credit spread.

Step	Operation	Equation	Equation
1	Probability of hitting trigger	6	$p^* = 48.3\%$
2	Trigger intensity	8	$\lambda_{trigger} = -\frac{\log(1 - 0.483)}{10} = 6.6\%$
3	Recovery	5	$R_{CoCo} = \frac{75}{150} = 50\%$

Source: *Author calculations.*

Thus, $cs_{CoCo} = 6.6\% \times 50\% = 330\text{bps}$. When this spread is included in the continuous interest rate (400bps + 330bps) the total yield on this CoCo becomes 7.3%.

2.4.4 CoCo Delta (Δ)

To build on the previous example, the yield of 7.3% calculated on the CoCo is a function of the stock price of the CoCo. An investor will require a higher credit spread (cs_{CoCo}) if the share price (S) decreases as this implies a greater probability (p^*) that the trigger event may realise (the trigger share price is inherently lower than the share price of a CoCo), prompting the higher spread demand due to this risk. Subsequently the CoCo also becomes less attractive as the price decreases. This may be illustrated as follows:

$$\frac{\partial cs_{CoCo}}{\partial S} < 0. \quad (10)$$

Thus, the CoCo exhibits a positive delta:

$$\Delta = \frac{\partial P}{\partial S} > 0. \quad (11)$$

To illustrate the observation above, assume for example that the share price level around which a CoCo is expected to get triggered does not change, but that the share price of the CoCo (S) suffers a drop in price of 10%, from R150 to R135. A conversion is more likely since S is now closer to S^* . In this case the CoCo spread (cs_{CoCo}) moves from 330 to 403bps. The sensitivity of cs_{CoCo} to the underlying share price is given in Figure 2.8.

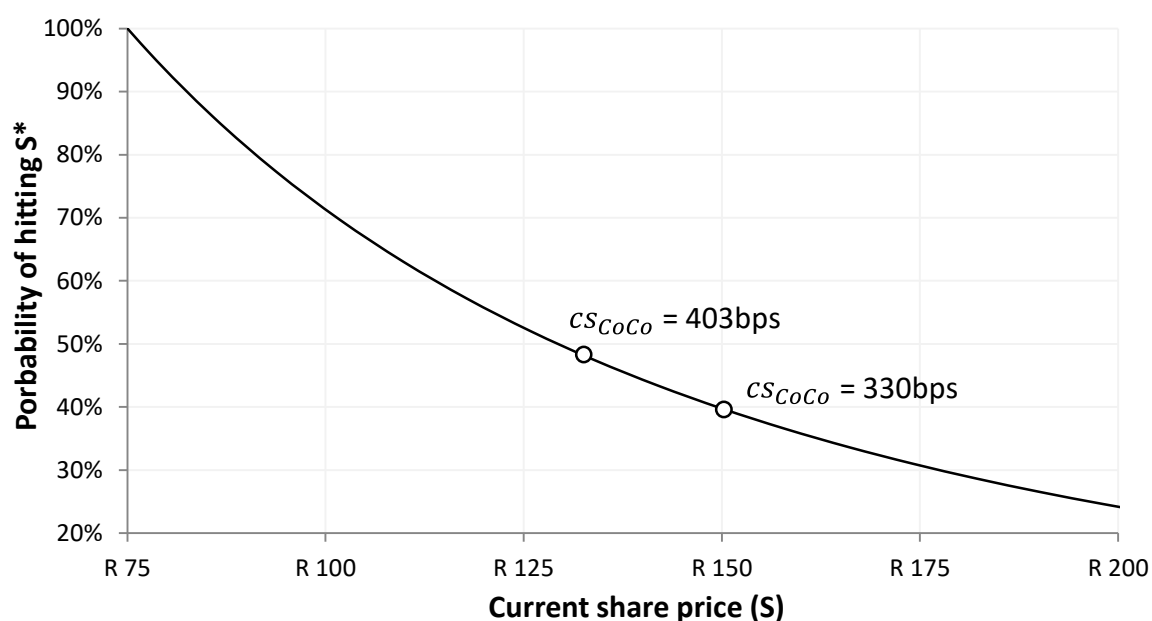


Figure 2.8: Probability p^* of hitting the trigger level S^* for different share prices.

Source: *Author calculations.*

2.5 Results and discussion

The parameters presented in Table 2.2 were used as input into the CoCo pricing model, each applicable to the country in which it resides, with the interest rate used being the prime lending rate as determined by the central bank of each country.

Table 2.2: Input parameters used in the CoCo pricing model.

Variable	South Africa (JSE ALSI)	Egypt (EGX 30)	Nigeria (ALSI)	All Africa (S&P all Africa index)
Dividend yield	2.2%	3.2%	7.8%	5.0%
Interest rate	9.0%	11.6%	17.2%	22%
Annual share volatility	18%	14%	16%	18%
CoCo maturity (years)	5.0			
Trigger share price	25			
C_p	50			

Source: *Author calculations.*

The results from the pricing model are illustrated graphically in Figures 2.9 through 2.12. The trigger probability, trigger intensity, credit spread and bond yield are individually displayed (y-axis) in conjunction with the share price (x-axis) and equity volatility (z-axis). The figures provide an illustration of how these variables change as the share price of the underlying equity approaches the trigger share price (R27 – see Table 2.2) on the x-axes, under different volatilities on the z-axes.

2.5.1 Trigger probability

The trigger probability of the CoCo responds as expected. As the share price approaches the trigger level of R26 in Figure 2.9 (plotted with decreasing share prices on the x -axis) the probability of the trigger being breached increases. Furthermore, as volatility in a market increases the trigger probability also increases at all share price levels. For South African data, the probability that the CoCo trigger is breached at a share price of R34 is 0% when volatility is 10% and increases to 63% when volatility is 30% for the same share price. The same is evident in the Egyptian data where the probability that the CoCo trigger is breached at a share price of R34 is close to 0% when volatility is 10% and increases to 60% when volatility is 30% for the same share price. The trigger probability is lower at all share price levels in the Egyptian market when compared to the South African market mostly because the Egyptian market is less volatile than the South African market.

At a share price of R30 and volatility of 10% the trigger probability in South Africa is the highest, followed by Egypt, Nigeria and finally all Africa. The trigger probability in the South African market is thus more sensitive to a change in share price relative to other regions.

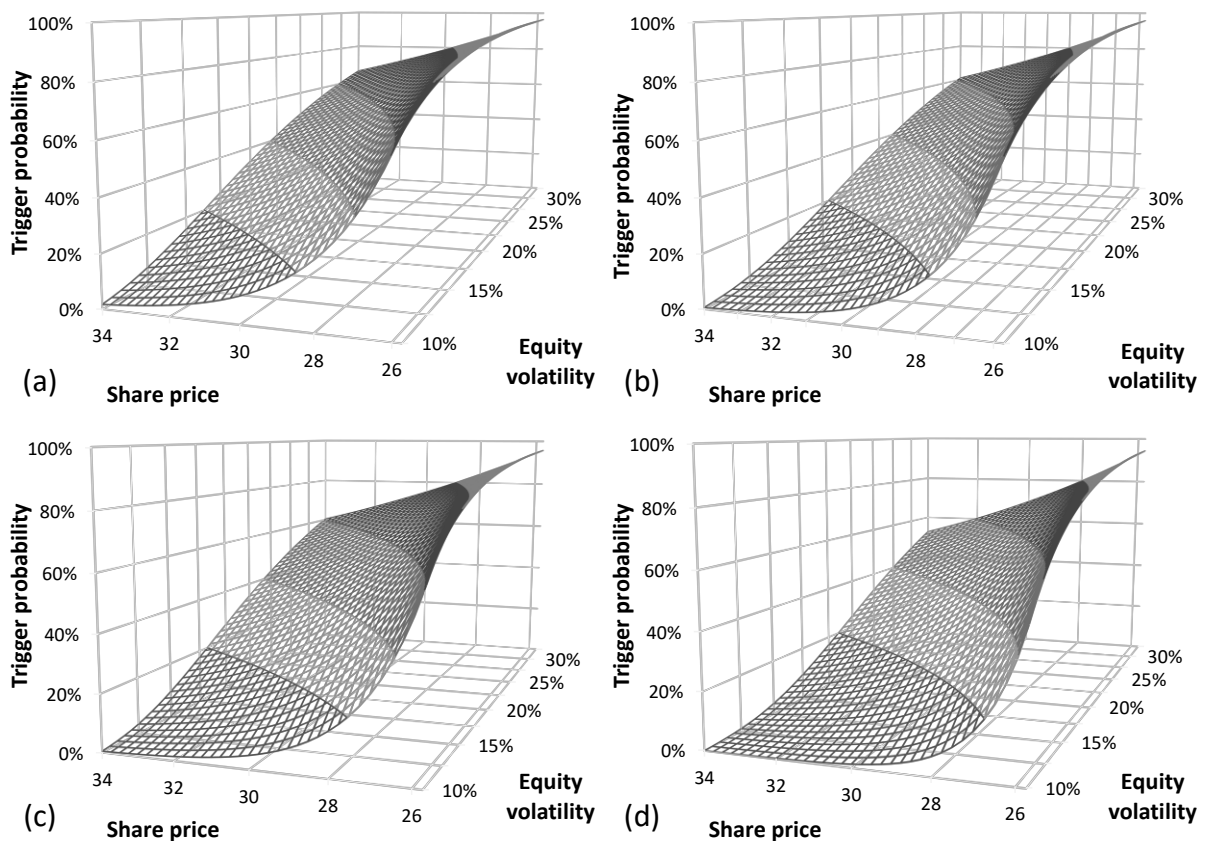


Figure 2.9: Trigger probability at various share prices for (a) South Africa (b) Egypt, (c) Nigeria and (d) all Africa.

Source: *Author calculations.*

2.5.2 Credit spread

The credit spread of the CoCo increases as the share price approaches the trigger share price as investors require a higher yield on the CoCo when conversion becomes more probable (Figure 2.10). The volatility in the stock market also has a dramatic impact on the credit spread and in stressed economic scenarios, represented by the 30% volatilities in the graphs, the credit spread reaches levels of more than 100 basis points for South Africa and close to 100 basis points for Egypt and Nigeria when the share price is at R34 and relatively far removed from the R26 trigger share price. This coincides with the notion that the trigger probability is higher when the share price approaches the trigger share price, as shown in Figure 2.9.

Between a share price of R28 and R30 (volatility at 10%) the South African market has a larger reaction in terms of the credit spread as the share price approaches the trigger price relative to other regions.

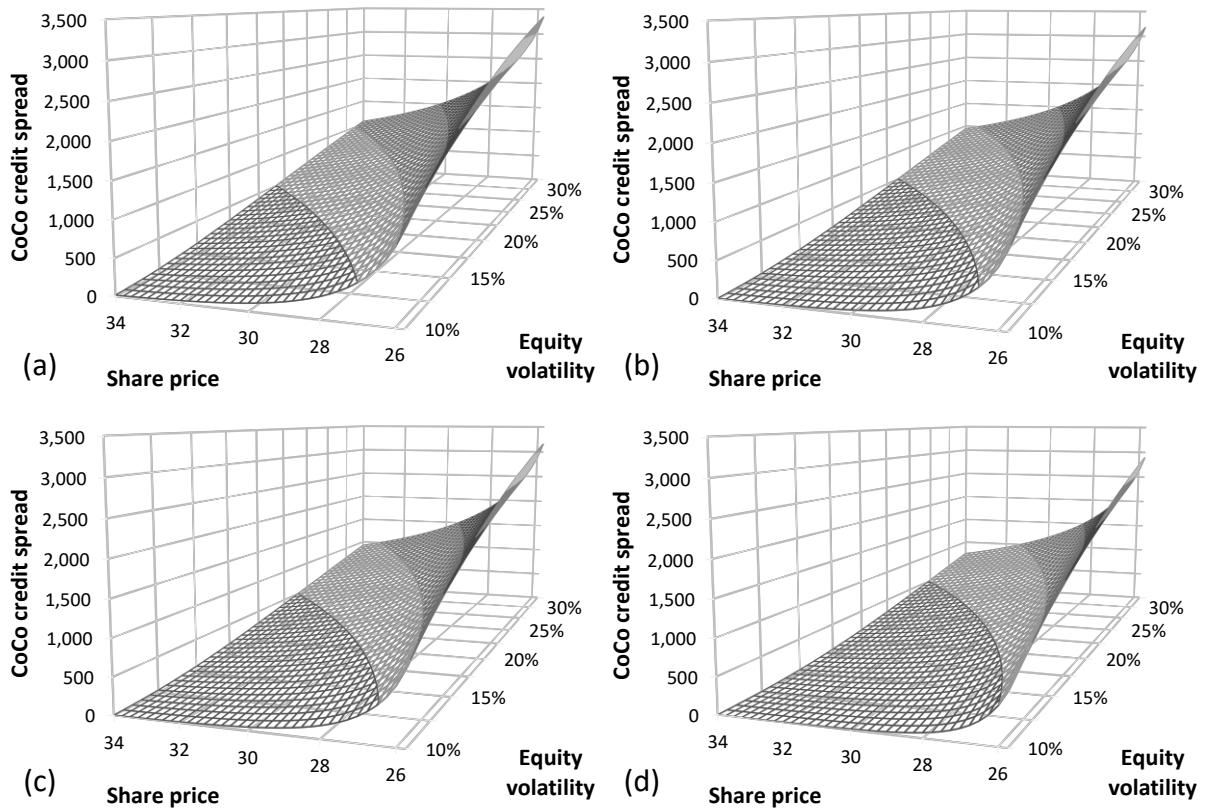


Figure 2.10: Coco spread at various share prices for (a) South Africa (b) Egypt, (c) Nigeria and (d) all Africa.

Source: *Author calculations.*

2.5.3 Trigger intensity

The trigger intensity is calculated using (8), i.e. $\lambda_{trigger} = -\frac{\log(1-p^*)}{T}$ where p^* is the probability of the trigger occurring. The trigger intensity increases as the share price approaches the trigger share price

(Figure 2.11). Furthermore, volatility has a profound impact on the trigger intensity as the trigger intensity is 68% in South Africa, 62% in Egypt, 61% in Nigeria and 59% in all Africa at a share price of R26 under a volatility of 30%. The behaviour of the trigger intensity under simulated conditions infers that special attention is to be paid with this metric in African markets, especially in times of high volatility, which is a historic feature of said markets.

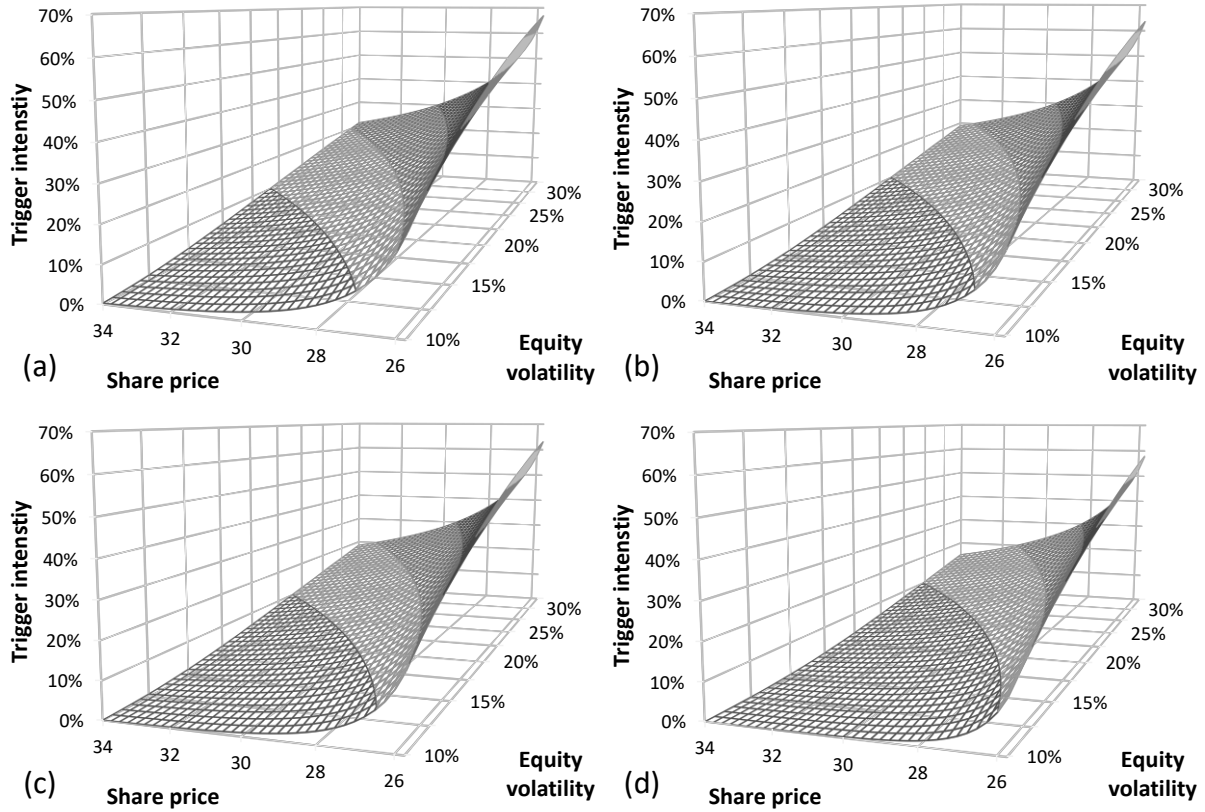


Figure 2.11: Trigger intensity at various share prices for (a) South Africa (b) Egypt, (c) Nigeria and (d) all Africa.

Source: *Author calculations.*

2.5.4 Total yield

The total yield of the CoCos can be interpreted in the same way as the credit spread in Figure 2.10, and although there are differences in the graphical presentation, trends are coherent (Figure 2.12). The total yield on a CoCo will increase as the share price approaches the trigger share price because the probability that the CoCo will trigger also increases under this share price movement (Figure 2.9). The risk-return reward for the CoCo investor in a situation where the CoCo is close to the trigger price will be the higher total yield. To further emphasise the risk-return reward note that in Figure 2.10 that the total yield of a CoCo also increases as the volatility in the market increases, even at constant share prices.

An increase in market volatility will also lead to a situation where a CoCo trigger becomes more probable (as is evident in Figure 2.9 and the discussion thereof) and this supports the theory that a higher trigger probability will result in a higher total yield for the investor of a CoCo.

The behaviour of the total yield in South Africa shows that the lowest total CoCo yield (9%) is expected at a share price of R34 and volatility at 10%, with Egypt a close second at 11%. Under the same market conditions, a CoCo in Nigeria and all Africa will demand 18% return, i.e. substantially higher. The same phenomenon occurs at the trigger share price of R26 when volatility is 30%. South Africa and Egypt will demand 41% and 43% respectively with Nigeria and all Africa demanding 49% and 48% respectively.

In times of low volatility and a share price far from the trigger, investors could expect double the total yield from Nigerian CoCos than what is offered by South African CoCos (9% versus 18%) though this is largely a contribution from local interest rates. However, in times of high volatility with the share price close to the trigger point, the CoCos are proportionately closer with the Nigerian CoCo only offering 19.5% more in total yield (41% versus 49%). Thus, a shift towards the trigger price, combined with amplified volatility results in a convergence in the amount of total yield that one African CoCo offers above another.

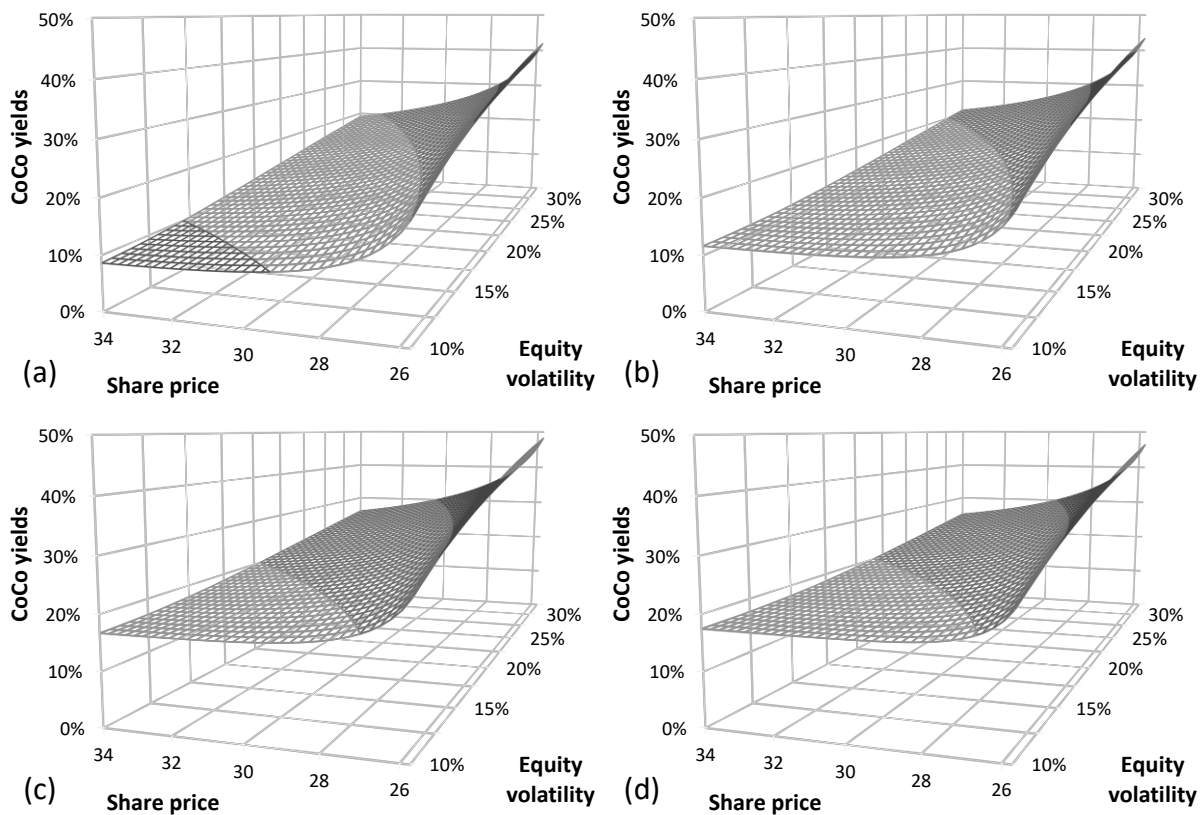


Figure 2.12: Total yield at various share prices for (a) SA (b) Egypt, (c) Nigeria and (d) all Africa.

Source: *Author calculations.*

2.6 Conclusions

The BCBS have set out to rectify the failures of the Basel II accord through the new Basel III set of regulations. The amount of capital has been under Basel II and still is under Basel III a focus area and is pivotal in the management of risks in the banking world. To extend on the amount of capital required by regulation the type of capital is an equally important discussion and influences the business case of banks in many ways, including liquidity and return on capital. The ideal capital from a bank's point of view may be a form of security which produces the highest possible return whereas the regulatory authorities are more concerned with the robustness and liquidity of said asset. This provides a unique challenge where regulators set the rules of the game and banks set out playing within these rules while trying to maximise their advantage.

The success of Basel III regulation lies in the adoption thereof, with banks in both developed and developing countries facing unique difficulties in the implementation process which is often attributable to external economic factors from the markets in which they operate. Banking institutions in developing economies tend to be more volatile and certainly more fragile as is evident from the sovereign debt crisis in Greece. African banks are largely either subsidiaries of larger banks in developing nations or are independent banks which used standardised risk management and are heavily correlated to the performance of the economies in which they function. On the contrary, however, South African banks have shown to be resilient in stressed economic conditions as is evidenced by the stable performance of the top four South African banks during the 2008 financial crisis. It still makes sense that, in the overall case for African banks, the type of capital held by banks is critical, both to the success of the bank's business case as well as the survival of the bank in stressed economic conditions.

African banks pose a unique set of attributes in terms of their size, correlation to the market performance of the economies in which they operate and also because of the higher volatilities experienced in the markets in which they operate. This adds to the challenge of designing CoCos in a unique way which would render them to remain robust from the investor's point of view but also be loss absorbing in times of economic stress from the bank's point of view. The trigger mechanism of CoCos should be effective in the sense that these bonds should be triggered while the bank is still a going concern. This poses a challenge, as markets can move rapidly in volatile times. The pricing of African CoCos would require a trigger mechanism higher than would be normally set in a similar CoCo in a developed economy (such as the US or UK) and would offer a substantial yield due to the large impact that the volatility of the African markets has on the pricing of the CoCo. The high volatility in the African markets could result in CoCos that are very expensive to issue due to the high-risk present in the African markets. As such, alternative structures to CoCos (as proposed in Chapter 4) should be considered for the African market.

The BCBS needs to be clearer on the exact composition of acceptable CoCos and continue on the investigation of CoCos as a possibility for Tier 1 capital in banks, especially in developing economies.

Furthermore, in addition to the pricing of CoCos further investigation is warranted into the structure of CoCos in African markets, specifically pertaining to the type of trigger and conversion mechanism. The case for Call Option Enhanced Reverse Convertibles (COERCS) may also be investigated as this type of CoCo may be more suited to African markets.

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Chapter 3

Contingent convertible bonds as countercyclical capital measures

Contingent convertible bonds as countercyclical capital measures

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Abstract

The procyclical nature of capital models under the Basel II accord has been widely criticised for exacerbating lending in economic expansions and restricting lending during economic contractions. These criticisms have led regulators to employ countercyclical measures in subsequent Basel accords. One of these measures, the Countercyclical Capital Buffer, has been proposed as an effective *countercyclical* measure in expansionary periods as a deterrent to excessive lending through increased bank capital requirements. The effectiveness of this measure during contractions, however, is less obvious. Contingent Convertible (CoCo) bonds – which are bond-like until triggered by a deterioration of a prescribed capital metric, at which point they convert into a form of equity – are explored as a supplementary countercyclical capital measure for such periods.

Keywords: Contingent convertibles, CoCos, procyclicality, Basel III

JEL classification: C134, C16, C53

3.1 Introduction

The credit crisis which disrupted the global economy in the latter part of 2007 had its roots nested in complex financial instruments (particularly derivative instruments) which inflated asset prices to levels which were far higher than their historic trends. These instruments behaved in complex ways and were riskier than believed at the time (Baily *et al.*, 2008). The risk mitigation techniques that were consequently employed were ineffective, leading to the large-scale collapse of the global financial system once these hidden risks materialised (G20, 2009).

The first internationally recognised company to fall victim to the crisis was the American bank Lehman Brothers which filed for a Chapter 11 bankruptcy on 15 September 2008 (De Haas & van Horen, 2012). The systemic contagion precipitated by Lehman's collapse became manifest in a conservative view of lending, including the widespread avoidance of securitised products and the severe reduction of credit (both consumer and commercial). These effects were largely due to the pro-cyclical nature of capital requirements at the time (Nikolov, 2010). If an economic indicator thus increases when the economy exhibits economic growth, it is deemed a procyclical indicator, and is used as a metric to measure procyclicality. Credit losses suffered by banks during the credit crisis were higher than those experienced during economic expansions, evidence that the inherent procyclical nature of risk management models may amplify losses during economic downturns (BCBS, 2010b; van Vuuren, 2012). Heid (2003) described the exacerbation of bank losses in economic downturns as diminished lending capacities ac-

accompanied by increases in risk weighted assets, a combination which significantly reduces bank's capital ratios.¹⁵ This effectively portrays the inherent pro-cyclicality of capital measures under Basel II (BCBS, 2010b).

The effect of the procyclicality in the broader economic environment meant that the majority of banks also suffered under the economic environment that the reaction created, especially in terms of lending, and this placed pressure on the other parts of economies globally as bank lending dried up in the economic downturn (de Haas & van Horen, 2012). Following on the heels of the credit crisis, the European sovereign solvency crisis occurred in 2010. The European Union initiated fiscal relief (a sovereign bailout for Greece) indicating that capital levels were insufficient (Sorkin, 2010). South Africa absorbed the effects of the crisis relatively well compared with other developing economy peers, due in large part to prudent risk management (Maredza & Ikhude, 2013). The robustness of the South African economy is evident in the fact that all South African banks survived the crisis while many global banks required sovereign bailouts (SA National Treasury, 2011). Despite these prudent risk management policies, the country still slid into the first recession in 17 years in 2009 (SARB, 2011).

In response to the credit crisis and the liquidity crisis that ensued due to diminished capital, the Bank for International Settlements (BIS) implemented a number of amendments to the then-existing Basel II accord (BCBS, 2006) with an updated set of regulations, called Basel III (BCBS, 2011b). The phased implementation of the new Basel III regulation began in 2013 and is at this stage (2016) expected to be fully implemented by 2019. The principal aim of Basel III is for better quality, consistency and transparency of Tier 1 capital (BCBS, 2010a), but it also introduces measures which increase the robustness of banking legislation including a reconstitution of the composition of acceptable regulatory capital, enhanced capital levels for aspects of the trading book and the introduction of new concepts such as the leverage ratio and a number of capital buffers which increase the capital ratio from 8.0% to 10.5% (and, under certain specified conditions to 13%) (BCBS, 2011b). A specific inclusion of Basel III – the countercyclical capital buffer (CCB) – is the proposed countercyclical capital measure which can increase the capital ratio to 13.0%. The CCB works principally at the peak of an economic cycle – i.e. it is effective at reducing excessive credit extension, but it is yet to be tested in real-world scenarios (van Vuuren, 2012) and as such it may not be as effective at releasing capital back into economy (i.e. it may not effectively encourage lending in economic cycle troughs), hence the potential need for additional countercyclical measures.

One such countercyclical measure is CoCos, which converts into common equity in severely stressed economic conditions and may prove to be a good addition to be used in conjunction with the CCB.¹⁶

¹⁵ The capital ratio of a bank is obtained via the quotient of the Core Equity Tier 1 (CET1) capital and the bank's total risk weighted assets (RWA). The CET1 capital ratio diminishes when the denominator (RWA) rises, largely because of a rise in the default probability of outstanding loans (a deterministic of the RWA).

¹⁶ These bonds can potentially also suffer a partial or full write-down on the par value.

CoCos are thus effective loss-absorbing financial instruments which function as a mechanism for bank recapitalisation in times of economic stress (De Spiegeleer & Schoutens, 2011) and have been proposed for use in banks (Pennacchi *et al.*, 2011) as loss-absorbing instruments. Despite these useful characteristics, these bonds have been overlooked as a source of countercyclical capital and as such CoCos are the main focus of this paper.

The paper proceeds as follows: Section 3.2 interrogates the literature regarding economic pro-cyclical-ity, its origins and implications on a global scale as well as in the South African market. The BCBS's choice of pro-cyclical measure, the CCB, is further explored as a countercyclical capital measure in times of economic expansion. CoCos are also discussed as a countercyclical capital measure with a particular focus on the behaviour of CoCos upon conversion in economic contractions. CoCo properties (such as trigger mechanisms and conversion details) are discussed as well as specific examples currently (2016) in issue.

Section 3.3 introduces and discusses the Hodrick-Prescott (HP) filter, assesses its relevance and applicability to financial data and points out the pros and cons of its use and also explores the equity derivative pricing model of CoCoS. The HP filter is then applied to historical South African data to identify economic downturns and establish capital levels required had the CCB been implemented at those times. A simulation of CoCo triggers in the 2007 financial crisis is produced along with the resulted increase in common equity Tier 1 (CET1) capital of the four main South African banks due to the conversions. The results of the calculations are analysed and presented in Section 3.4. Section 3.5 concludes.

3.2 Literature study

3.2.1. Procyclicality

The complex nature of financial market securities resulted in a severe test for risk managers as well as the Basel II accord during the 2007 credit crisis (Merrouche & Nier, 2010). A leading catalyst of the credit crisis was the Chapter 11 bankruptcy filing of Lehman Brothers. The pro-cyclical nature of capital requirements at the time resulted in the considerable reduction of bank lending. The associated capital reduction and contagion effects left banks without the means to raise additional capital, and governments, regulators, central banks and quantitative models at the core of risk management were blamed for the crisis (US Financial Crisis Inquiry Commission, 2010).

South African Banks proved to be resilient in the financial crisis largely due to two factors.¹⁷ Firstly, the credit crisis erupted as a result of the securitisation of sub-prime mortgages (Peicuti, 2013). These securities were sold to investors with the assurance of accurate ratings from global credit rating agen-

¹⁷ The South African capital requirements in the 2008/9 financial crisis were not the saving grace of local banks and may not be sufficient in the future. Better quality capital may prove to be extremely helpful in the future.

cies. Banks in South Africa were not able to purchase these grouped loans due to tight banking regulations, and the implementation of the National Credit Act No. 34 of 2005 (NCA) (Maredza & Ikhide, 2013). The NCA introduced prudent financial legislation shortly before the crisis (Gauteng Provincial Treasury, December 2012). South Africa has, as a result, not yet experienced a full financial crisis, but rather periods of financial distress.

Secondly, the resilience of South African banks is linked directly to sound profitability, low leverage ratios, limited exposure to foreign assets and foreign funding as well as adequate levels of capital in times of crisis (Maredza & Ikhide, 2013). In a period where many banks were declared bankrupt globally, all South African banks survived. This earned the South African banking system the reputation for being well developed, well-regulated and sophisticated and therefore ranked among those of first world economies even though South Africa is viewed as a developing economy (SA National Treasury, 2011). In response to the financial crisis, South Africa also employed various monetary policies including an increase in government expenditure of R127bn and a R34bn decrease in tax revenue. This, along unprofitable public companies like Eskom, led to the government funding needs increasing to R285bn in 2009, from R89bn in 2008. Due to the recession, the government saw its budget balance fall from a 0.7% surplus in 2007 to a 5% deficit by 2009. Economic growth recovered to 3.1% in 2010 and prudent fiscal management reduced the government deficit to 4.8% (Gauteng Provincial Treasury, December 2012).

Despite this resilience though, the industry wide recognition of the impact of procyclicality prompted a call for measures to change the procyclical nature prevalent in risk models (Financial Services Authority, 2009). This in turn highlighted the danger of procyclicality and demands a reformed risk measure to be engineered which is inherently countercyclical, thus providing a thicker capital buffer during good times that could be drawn down during crises.

Heid (2003) argues that in economic downturns as maximum lending capacities decrease alongside a rise in risk weighted assets, a shortage in capital arises. Two outputs from risk management models cause this. If assets are perceived to become riskier and this is correlated with business cycles, capital charges suffer large swings, consequently leading to increased volatility in not only the asset prices but also in the linked interest rates. Consequently, this increase in financial sector volatility would naturally spill over into the rest of the economy. Perceived increases in credit risk trigger an increase in banks' credit risk capital, leading to increased cost of money in the economy which is positively correlated with a decrease in investment ultimately causing a further systemic stunt to economic expansion. These combined effects explain the inherent procyclicality of capital measures under Basel II and highlight the need for countercyclical capital measures in the regulatory environment. The procyclicality in the economic environment during the 2007 financial crisis meant that most banks struggled to obtain liquid funds for their lending purposes, and this placed pressure on the other parts of economies globally (De Haas & van Horen, 2012).

The procyclical nature inherent to the internal ratings based (IRB) methodology prescribed in Basel II may potentially be alleviated by using a through-the-cycle (TTC) rating system in financial models. This rating system may decrease the reaction of a lending party's probabilities of default (PDs) to macroeconomic conditions and as such dampen the effect that this has in the calculation of risk weighted assets in the capital ratio of a bank (Catarineu-Rabell, Jackson & Tsomocos, 2003). The study by Catarineu-Rabell *et al.* (2003) found that the TTC method would not reduce procyclicality and as such their conclusion was that Basel II regulation is ineffective at combatting the procyclical nature of lending in times of financial distress. Repullo & Suarez (2008) employed an endogenous, dynamic capital-structure model under the assumption that banks have limited access to capital markets in stressed periods, as was the case in the 2007 credit crisis. They found that Basel II *encouraged* capital buffers to be procyclical in nature. The results from the study also showed that the buffers suggested in times of economic growth would be unable to mitigate the heightened requirements during economic contractions. These effects would in turn also cause a vast reduction in the supply of credit leading to knock-on effects resulting in systemic failure of capital markets as capital dries up.

Various counteractive measures were subsequently employed by the BIS as an addition to, but not replacement of, Basel II rules to supplement existing risk management regulation and address its procyclical flaws. These measures were introduced by the Basel III accord as part of their principal aim of better quality, consistency and transparency of Tier 1 capital (BCBS, 2010a). The CCB, introduced by Basel III, aims to reduce bank capital procyclicality by increasing capital requirements in favourable economic conditions (BCBS, 2010b). CCBs were thus proposed as a measure which would assist in protecting the financial system from systemic risk due to periods of increased credit growth (BIS, 2009).

The CCB is not a regulatory minimum capital requirement under traditional regulation, but rather unencumbered capital more than the normal minimum requirement of the regulation. This is to ensure that this capital will be available to absorb losses in times of economic contraction. Building up this buffer capital is thus a countercyclical measure designed to strengthen the individual bank's treasury, and cumulatively the banks of the entire financial system. It is specifically designed to combat risks which accumulate during economic expansions and is only imposed when the economy is perceived to be "overheating" (BCBS, 2010b).

3.2.2. The CCB

The initial (2013) minimum capital requirement for banks under the Basel III regulation was 8% of the total risk weighted assets (RWA) of the bank of which 4.5% must be common equity Tier 1 (CET1) high quality capital. Basel III also requires that banks maintain a CCB of 2.5% of RWA above the 8% regulatory minimum capital requirement which must comprise entirely of CET1 capital. This additional capital brings the total required capital amount to 10.5%, and implies a confidence level of 99.97%, instead of the 99.90% employed by the previous total minimum requirement of 8% as shown in Figure

3.1 below (BCBS, 2011a). Should a bank fail to sustain this level of capital (10.5%), it will be penalised by the regulator. The distribution of bank earnings will thus be reined in to ensure that buffers accumulate before profits are redistributed, causing negative sentiment amongst shareholders. Lastly, a CCB of up to 2.5% of RWA is imposed, also consisting solely of CET1 capital, should national authorities detect an increase in system-wide risk associated with a specific metric measuring normalised excess aggregate credit growth. This is done to further bolster the banks during economically good times to assist in the rainy days when the economy turns for the worse (BCBS, 2010b).

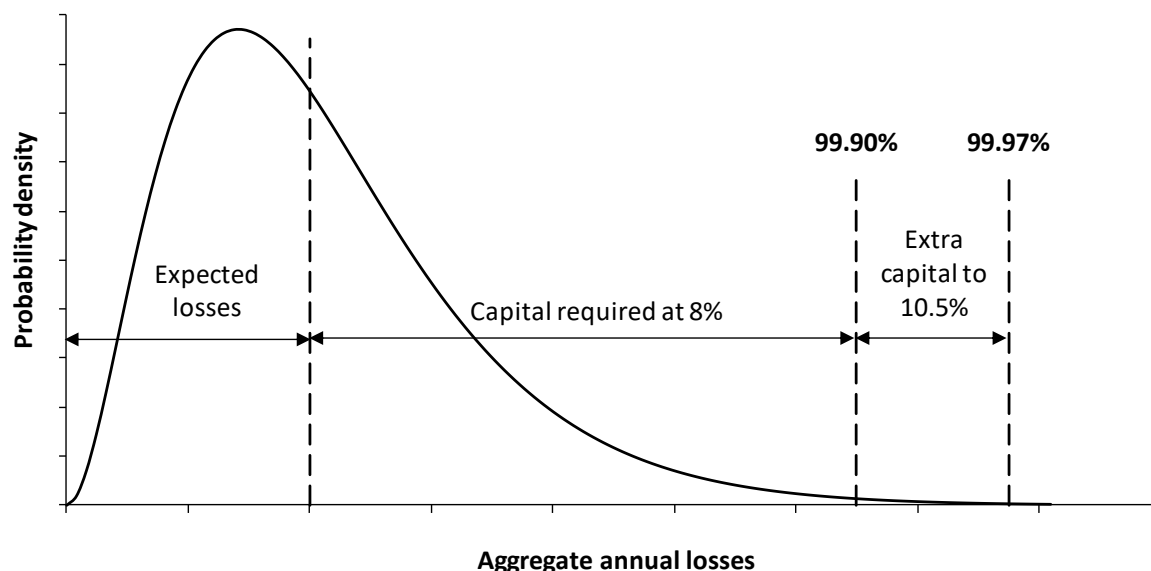


Figure 3.1: The strengthening of the banking sector due to the capital conservation buffer.

Source: *Author calculations.*

The CCB is designed to be deployed on an infrequent basis as the trigger is correlated with aggregate credit growth. Consider Table 1 as an indication of the minimum capital conservation ratios that would be enforced upon banks for respective levels of CET1 capital ratios. To explain these ratios, consider a bank with a CET1 capital ratio of between 5.750% and 6.375%. This bank would be required to conserve at least 60% of its earnings in the next financial year (i.e. pay out no more than 40% in terms of share buybacks, dividends and discretionary bonus payments) to the detriment of current shareholders and investors. Furthermore, should the bank's CET1 ratio fall below 5.125%, no dividend distribution would be permitted. Conversely, if the bank maintained a CET1 ratio of $> 7\%$ there would be no impediments on dividend distribution. The Capital Conservation Ratio (CCR) which banks are required to maintain under the conditional failure to meet minimum CET1 ratios is shown in Table 2 and Figure 3.2.

Minimum capital conservation ratios as % of earnings	CET 1 ratio	CET 1 ratio under countercyclical requirement
100%	4.500% - 5.125%	4.50% - 5.75%
80%	5.125% - 5.750%	5.75% - 7.00%
60%	>5.750% - 6.375%	>7.00% - 8.25%
40%	>6.375% - 7.000%	>8.25% - 9.50%
0%	>7.000%	>9.50%

Table 3.1: Proposed Basel III countercyclical rules implemented in South Africa in 2014 (BCBS, 2015).

Source: *BCBS (2010b)*.

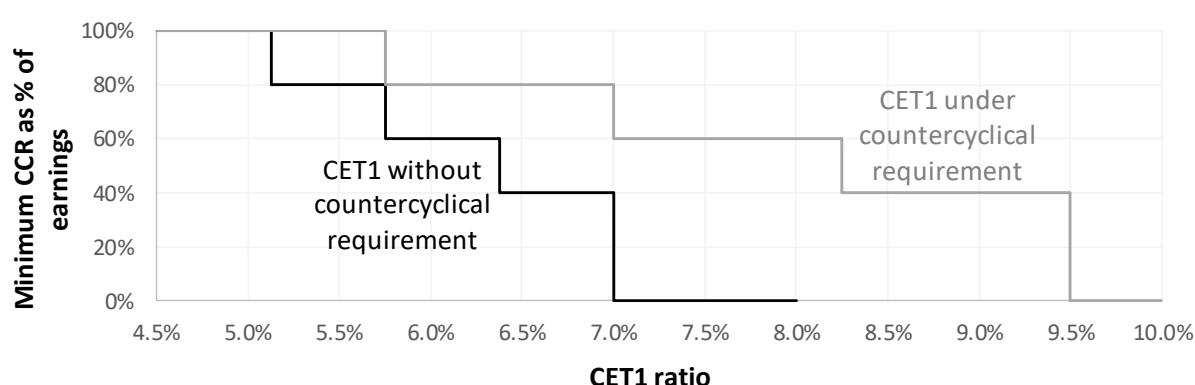


Figure 3.2: Proposed Basel III countercyclical rules.

Source: *BCBS (2010b)*.

For regulators to impose the CCB the economic cycle of a market must first be expressed using an accurate metric which measures the financial cycle. Potential measures of aggregate output and credit growth were explored and found to be the best fit when measuring the state of the financial cycle (Saurina & Trucharte, 2007).¹⁸ The herding behaviour exhibited by the collective banking sector has a substantial influence on aggregate macro indicators, depending on the sectoral market share of the banks in the economy. Thus, individual banks will need to bolster their capital if the CCB measures are imposed even though they may not be directly responsible for the excessive credit in the market. This does offer the advantage that the CCB metric is to some extent resilient to external manipulation by individual banks (Saurina & Trucharte, 2007). The measure proposed by Basel III regulation is the deviation from the long-run trend of the aggregate credit-to-real GDP growth ratio (further referred to in this document as the “credit-to-GDP ratio” and the difference between this ratio and the long-run trend referred to as the “credit-to-GDP gap”). The HP filter is used to fit the long-run trend. Table 2 summarises the proposed Basel III countercyclical capital rules.

¹⁸ Asset prices were also considered to be useful aggregate indicators as they tend to rise strongly ahead of systemic banking crises, but these were eventually abandoned.

Difference between Credit/GDP and long-run trend (d)	Additional regulatory capital	Total capital ratio
$d \leq +2\%$	0%	10.5%
$+2\% < d \leq +10\%$	Increases linearly from 0.0% $\rightarrow$ 2.5%	$+10.5\% < CR < +13.0\%$
$d > +10\%$	2.5%	13.0%

Table 3.2: Proposed Basel III countercyclical rules.

Source: BCBS (2010b).

Note that the last column ('total capital ratio') refers to the capital ratio *after* the full implementation of Basel III as it currently stands (May 2016). The minimum capital ratio of 8% increases under current proposals to 10.5% by 2017 – the extra 2.5% arising from the CCB. The rules presented in Table 3 are shown in Figure 3.3.

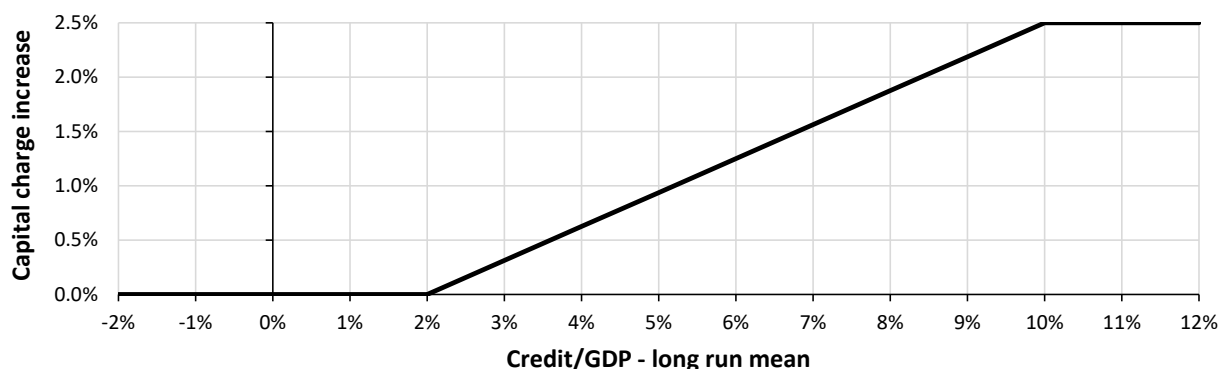


Figure 3.3: The Basel III procyclical capital rules for various credit growth/GDP gap levels.

Source: BCBS (2010b) and author calculations.

The BCBS are proponents of this measure as a mechanism which could solve the problem of an economy expanding in an uncontrolled fashion and has also substantiated these claims through empirical application to financial metrics in developed economies such as the United States and United Kingdom (BCBS, 2010b). This is as yet inconclusive because historic analysis is not a guarantee of future accuracy and also when regulations are applied to smaller, less developed economies (such as South Africa) the model and data face considerably different assumptions and reactions (van Vuuren, 2012). In terms of the CCB, South Africa's banks are in the process of migrating to Basel III compliance and are geared to implement proposed solutions that Basel II offers to combat procyclicality (PWC, 2015).

Procyclicality does not affect an economy solely in times of economic expansion, but also in times of economic distress via the dearth of capital in the banking system. The effects of procyclicality, however, need to be dealt with in times of crisis i.e. when the economy is contracting and as such banks may need another measure in addition to the CCB. CoCos have been proposed as a loss-absorbing capital instru-

ment for use as Tier 1 capital by banks. We propose that CoCos may prove to be useful as countercyclical capital measures in times of economic distress and could be adapted together with the CCB as an additional countercyclical measure improving the quality of capital.

3.2.3. CoCos

CoCos are securities consisting of both an underlying equity and also a fixed income component. These bonds are known to absorb losses by converting into common equity when certain conditions – usually heightened systemic risk – become prevalent (BCBS, 2010a).

CoCos and convertible bonds share many traits, with a few fundamental differences. Similarities include that a convertible bond may be called to convert into a predefined number of the common shares of the issuing bank at the bondholder's decision. This bond is also callable by the issuer, i.e. the bondholder may be required to surrender the bond to the issuing entity for a predetermined price if the issuer exercises their call option (Huang, 2009). Thus, both the bondholder and/or the issuer of the security can determine when the contractual agreement of the bond ceases. Convertible bonds offer higher yields than standard non-convertible bonds because of uncertainty associated with the bond's conversion attribute. Income-only investors may also have mandates to invest solely in financial instruments that generate interest or coupon payments. Convertible bonds have the property of potentially converting to equity and, in most cases, this risk will prevent such income-only investors from investing in convertible bonds, when the yields offered are greater than that of standard bonds (Huang, 2009). Differences include the fact that CoCos are automatically triggered, so their loss-absorbing characteristics (bolstering a bank's capital when the bank suffers when stressed) avoid bondholder sentiment, unlike convertible bonds.

CoCos had a discreet launch into the financial world when the Lloyds banking group offered the holders of some of its hybrid debt a swap where their bonds will be traded for CoCos which had a possible conversion clause to convert into shares in November 2009 (De Spiegeleer & Schoutens, 2011). Credit Suisse soon followed, raising \$2bn in new capital using this new asset class. The Coco market today, however, paints a totally different picture with \$98bn in CoCos in circulation until end 2015 as illustrated in Figure 3.4. CoCos in issuance paid an average coupon of 6.6% at the start of 2016, roughly double the interest payment on senior bank bonds making them attractive to investors (Bloomberg, 2016).

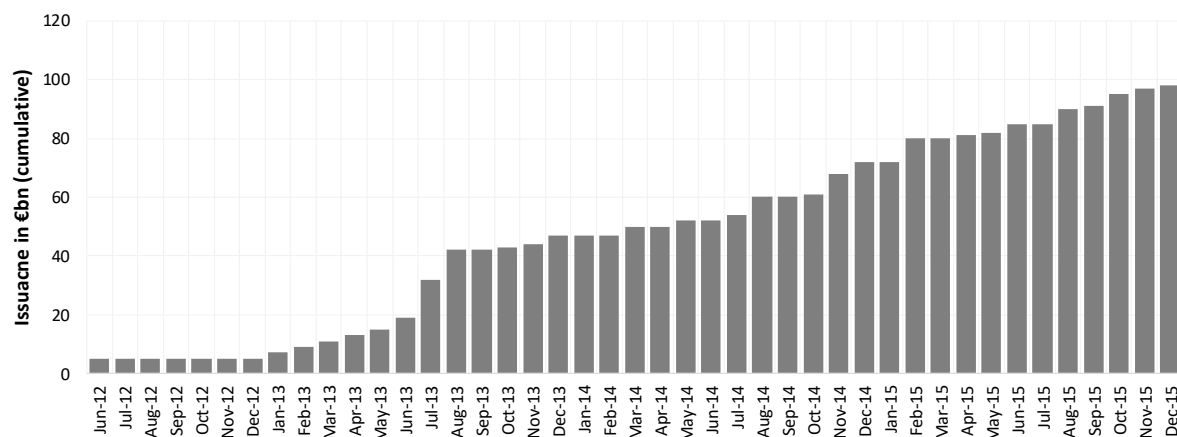


Figure 3.4: Total global CoCos issuance (to end 2015).

Source: *Bloomberg (2016)*.

CoCos have an array of appealing properties from the point of the investor and the issuing bank. Firstly, CoCos have loss-absorbing properties, bolstering a bank's capital when the bank suffers under economically stressed conditions and it is hard for the bank to issue new equity affording CoCos a countercyclical property in times of economic distress. By automatically restructuring the capital of a bank, CoCos reduce the "debt overhang" problem, i.e. the failure of a bank to timeously acquire funds to finance additional loans because a portion of their return accrues to existing debt holders (Chen *et al.*, 2013).¹⁹ It is this property of CoCos that would have rescued many banks during the financial crisis when they were required to issue new equity (Prescott, 2011). Second, CoCos automatically restructure the capital of a bank before bankruptcy, while the bank is still viewed as being a 'going concern' as opposed to a 'gone concern', thereby mitigating the probability of the bank suffering bankruptcy. The Lehman Brothers case provides a concrete example of the impact of perception in guiding the financial market decisions: knowledge of pre-bankruptcy reorganisation of financial institutions (especially a systemically important one) is valuable. Lastly, if a CoCo bond is properly structured, regulators, issuing banks and bondholders can potentially all benefit from a CoCo conversion scenario, as opposed to a single entity taking a loss as the bank may receive additional capital, the existing shareholders making a profit and the bond holder receiving a repayment on the par value of the bond (Pennacchi *et al.*, 2011:16).

CoCos also have a variety of conversion mechanism in addition to equity including cash, or in some instances, a write down on the bond (either partially or completely) may occur. Investors should take care when assuming that returns from a callable convertible bond and a CoCo are comparable. The potential for profit of a CoCo may be limited when compared to a standard convertible bond, depending on the underlying terms, and the full downside may come into play for an investor once the bond is converted to shares (De Spiegeleer & Schoutens, 2011:8). One of the main differences between the

¹⁹ Although the conversion of debt to equity raises the book value of equity, it fails to raise new cash for the bank like a new issuance of equity would (Prescott, 2012).

bonds is the composition of the trigger mechanism inherent in the CoCo, an event that must occur in order for the CoCo bond to be converted into the loss absorption mechanism.

The trigger is specified in the prospectus of the CoCo, and defines the scenario where banks will most likely suffer under financial pressure (De Spiegeleer & Schoutens, 2011). Initial studies by Flannery (2005) suggests that a single trigger mechanism be used. Later studies, however, have suggested the use of more triggers, with CoCos becoming an increasingly important topic post financial crisis (see, Flannery, 2009; Huertas, 2009; Albul *et al.*, 2010; Plosser, 2010; McDonald, 2010; Pennacchi, 2011 and Pennacchi *et al.*, 2011). In the case of a CoCo with more than one trigger, the loss conversion to equity (or write-down) will occur when any or a combination of triggers are breached. Triggers are either modelled on a mechanical rule or on the authority which may be executed by regulators. In the former case, also known as book-value triggers or accounting-value triggers, the trigger mechanism is typically set contractually as the ratio of CET1 to risk-weighted assets, the CET1/RWA ratio. The loss absorption mechanism is activated should the CET1/RWA ratio of the issuing bank fall below a level which was pre-defined with the CoCo issuance. In order for a bank to remain a going concern the trigger mechanism of a CoCo must come into effect before the bank is in trouble regarding its capital.²⁰ The Lloyds Banking Group issued a CoCo in 2009 which illustrates this very nicely.²¹ The CoCo referred to has a 15% semi-annual coupon rate tied to the bond, with a conversion price of £0.59 per share, should the CET1 ratio of the bank falls below 5%. Under Basel III, the minimum CET1/RWA ratio for a CoCo to qualify as Additional Tier 1 capital (AT1 capital: capital which is Tier 1, but not CET1 capital) is 5.125%. Since 2011, issuing banks have set their trigger at that level or at 7% as is illustrated in Table 3 below. This is most likely due to the phasing-in of capital rules by the regulators in the various markets with the triggers set at “current” or “fully loaded” levels (BCBS, 2012).

Bank	Curr	Coupon (%)	Notional (m)	Call	Issue	YTM	Rating	Trigger (%)
EUROPEAN BANKS								
Credit Agricole	USD	6.625	1 250	2019	2014	7.03	BB+	7.000
Credit Agricole	EUR	6.500	1 000	2021	2014	5.92	BB+	7.000
Barclays	EUR	8.000	1 000	2020	2013	7.07	BB+	7.000
Barclays	GBP	7.000	698	2019	2014	7.12	BB+	7.000
Barclays	EUR	6.500	1 077	2019	2014	6.59	BB+	7.000
Barclays	USD	6.625	1 211	2019	2014	7.40	BB+	7.000
Banco Bilbao	EUR	7.000	1 500	2019	2014	6.92	BB	5.125
Banco Bilbao	EUR	6.750	1 500	2020	2015	7.27	BB	5.125
Danske Bank	EUR	5.750	750	2020	2014	5.39	BB+	7.000
Danske Bank	EUR	5.875	750	2022	2015	6.04	BB+	7.000
Deutsche Bank	EUR	6.000	1 750	2022	2014	5.65	BB+	5.125

²⁰ The results explore the need for CoCo triggers to be set at a level which activate when the bank is a going concern with proposals for the African market.

²¹ Specifically, CoCo ISIN XS0459089255.

Deutsche Bank	USD	6.250	1 250	2020	2014	6.69	BB+	5.125
INTNED	USD	6.000	1 000	2020	2015	6.73	BB	7.000
KBC Bank	EUR	5.625	1 400	2019	2014	5.59	BB	5.125
Lloyds	EUR	6.375	750	2020	2014	5.85	BB	7.000
Lloyds	GBP	7.000	1 481	2019	2014	6.93	BB	7.000
Nationwide	GBP	6.875	1 000	2019	2014	6.87	BB+	7.000
Santander Bank	EUR	6.250	1 500	2019	2014	6.32	NR	5.125
Santander Bank	USD	6.375	1 500	2019	2014	7.23	NR	5.125
Santander Bank	EUR	6.250	1 500	2021	2014	6.53	NR	5.125
Societe General	EUR	6.750	1 000	2021	2014	6.34	BB	5.125
Societe General	USD	6.000	1 500	2020	2014	6.74	BB	5.125
UBS	USD	7.125	1 250	2020	2015	7.29	BB+	7.000
UBS	EUR	5.750	1 000	2022	2015	5.71	BB+	5.125
Unicredit Group	EUR	6.750	1 000	2021	2014	6.81	BB-	5.125
ASIAN BANKS								
IAC Bank of China	USD	6.750	6 500	2019	2014	6.80	NR	5.125
IAC Bank of China	USD	6.000	2 940	2019	2014	6.23	NR	5.125
IAC Bank of China	EUR	6.000	600	2021	2014	5.67	NR	5.125
IAC Bank of China	CNH	6.000	12 000	2019	2014	4.85	NR	5.125

Table 3.3: CoCos in issuance in Europe and Asia with additional information pertaining to their trigger mechanisms and yields.

Source: *Bloomberg (2016)*.

The overwhelming majority of CoCos currently in issuance rely on book-value triggers. However, this mechanism has received criticism for being a reactive measure of capital issues and depends on the frequency that banks publish their financial results, thereby raising questions as to internal risk model comparisons (Culp, 2009 and Flannery, 2009). The reporting delay may cause book-value triggers to be activated slower than the rate at which capital is required. The trigger mechanism is also difficult for investors to model as the fundamental information comprising the capital calculation differs widely between banks. History has proven this concern as prominent global banks reported regulatory capital well above the minimum level of 8% when they went bankrupt in the financial crisis (De Spiegeleer & Schoutens, 2011). Figure 3.5 illustrates the CET1 capital levels and the corresponding yields of banks who have issued CoCos with the trend generally showing that investors are rewarded with a higher yield as the CET1 capital levels decrease.

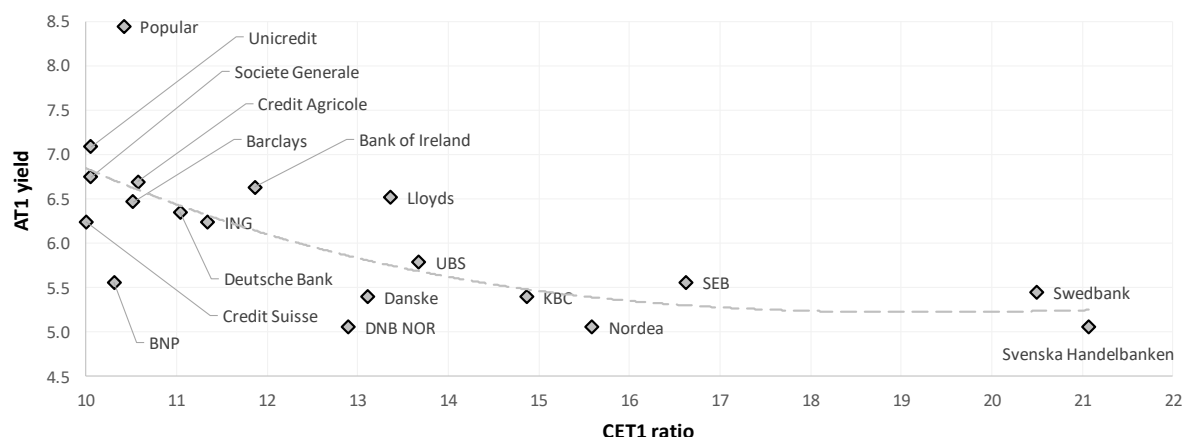


Figure 3.5: CoCo CET1 ratios and associated AT1 yield.

Source: *Author calculations.*

The ideal trigger to use may thus be market-value triggers as these triggers address the shortcoming of inconsistent accounting valuations (Pennacchi *et al.*, 2011, Sundarsen & Wang, 2011 and Calomiris and Herring, 2012). If these trigger-types are priced and composed correctly, the CoCo will convert to the triggered asset class at a given ratio of the bank's stock market capitalisation and/or Credit Default Swap (CDS) spread to its assets (Flannery 2005, 2009). Such a composition reduces the risk of balance sheet manipulation and may also (hopefully) prevent regulatory forbearance (Avdjiev *et al.*, 2013). Market-value triggers, however, may prove to be difficult to price, could suffer from stock price manipulation and has the potential to exhibit multiple equilibria problems (Sundaresen & Wang, 2011).²²

The last trigger type, discretionary triggers (also referred to as point of non-viability, PONV triggers), will activate when regulators deem that it is appropriate to do so (Albul *et al.*, 2012). These CoCos will allow a pre-defined regulator (usually a central bank) the power to trigger the conversion mechanism of said CoCo if and when they view the action as necessary to save the bank. PONV triggers may offer a solution to the time-lag factor of book-value triggers. The problem with a regulator causing a trigger though, is that the market could perceive this to be a blow to the financial stability of the issuing institution.

3.3 Methodology and data

3.3.1. Hodrick-Prescott (HP) filter

The long-run trend of the GDP is used to determine the credit-to-GDP gap of an economy. The best method to derive this trend is the HP filter (Ley, 2006). The HP filter dates to 1980 (Hodrick and Prescott, 1980) as "a metric to measure business cycles", however the academic research was only published in 1997 long after the filter was used globally by practitioners of macroeconomics (Hodrick &

²² See Sundaresan & Wang (2011), Pennacchi *et al* (2011).

Prescott, 1997). Thus, the HP filter was the logical choice for the BCBS to detrend relevant macroeconomic ratio data to produce the information required to assess excessive growth in economies (van Vuuren, 2012).

The HP filter has been criticised academically for various limitations and inadequate properties (Ravn & Uhlig, 2002, van Vuuren, 2012). Canova (1994 & 1998) was a proponent of using the HP filter in estimating business cycles from macroeconomic data where the duration of the trend was between 4 - 6 years, but also had many concerns around the methodology's capability of determining certain key parameter inputs. A series of spurious cycles and distorted estimates of the cyclical component were found by Harvey & Jaeger (1993) when using the HP filter. The authors argued that this property may lead to misleading conclusions specifically pertaining to the relationship between short-term movements in macroeconomic time series data. The measures of persistence, variability and co-movement were found to be changed dramatically when the HP filter was applied to US time series data (King & Rebelo, 1993). Economists have continued to use the HP filter to detrend data which indicate short-term fluctuations when they are superimposed on business cycle-like trends (Ravn & Uhlig, 2002).

The premise on which the HP filter based is that an observable macroeconomic time series (x_t) may be decomposed into its long-run, non-stationary secular trend (τ_t) and a stationary residual, or cyclical, component (c_t) (van Vuuren, 2012):

$$\underbrace{x_t}_{\text{Observed series}} = \underbrace{\tau_t}_{\text{Long-run trend}} + \underbrace{c_t}_{\text{Cycle}} \quad (1)$$

Both the long-run trend and the cycle are impossible to observe directly so these elements are defined somewhat arbitrarily in detrending approaches. Equation 2 indicates how the HP filter extracts the cycle through a standard-penalty program:

$$\min_{\tau_t} \underbrace{\sum_{t=1}^T (x_t - \tau_t)^2}_{\text{Goodness of fit}} + \lambda \cdot \underbrace{\sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2}_{\text{Penalty for deviations}} \quad \lambda > 0 \quad (2)$$

where the parameter, λ , controls the smoothness of the adjusted trend series, $\hat{\tau}_t$, i.e., as $\lambda \rightarrow 0$, the trend estimates the actual series, x_t , while as $\lambda \rightarrow \infty$ the trend becomes linear and the procedure converges to a standard least squares solution. The optimisation procedure in Equation 1 maximises the fit to the trend of the series, i.e. minimise the cycle component c_t by minimising changes in the gradient of the trend τ_t . Both τ_t and c_t are unobservable and since c_t is a stationary process, x_t is a noisy signal for the non-stationary trend τ_t .

In determining the ideal value for λ Hodrick & Prescott (1980) used an exogenous and subjective value of 1 for quarterly data. Backus & Kehoe (1992) however performed more research on the topic and found that adjusting λ based upon the square of the frequency of observations relative to quarterly data yields better results. The relative frequency is three for monthly data and 0.25 for annual data, so the

corresponding λ s are 14 400 and 100, respectively. Further research (e.g. Ravn & Uhlig (2002) and Marcet & Ravn (2003) who derived λ through solving Equation 1 as a constrained minimisation problem) confirm that the values for λ discussed above are still in common use (van Vuuren, 2012). du Toit (2008) did a study to determine the optimal value for λ for South African business cycle. The study found that the optimal smoothing constant was that value of λ that least distorts the frequency information of the time series (in this case, $\lambda = 524$ for quarterly data used to evaluate a business cycle with a frequency of ~ 7 years). The HP filter has been used to explore South African business cycles and estimate long-run output levels (see Woglom, 2003, Kaseeram, Nichola, & Mainardi, 2004, Fedderke & Schaling, 2005 and Burger & Marinkov, 2006). Drehmann, Claudio, Gambacorta, Jimenez, & Trucharte, (2010) found $\lambda = 1600$ and $\lambda = 25\ 000$ performed poorly on historical data whilst $\lambda = 125\ 000$ and $\lambda = 400\ 000$ performed well with quarterly data. The higher value of $\lambda = 400\ 000$ is considered important from a policy perspective as it provides both a greater range and more time when the indicator provides strong and reliable signals (van Vuuren, 2012).

The solution to Equation 2 has been shown by Danthine & Girardin (1989) to be:

$$\hat{\tau} = [I + \lambda \cdot K'K]^{-1}x$$

Where $x = [x_1, \dots, x_T]'$ (i.e. the observed time series), $\tau = [\tau_1, \dots, \tau_T]'$, I is a $T \times T$ identity matrix, and $K = [k_{ij}]$ is a $(T - 2) \times T$ matrix with elements:

$$k_{ij} = \begin{cases} 1 & \text{if } i = j \text{ or } i = j + 2 \\ -2 & \text{if } i = j + 1 \\ 0 & \text{otherwise} \end{cases}$$

which gives

$$K = \begin{pmatrix} 1 & -2 & 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 & \dots & 0 & 0 & 0 \\ 0 & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & \dots & 1 & -2 & 1 \end{pmatrix}$$

The HP filter works to optimise the fit to the data series, but the effectiveness of the filter is dependent on the application on an infinitely long time series. For practical purposes, though, a moderately long series works just as well (Mise *et al.*, 2005), however at the end points the HP filter is demonstrably suboptimal (van Vuuren, 2012). Kaiser & Maravall (1999) applied AutoRegressive Integrated Moving Average (ARIMA) forecasts and backcasts when investigating the end-point problem and found that this considerably improved the performance of the filter. The two-sided, symmetrical HP filter works through applying large symmetrical weights to the end points of the observed values²³ to estimate the

²³ That is, the 2-sided HP filter uses past and future data to estimate the components of (1), so cycle data generated using it could be biased.

corresponding trend value (Ley, 2006) disproportionately distorting the filtered values at the most recent time period (Baxter & King, 1995, Apel, Hansen, & Lindberg, 1996, St-Amant & van Norden, 1997 and van Vuuren, 2012).

Problems linked to the two-sided filter are mitigated by implementing a *single*-sided filter, a technique which uses the standard two-sided HP filter *incrementally* when constructing the long-term trend (van Vuuren, 2012). The long-term trend is estimated by employing only information which is available at the time the calculation was made (Drehmann *et al.*, 2010) and is carried out by running a loop over time and keeping the last value derived from the standard HP-filtered output at each point in time (Mehra, 2006). The BCBS's proposed countercyclical buffer ratio employs the cycle and trend data produced by a one-sided HP filter which may differ vastly from two-sided filtered data. The BCBS could have been clearer in their choice between the one- and two-sided HP filters as in the main document detailing the implementation of the measure, only a footnote discusses this important distinction. This distinction is important, however, as it was conclusively shown to affect the difference between the credit/GDP ratio and its long-run mean (and hence capital charges) significantly (van Vuuren, 2012).

3.3.2. The HP Filter applied to South African data

The data chosen were nominal GDP (monthly) and the credit extended by all South African monetary institutions to the domestic private sector, since 1965. These data are prescribed by the BCBS (BCBS, 2010b) and were downloaded from the South African Reserve Bank. Growth rates as well as the credit growth/GDP ratio was determined from these data. Data from January 1966 were used to calculate the credit growth/GDP growth ratio and its long-run trend and is illustrated in the top graph of Figure 3.6. The rules listed in Table 3.2 and Figure 3.2 were then applied to the South African credit/GDP data to determine what the capital charges *would have been* had the new countercyclical rules been in place historically. The results are shown in the final two graphs in Figure 3.6 for the capital charges using a one-sided HP filter and using the prescribed λ of 14 400. The shaded area in Figure 3.11 indicates the transition period between an economic expansion and the resultant contraction.

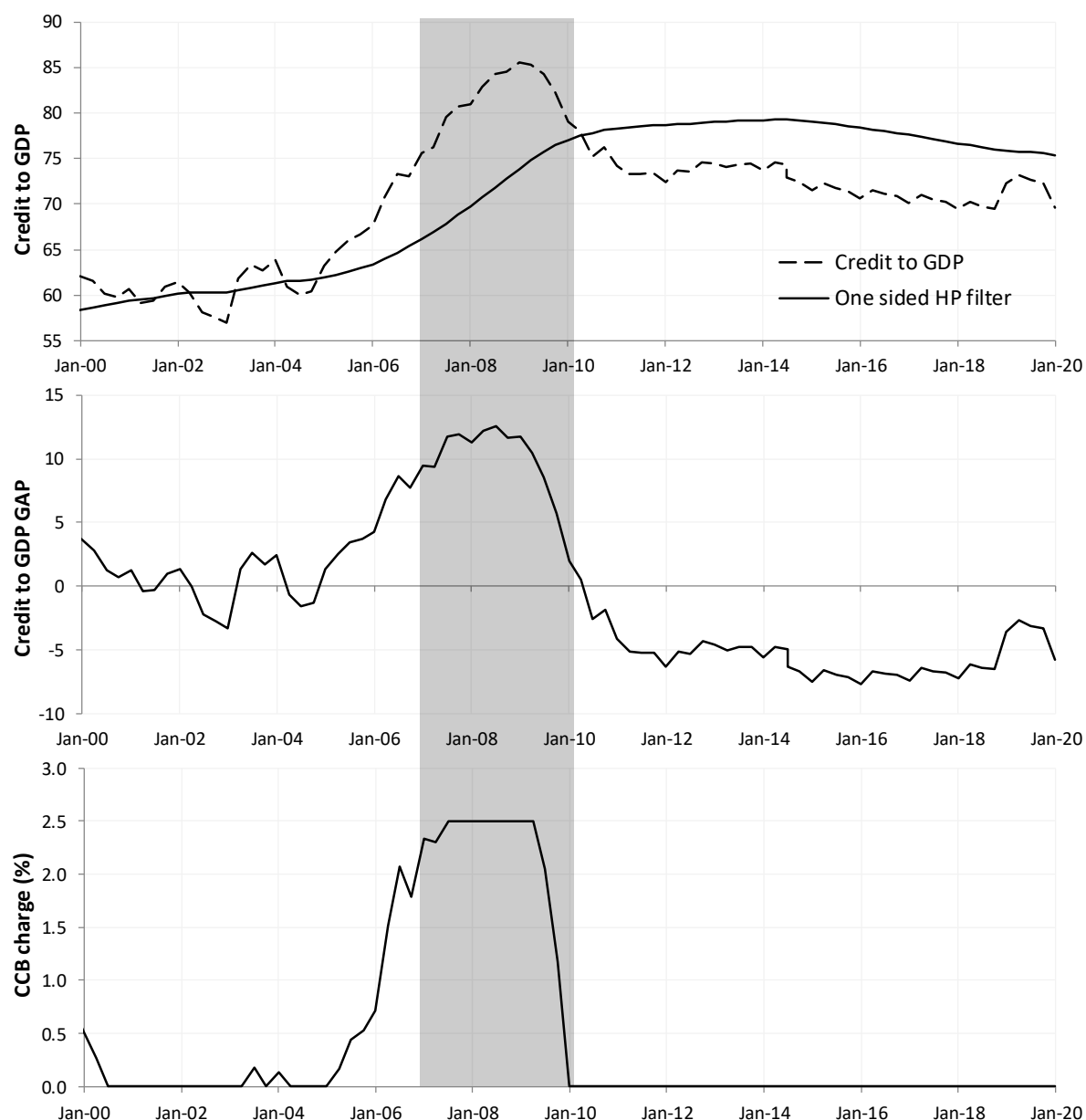


Figure 3.6: Credit/GDP and Credit/GDP Gap for the South African economy and capital charges associated with the CCB charge. The shaded area indicates the 2007 credit crisis period and illustrates how the CCB would have been at its peak during this period.

Source: *Author calculations.*

In the instance when Basel III rules come into force, capital charges will increase to the 2.5% maximum of extra capital required, and this would have been applicable during the period leading up to and also during the financial crisis. Even without the punitive capital charges in place – the ratio returns to levels at which the difference between it and its long-run trend would have resulted in a 0% capital add-on within a few years (two, in this case). It is unclear whether the reduction in credit extended was a direct result of the lack of capital in the banking sector or the flight to safety. Figure 3.7 demonstrates that the CCB charge will function well as a countercyclical capital measure in times of economic expansion, but it may be an ineffective measure during a crisis because it does not actively encourage lending

during or after a crisis. Furthermore, the CCB does not discourage lending through a capital charge in economic downturns as is shown from 2010 onward. However, the lack of a disincentive does not imply the presence of an incentive, and without an incentive to extend credit, banks may prolong the liquidity shortfall procyclically as demonstrated in the 2007 financial crisis.

We note, however, that the CCB was never intended to provide an incentive (nor to provide a disincentive) for lending or economic activity. It has been instituted purely to ensure that banks have sufficient capital when required. Obviously, there would be knock-on effects on lending and profitability, which are not ideal in a contractionary phase, but since the contraction would be a systemic issue, one might reasonably expect that monetary and fiscal policy tools should be used to attempt to stimulate economic activity, including lending.

The results from the HP filter indicate how the CCB will function correctly in times of economic expansion. The pricing of CoCos (as a countercyclical capital measure) is explored next.

3.3.3. Equity Derivatives Approach CoCo Pricing Model

CoCo pricing is closely related to the field of equity derivative pricing, and may be divided broadly into three model types, structural models (Pennacchi, 2011; Albul *et al.*, 2012), credit derivatives models (De Spiegeleer & Schoutens, 2011; Serjantov, 2011) and equity derivatives models (De Spiegeleer & Schoutens, 2011). The hybrid instrument nature of CoCos, somewhere between pure equity and pure debt, causes a challenge when choosing a suitable pricing model.

Various ways to price CoCos have been explored. The Black-Scholes model is a suitable method for pricing CoCos, because of the derivative nature of the constructs of the instruments. The Black-Scholes assumptions have, however, been found to be empirically unsound for pricing CoCos as the implied market trigger of a CoCo is time dependent and volatile (Jung, 2012).

Structural pricing models view CoCos as being deleveraging tools, focussing on estimating the trigger event. On the other hand, credit derivative models assume that CoCos exhibit inherent credit risk, paying coupons until either maturity or conversion. Lastly, equity derivative models rely on the market share price as a measure of the underlying financial position of the bank and uses this as an estimate of the value to be transferred at conversion. There is an overwhelming favour among academic papers for the use of equity derivative models when pricing CoCos, as these models come very close to reflecting the fair value of current CoCos in the market (De Spiegeleer and Schoutens, 2011 and Wilkens and Bethke, 2014). This method has thus been chosen for use in this paper.

Variations of CoCo trigger mechanisms exist, as discussed in Section 3.2. Market triggers (such as the bank's share price) are popular. The way in which a market trigger S^* is associated to an accounting trigger is illustrated in Figure 3.6, assuming an accounting trigger of 7% Core Tier 1 capital with a corresponding trigger share price of 159.

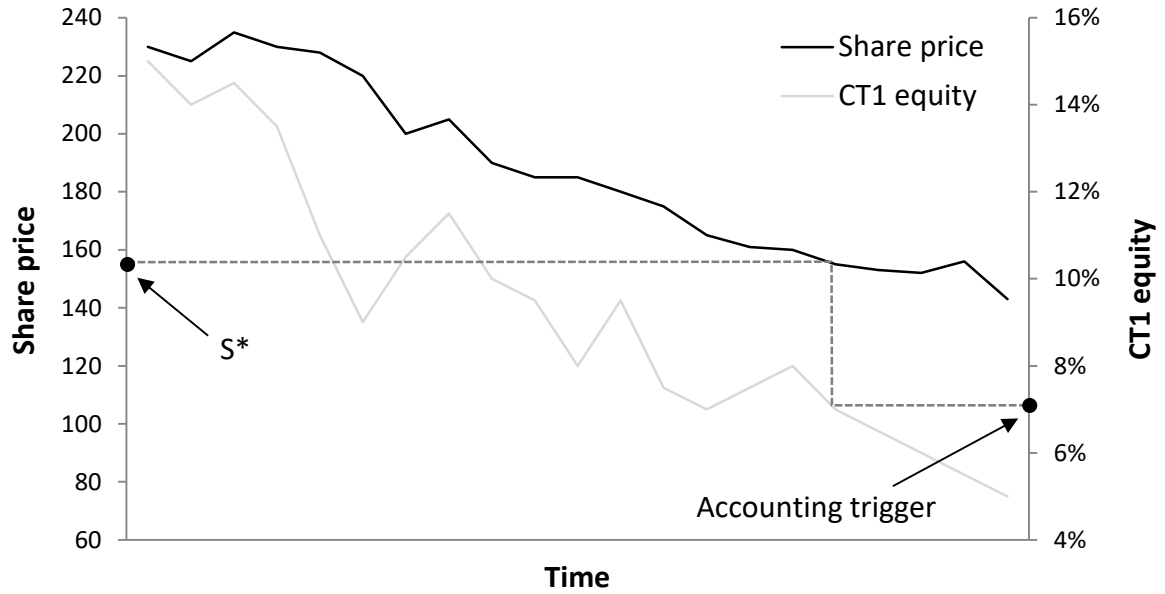


Figure 3.7: Accounting trigger with the projected market trigger S^* .

Source: *Author calculations.*

The nominal amount of CoCos of a bank in issuance is an important factor in estimating the increase in the CET1 capital because of the CoCo conversion. Beginning with the CET1 ratio:

$$\frac{CET_1 \text{ Capital}}{RWA} = CET_1 \text{ ratio}.$$

When a CoCo converts into equity there is an increase in CET1 Capital which increases the bank's CET1 ratio (if RWA remains constant). Consider the change in the CET1 ratio because of the increase in CET1 capital due to the trigger of a CoCo:

$$\begin{aligned} \frac{CET1 \text{ capital}}{RWA} &= CET1 \text{ ratio} \\ \frac{CET1 \text{ capital} + CoCo}{RWA} &= CET1 \text{ ratio}^* \\ \frac{CET1 \text{ capital} \cdot \left(1 + \frac{CoCo}{CET1 \text{ capital}}\right)}{RWA} &= CET1 \text{ ratio}^* \\ \left(\frac{CET1 \text{ capital}}{RWA}\right) \cdot \left(1 + \frac{CoCo}{CET1 \text{ capital}}\right) &= CET1 \text{ ratio}^* \\ 1 + \frac{CoCo}{CET1 \text{ capital}} &= \frac{CET1 \text{ ratio}^*}{CET1 \text{ ratio}} \\ \frac{CoCo}{CET1 \text{ capital}} &= \frac{CET1 \text{ ratio}^*}{CET1 \text{ ratio}} - 1 \end{aligned}$$

where: *CoCo* is the amount of CET1 capital resulting from a CoCo conversion; and *CET1 ratio* is CET1 capital as a percentage of RWA.

For an $x\%$ increase in the CET1 ratio, then, the total number of shares issued because of CoCos at conversion must be equal to $x\%$ of CET1 capital.

Consider, as an example, a bank that has CET1 Capital of ZAR100 and total RWA of ZAR1 000. The CET1 ratio is 10% (ZAR100/ZAR1 000). If the bank has CoCos which convert to ZAR30 of shares (30% of CET1 Capital [ZAR30/ZAR100]) this will also result in a relative increase to the CET1 ratio of 30% (from 10% to 13%) as the total CET1 capital will be ZAR130 post conversion (Capital ratio = ZAR130/ZAR1 000).

3.4 Results and discussion

To calculate the CoCo prices for South African banks the historic share prices, annual market volatility, dividend yield and interest rates are required. Data pertaining to the CET1 ratios of each bank were obtained from their annual financial statements or their annual integrated reports. Johannesburg Interbank Agreement Rates (JIBAR) were obtained from the SARB. Historic share prices of the four largest South African banks as well as the CET 1 capital ratios are given in Figures 3.7 and 3.8. To illustrate the effectiveness of a CoCo upon trigger in times of economic contraction a potential share value trigger for each bank is also illustrated in Figure 3.7 and Figure 3.8, derived through the same method as is illustrated in Figure 3.5 in Section 3.3 by linking the lowest share price during the financial crisis with the CET 1 capital ratio at that point. It is worth noting though that although the lowest share price attained would have not have been known at the time, some reasonable constraint could have been applied with equal validity, such as a share price absolute decrease of 50%, for example. Assuming the amount of the CoCo in issuance by each bank is equal to 2% of the RWA of each bank, the resultant conversions of CoCos into CET1 of each bank would cause a 2% increase in the CET 1 capital ratio of the respective banks as shown by the projected CET 1 capital ratio.

The assumption was made that the CoCo conversion to equity is instantaneous for illustrative purposes, however, in practice this may not be plausible, practical or desirable. Similarly, the trend in the projected capital ratio was assumed to remain the same as the underlying capital ratio for the period following the addition to the capital ratio, however, this may not be the case. Table 3.4 summarises the various trigger levels illustrated in Figure 3.8 and Figure 3.9 together with other market-related information used in the equity derivatives approach CoCo pricing model. The interest rate used was the 3-month JIBAR – the Johannesburg Interbank Average Rate, an average prime lending rate quoted independently by several South African banks – at the trigger event date for each share. A maturity of five years was chosen as this is the most common maturity amongst previously issued Cocos (see Table 3.3).

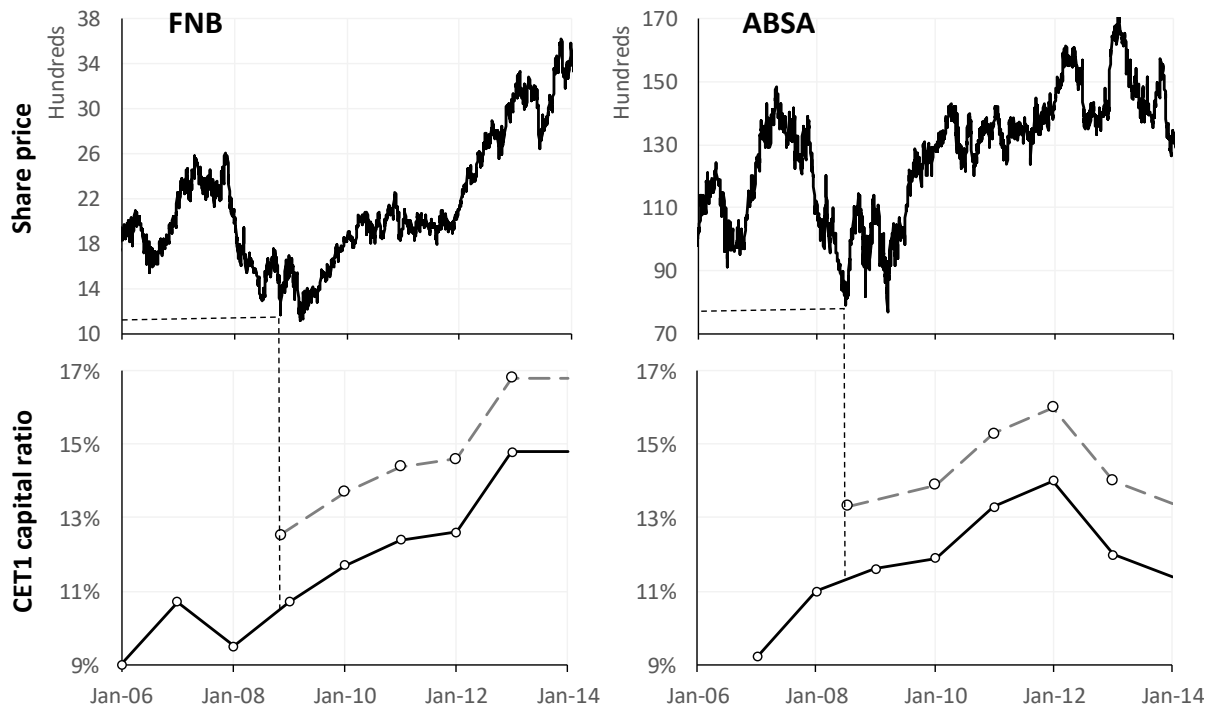


Figure 3.8: Share price of First National Bank (FNB) and ABSA with CET 1 capital ratios prior to- and after CoCo conversions.

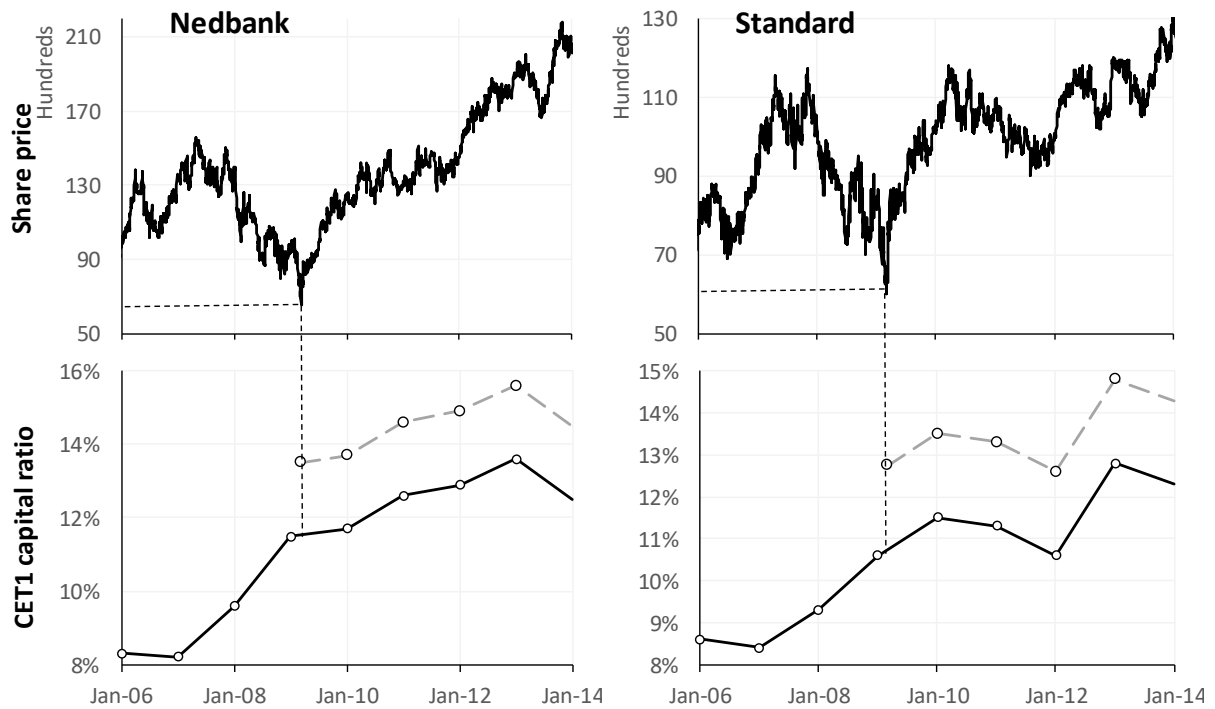


Figure 3.9: Share prices of Nedbank and Standard Bank with CET 1 ratios prior to- and after CoCo conversions.

Source: *Author calculations.*

INPUT	FNB	ABSA	NEDBANK	STANDARD BANK
Annual share volatility	38.4%	37.0%	34.8%	35.8%
Dividend yield	4.70%	7.04%	5.84%	5.37%
March 2016 share price	47.9	142	185.0	131.5
Not Trigger share price	13	80	65	63
Interest rate	10.5%			
CoCo maturity (years)	5			

Table 3.4: Trigger share prices derived from Figure 3.6 and Figure 3.7 with market-related pricing model inputs.

Source: *Author calculations.*

Figure 3.10 provides the yields derived through the equity derivatives CoCo pricing model for the CoCo of each bank if the issuers composed the CoCos according to the input parameters in Table 3.4.

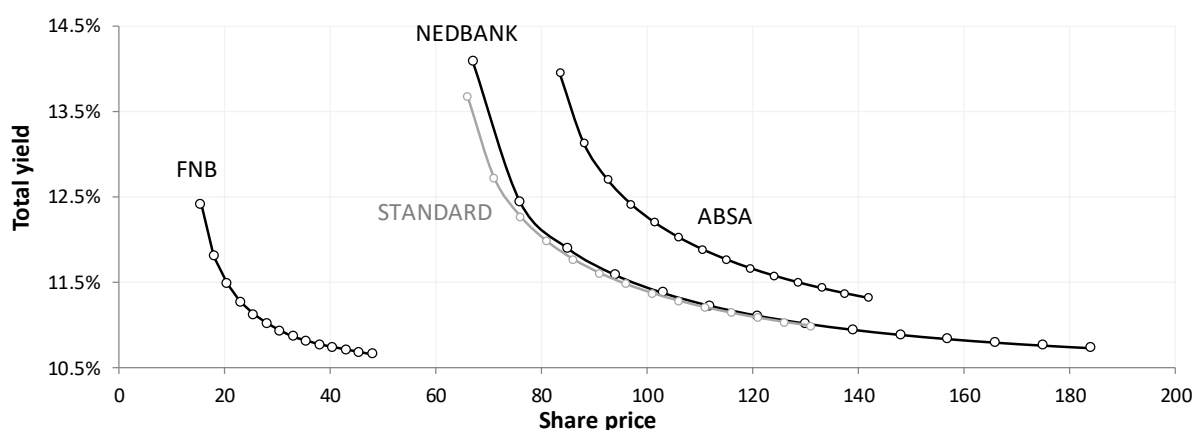


Figure 3.10: Coco yields for various South African bank share prices.

Source: *Author calculations.*

From Figure 3.6 it is clear that the CCB requires banks to keep more capital in times of economic expansion. Total credit extended may take considerable time to diminish, however, and if the increase in the CCB is accompanied by a downturn in the economy (as in the 2007 financial crisis), banks may be required to sustain a higher capital ratio while being under pressure to supply the capital in the ordinary course of business. Figure 3.11 further illustrates the countercyclical capital nature of CoCos: bank's capital ratios *would have* been increased through the conversion of CoCos at precisely the time when banks needed an increase in capital. This may offer an internal solution to a capital shortage in situations where banks have traditionally sought after external, often sovereign, bailouts. The shaded area in Figure 3.11 indicates the transition period between an economic expansion and the resultant contraction and shows how the CoCo conversion happens at a point when the economy was in a financial crisis.

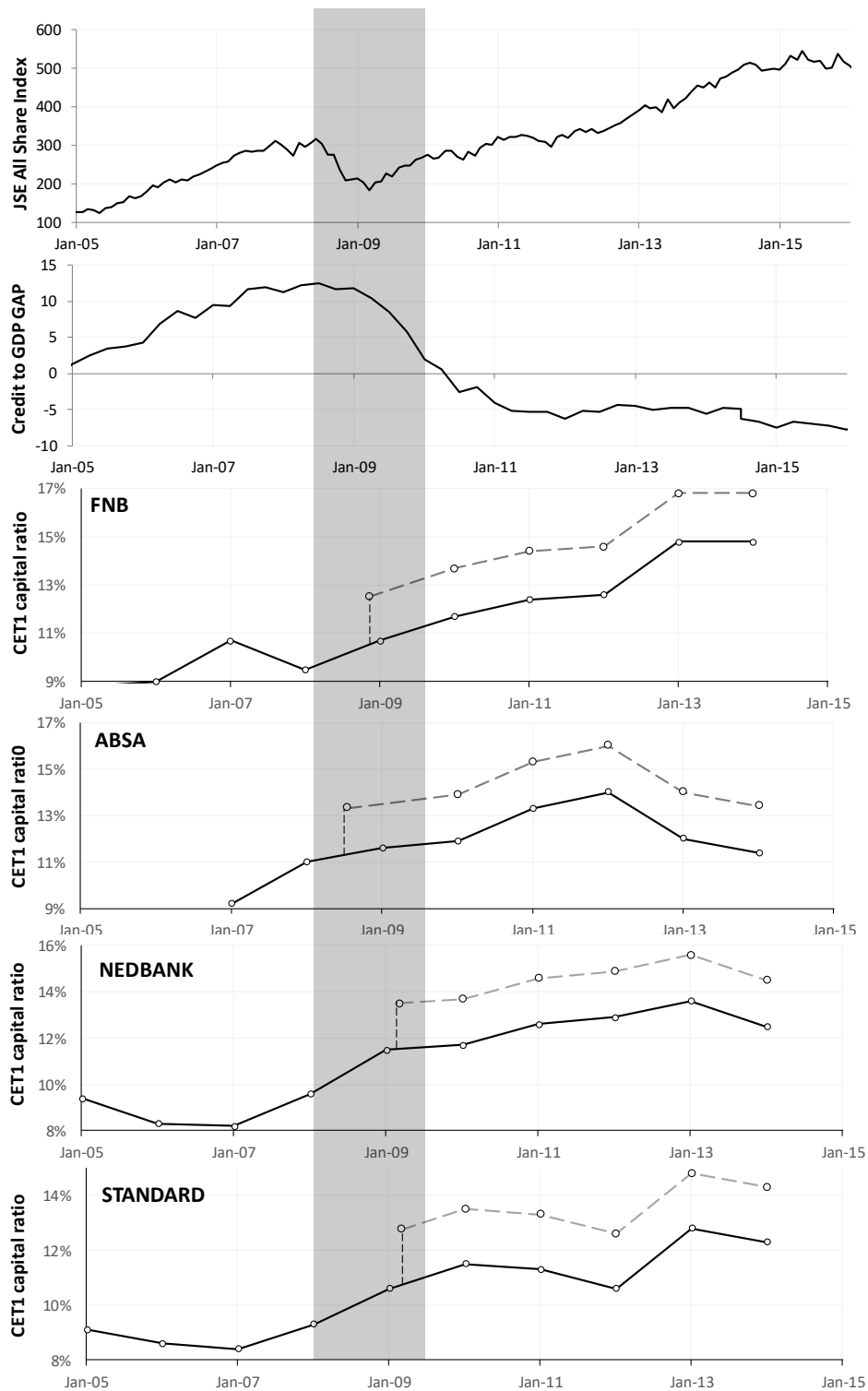


Figure 3.11: The conversion of proposed CoCo instruments of South African banks during an economic contraction. The shaded area represents the fall in the market due to the 2007 credit crisis and illustrates that the simulated CoCo triggers could have produced a CET1 capital injection during this period, for all four banks.

Source: *Author calculations.*

3.5 Conclusion

The BCBS have clearly understood that the procyclical nature of capital models in global banks have caused an over-extension of credit in bull markets as well as a dire requirement for capital in bull markets and deliberately structured a gradual phase-in of the Basel III rules for banks as a result. To avoid exhausting capital, the BCBS has increased the amount as well as the quality of capital that banks are required to keep under normal economic conditions with new regulation that include, amongst other improvements, the CCB. The addition of the CCB to the regulation is an attempt to further increase the required capital of banks in times when the economy is overheating, saving for a rainy day. The CCB remains, however, a purely theoretical exercise as the regulatory implementation of this buffer has not been completed and not a single bank up to date has had to increase their capital under the CCB rules. Furthermore, most of the academic research conducted on the CCB was done on developed economies; although some (van Vuuren, 2012 and Burra, de Jongh, Raubenheimer, van Vuuren & Wiid, 2014) indicate that the CCB holds various implications for developing economies, such as South Africa, as well.

An historical analysis on the CCB indicates that the buffer will come into effect in times of economic expansion such as the build-up to the 2007 financial crisis. It does also, however, indicate that once the CCB requirements come into force there is a significant time-lag that must be considered before the requirements are relaxed. History has also shown that markets are self-adjusting and may regulate back to their long-run trend after a period of excessive growth which poses interesting challenges for banks who will be required to keep the additional capital required by the CCB while operating in a market where capital becomes increasingly more expensive and increasing in scarcity.

CoCos are designed to absorb losses in severe economic conditions. The inherent mechanism which allow for a bank to cease paying the coupon on the bond in economic contractions afford the banks the opportunity to use the additional cash flow to service growing liquidity requirements. Furthermore, in a situation where the conversion trigger mechanism is triggered with the CoCo either suffering a write-down and/or converting into equity, the capital ratio of a bank is immediately boosted. Results from this study indicate that South African banks may have benefited from the increased liquidity and capital boosts if they had CoCos in issuance prior to the 2007 credit crisis.

The CCB thus seems to function as a good countercyclical capital measure in times of economic expansion, however, the absence of the disincentive to increase the capital of a bank in economic contractions does not necessarily imply that the banks will be incentivised to use the extra capital to extend credit into the market, especially as the RWA and PD of the banks will rise under these conditions. The issuance of CoCos, if their trigger mechanisms are designed correctly, would have proved helpful to banks and the broader financial sector in times of economic contraction through their countercyclical capital and loss-absorbing properties.

In addition to the countercyclical capital nature of CoCos further studies need to investigate the time-lapse between a CoCo conversion and the resultant increase in the CET1 capital ratio as the mismatch in timing could see the increase in capital coming at a stage when the bank is a gone concern as opposed to a going concern. An investigation into the trigger mechanism which results in a bank only stopping coupon payments (as opposed to converting the CoCo into equity) on CoCos will also prove useful as currently there are no fixed rules regarding trigger mechanisms to be used for such an addition to CoCos.

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Chapter 4

Exploring contingent convertible bond alternatives for African banks

Exploring contingent convertible bond alternatives for African banks

Francois Liebenberg,²⁴ Gary van Vuuren²⁵ and André Heymans²⁶

Abstract

A variant of the contingent convertible bond, first proposed in 2011, is investigated: the Call Option Enhanced Reverse Convertible (COERC). Although issued as a bond, it converts to new shareholder's equity if a bank's market share of capital falls below a pre-specified trigger point. COERCs avoid the problems with market-based triggers (e.g. sell offs and death spirals) due to panic and market manipulation. Banks that issue COERCs have less incentive to choose investments which may be subject to large losses and disincentive problems associated with the replenishment of shareholder's equity after market declines (also known as debt overhang) are also avoided. Proposed amendments to the COERC structure are suggested for the African market.

Keywords: Contingent convertibles, CoCos, procyclicality, Basel III

JEL classification: C134, C16, C53

4.1. Introduction

The credit crisis of 2008 triggered global financial distress – particularly in banks. As a direct result, regulators were mobilised to alter banks' capital structure so that losses and bankruptcy costs could be shouldered by the banks' creditors rather than by taxpayers as was the case in most developed markets for the 2008 crisis (Sundaresan, 2013). One of the many suggestion put forward by global regulatory authorities was the proposal that banks should implement and install contingent convertible debt (Co-Cos), which automatically convert into equity when prespecified triggers level are breached. These triggers could be accounting information based, market price based, or wholly decided by bank supervisors. Whatever the initiating event, the aim is to ensure the automatic recapitalisation of bank when crises occur to liberate them from the ensuing debt service (and default) payments (Albul *et al.*, 2010).

Global CoCo issuance soared post the credit crisis (2009 – 2014): additional Tier 1 capital CoCo issuance increased from US\$2bn in 2010 to US\$93bn in 2014. Tier 2 CoCo issuance was stable during these periods at around US\$10bn, but increased to US\$82bn in 2014. Since then (between 2015 and 2018) both types of capital CoCo issuance have stabilised but diminished, additional Tier 1 at around US\$60bn and Tier 2 at about US\$16bn as shown in Figure 4.1 (Ainsworth, 2017).

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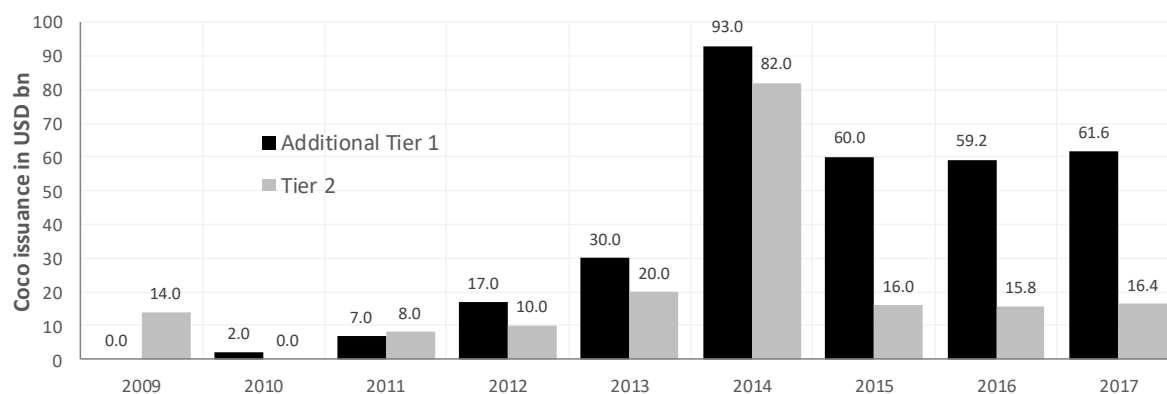


Figure 4.1: Global CoCo issuance (in USDbn).

Source: *Ainsworth (2017)*.

Early proposals embraced CoCos with regulatory triggers (e.g. Glasserman & Nouri, 2012; Pennacchi, 2011 and Sundaresan & Wang, 2012). The idea was simple enough: when banks' Tier 1 capital ratios fall below a prescribed level, these convertible bonds will convert into equity and recapitalise the ailing bank.

Problems arise, however, because it is unattractive to issue CoCos unless

- regulatory authorities deem them sufficiently like equity to qualify as Tier 1 capital and
- tax authorities judge them as sufficiently like debt to permit interest payments to be tax deductible (Calomiris, & Herring, 2013).

Although most European countries and their relevant regulatory and tax authorities recognise this, the Internal Revenue Service (IRS) declined to do so. As a result, United States (US) banks do not issue CoCos (Herring, 2017).

Some of these issues were addressed by Liebenberg, van Vuuren & Heymans (2016, 2017) with focus on the unique African financial milieu. The SARB, for example, deems that CoCos do qualify as Tier 1 capital and local tax authorities do judge them as sufficiently similar to debt to allow tax deductible interest payments (Shawe & Colegrave, 2017).

Despite some early successes (Flannery, 2009a,b and Bolton & Samama, 2010), however, CoCos based on purely regulatory triggers (or, indeed, market-based triggers) were plagued by problems (Berg & Kaserer, 2011 and Sundaresan, & Wang, 2012). In June 2017, the 6th largest Spanish (Banco Santander) bank's CoCos experienced considerable losses (RiskConcile, 2017 and Unmach, 2017). Banco Santander's Single Resolution Board (SRB) transferred all shares and capital instruments of Banco Popular Espanol (Banco Popular) to Banco Santander (Figure 4.2). The CoCo functioned exactly as it should: taxpayers did not pick up the bill for debt instrument investors and senior bond holders were rescued. For subordinated bond holders and CoCo bond investors, however, the SRB decision triggered the decimation of value for CoCo bond investors who witnessed the value of their initial investment decline

by over 60% in a few weeks. CoCo investors were painfully reminded of the high risks associated with CoCos, masked in good times by the CoCo bond's high coupon.



Figure 4.2: Banco Santander 8.25% CoCo price (USD).

Source: *Unmach (2017)*.

Other types of CoCos have been proposed whose conversion is triggered when a market value capital ratio is breached: Call Option Enhanced Reverse Convertibles (COERCs). These instruments are promising alternatives as they have several desirable features which circumvent problems which arose with regulatory based trigger CoCos (Pennacchi, *et al.*, 2014). COERCs are still (2018) relatively new and investors are unsurprisingly reluctant to purchase untested instruments, particularly so soon after the credit crisis and – more recently – so soon after the disastrous performance of Banco Popular (and other) CoCos (RiskConcile, 2017 and Unmach, 2017). COERCs, though, have features which might work well in the African bank space – and in this article, some amendments are proposed and examined. Implementation in African markets is subject to regulatory scrutiny and buy-in from both investors and banks, but given the theoretical success of the proposal to date, early signs are promising.

The remainder of this article proceeds as follows: Section 4.2 reviews the available, relevant literature regarding CoCos and the problem of procyclicality in banks. The regulatory response to the 2008 credit crisis is also reviewed here. Section 4.3 presents existing CoCo pricing and valuation approaches and the proposed mechanisms which govern the behaviour of COERCs. The relevant mathematics is dense, but explained elsewhere, so only a numerical example is provided for comparison purposed. The results of calculations are analysed and presented in Section 4.4 as well as a discussion regarding the theoretical ramifications of COERC implementation in African banks. Section 4.5 concludes.

4.2. Literature study

The following section will explore the origins of the credit crisis as a preamble to the introduction of CoCos as an alternatively proposed countercyclical capital measure.

4.2.1. The credit crisis

During 2007 the global economy experienced a credit crisis which had disastrous effects on international financial markets. The reasons behind the crisis are plentiful, however, it is universally agreed that the main driver behind the widespread crisis was the existence, use and eventually the failure of complex derivative investment instruments (Baily *et al.*, 2008). These instruments caused an inflation of asset prices beyond their historic trends and due to their complex nature, they were also not priced correctly. As a result, the banks who invested and traded in these instruments held more risk than what was anticipated in financial models and the effect of this risk was exposed when many banks filed for bankruptcy. The first bank to tumble was Lehman Brothers who officially applied for Chapter 11 bankruptcy in September of 2008 (De Haas & Van Horen, 2012).

The effect of the Lehman bankruptcy was a global mistrust between financial institutions leading to a drastic reduction in lending and a financial system whose member firms tried to sell off any securitised instruments at any cost. These effects are classic signs of a capital market which is procyclical in nature (Nikolov 2010). In other words, when an economic indicator experiences an increase in value when the economy exhibits economic growth, it is deemed a procyclical indicator and is used as a metric to measure procyclicality. When the procyclicality methodology is applied in analysing the losses suffered during the credit crisis it is evident that the losses which occurred during the credit crisis exceeded the gains which were evident in periods where the economy grew, proving the procyclical nature of the financial models used to model the risk of global financial institutions, especially under the Basel II framework employed in the period preceding the financial crisis (BCBS 2010b; Van Vuuren 2012).

When further examining the procyclical effects it is evident that the supply side of the financial system, banks lending money, reacted negatively to the financial shocks which the global markets experienced (De Haas & Van Horen 2012). Banks dried up virtually all lending of funds to clients and as such the broader financial system suffered as there was no liquidity for businesses with which to operate. In response to this crisis the Bank for International Settlements (BIS) updated the Basel II regulation with an additional set of requirements, in order for banks to be more prepared for similar crises in the future and combat the procyclicality inherent in previous financial models to some extent (BCBS, 2011a). This new set of regulations are known as Basel III and is expected to be fully implemented by 2019. The main aim of the newer Basel III regulation is to bolster the amount, liquidity, consistency, transparency and quality of Tier 1 capital (BCBS 2010a). Additionally, Basel III also includes a reconstitution of acceptable regulatory capital, enhancements to the amount of capital required for the trading book and also completely new rules such as the amount of required capital buffers and a leverage ratio. These measures are aimed at increasing the required amount of capital from 8.0% to 10.5% (even to 13.5% in specially defined circumstances) (BCBS, 2011b).

A noteworthy addition in requirements of Basel III is the countercyclical capital buffer (CCB) which aims to directly combat the procyclicality inherent in financial models. The CCB is a mechanism which is designed to bolster the capital ratio up to 13% when the economy is expanding. The CCB, thus, functions mainly at the height of an economic cycle and is designed to discourage excessive credit lending by banks. This measure, however, still remains (2017) a theoretical measure and has not been tested practically to the knowledge of the authors at the time of publication. Real-world scenarios may disprove (or alternatively may validate and prove) the theory behind this mechanism as it may not effectively motivate lending in economic cycle downturns, hence the pressing need for regulators to inspect additional countercyclical measures.

4.2.2. Contingent convertible bonds

An example of an alternatively proposed countercyclical measure is the contingent convertible (CoCo) bond. CoCos are a class of security which possesses both an underlying equity component as well as a fixed income producing component. These securities were designed to be loss-absorbing in the sense that they will be issued as bonds but will convert into equity after certain conditions are fulfilled (BCBS, 2010a). CoCos behave much like vanilla convertible bonds, but have fundamental differences. A standard bond which is callable and convertible may be manually converted into a predefined number of the common shares of the issuer at any time as required by the holder of the bond. This bond is usually also callable by the issuer, in the sense that the bondholder may be requested to surrender the bond to the issuer at a predefined price (Huang, 2009). Thus, the bondholder and/or issuer may choose at will when the contract comes to an end. These bonds are popular due to the higher yields that they offer versus traditional non-convertible bonds as they carry more risk due to the convertible clause attached to them. The trigger mechanism which results in the conversion of the bonds, is where CoCos and vanilla convertible bonds differ.

Glasserman & Nouri (2012) explored CoCos characterised by accounting based triggers (e.g. the book value of assets), using Merton's structural framework. The conversion to equity is just sufficient to meet the capital requirements and occurred whenever the trigger was reached (assuming the trigger point is greater than the bankruptcy barrier).

Albul *et al.*, (2010) also employed Merton's (1974) structural framework to address capital structure decisions for CoCos. Assuming asset value triggers, closed-form capital structure solutions were derived and for simplicity, debt maturities were assumed to be infinite. CoCos were found to provide the bulk of tax shield benefits of straight debt while providing similar protection as equity. Albul, *et al.*, (2010) concluded that CoCos should be substituted for straight debt in bank capital.

Pennacchi (2011), also using a structural approach, modelled a bank balance sheet comprising short-term deposits priced at par (long-term bonds were ignored for tractability reasons), common equity, and

CoCos. The ratio of the asset value to the combined CoCo and equity value - assuming costless bankruptcy – was chosen as the CoCo trigger.

CoCos triggered by equity market values could lead to either multiple equilibria or no equilibrium, unless there is no value transfer between bank equity and contingent debt at conversion (Sundaresan & Wang, 2012). Depending on investor beliefs as to whether conversion will take place, several equilibrium share prices are possible which can lead to price jumps or to investor manipulation of market prices leading to a 'death spiral' (Maes and Shoutens, 2012). Death spirals could be induced by CoCo holders short selling bank stocks as a CoCo hedge. If wealth is transferred from equity holders to CoCo holders at conversion due to heavy dilution, CoCo holders are incentivised to force conversion. A continuous-time framework indicated that a necessary and sufficient condition to guarantee a unique equilibrium was the no-value-transfer condition.

In 2009, three banks issued securities which were considered to be CoCos. These instruments had triggers which were activated based on regulatory capital values. Lloyds Bank was the first to issue a CoCo in November 2009 in a successful subscription offer. The second recognised CoCo was issued by Rabobank in May 2010 and presented terms that dictated a 75% write-down on the principal value of the bond when the bank's regulatory capital ratio fell to less than 7% with the remaining 25% stake being paid out in cash. The Rabobank CoCo does not exhibit the classic features of a CoCo in the sense that there is no equity conversion. The third CoCo bond issued was the security issued by Credit Suisse which was open to subscription from the public and offered a 7.875% coupon rate (a large credit spread at the time²⁷) and was heavily oversubscribed. This CoCo was also to be converted from a bond to equity with a conversion cap of \$20 set to the amount at which it could be converted into shares. A major empirical analysis of the of bank CoCo issues was conducted by Avdjiev, Bogdanova, Bolton, Jiang, and Kartasheva (2017). A market segment comprising over 730 instruments totalling \$521 billion were examined and four principal findings emerged: 1) the propensity for CoCo issuance increases as banks get larger and better-capitalised 2) because CoCos generate risk-reduction benefits and lower debt costs, CoCo issues precipitate statistically significant decreases in issuer CDS spreads, 3) CoCos that have only discretionary triggers have little to no impact on CDS spreads; and 4) CoCo issues do not influence stock prices.

A drawback to these instruments was that due to the relatively short period in which CoCos have existed, they have not been tested under the market conditions for which they were designed to perform as loss-absorbing instruments. Theoretically there may be untested weaknesses in the design of certain CoCos, beginning with the choice of trigger mechanism.

Both the Credit Suisse and Rabobank CoCos employ regulatory capital triggers which may prove to be

²⁷ At the issue date, the 30-year Treasury yield was 4.16%, the AAA corporate bond yield was 5.26%, and the BBB (which was Fitch's rating of the CoCo) corporate bond yield was 6.14%.

problematic (Pennacchi *et al.*, 2011). Regulatory capital is an accounting measure which is calculated internally by the finance department of a bank, usually on a quarterly basis. In a situation in which financial markets take a sudden and rapid decline, these quarterly reviews may prove to be too late to be effective. Consider as an example, the mean and median Tier 1 capital ratios for six banks in the US during the first four quarters of 2008, represented in Table 4.1 below.

Table 4.1: Tier 1 Capital ratios for banks in the US for the first four quarters of 2008.

Bank	2008			
	Q1	Q2	Q3	Q4
Bank of America	6.08	6.80	6.10	7.47
Bank of NY Mellon Corporation	7.44	7.94	8.00	11.90
Capital One	9.48	9.90	10.58	12.46
Citigroup	5.83	6.79	6.14	9.48
JP Morgan Chase	7.01	6.86	6.91	8.94
Wells Fargo	6.69	6.53	6.45	5.98

Source: World Bank (2016).

The variation in these capital ratios would have proved ineffective leading indicators to illustrate distressed conditions during the financial crisis. Even with Lehman Brothers going bankrupt in Q4 of 2008, it is evident that many of the capital ratios of these banks even increased from their levels in Q1. It is thus highly improbable that CoCos with regulatory triggers would have been activated during the 2008 financial crisis. A second shortcoming pertains to the risk that CoCos may not convert from debt to equity while the bank is still a going concern. The regulatory nature of the triggers for the Rabobank and Credit Suisse CoCos, may cause them to remain as debt even when the banks are no longer going concerns. The focus of the CoCos represented in this study is meant to trigger from debt to equity prior to a non-viable condition of a bank, to prevent a bank from being liquidated as opposed to just softening the blow post-bankruptcy. The approach taken by Flannery (2005) illustrates securities closely suited to this purpose, for which the CoCos contain a trigger mechanism which is linked to a market-based value of the issuing bank's equity.

As an example, the CoCo issued would convert into equity when the share price is at a certain level. The goal in setting up this specified share price is to obtain a share price where, historically, the bank was in a bad financial position, but not yet in a *non-viable* condition. Flannery, (2005) proposes that the CoCo investor receives several shares valued at the trigger price of the issued shares, equal to the bond's par value prior to conversion. While the market-based trigger appears better suited to the notion of a CoCo, which will convert while a bank is still a going concern, it is not free from criticism. The risk of a market-based trigger lies in the potential for market manipulators to influence the share price of the issuing bank to trigger the CoCo conversion. These manipulators may drive stock prices down to a level

well beneath their fundamental values for the sake of profiting from a CoCo trigger thereby providing an incentive for certain CoCo investors to manipulate share prices (McDonald, 2010).

To combat the weaknesses inherent to CoCos, various solutions have been proposed. Kashyap, Rajan & Stein (2008) propose that banks do not issue loss-absorbing securities such as CoCos, but rather purchase insurance against falling capital levels. This would, however, require an insurer which is free from systemic risk which may be the case when a bank is irresponsible, but not the case in a global financial crisis. Such an insurer will most likely also be under stress in a financial crisis and may not be able to meet its obligations (Duffie, 2010).

Pennacchi *et al.* (2014) augment the Pennacchi (2011) framework by introducing Call Option Enhanced Reverse Convertibles (COERCs), which permit the bank's original shareholders to buy back the shares at the bond's par value. Modigliani-Miller results are assumed to hold, so financial distress model costs were ignored. In this article, the application and structure (specifically the ideal trigger mechanism) of COERCs in an African market context are explored. COERCs may address most of the shortcomings of traditional CoCos²⁸ while still affording fixed-income investors the opportunity to invest in this security.

4.2.3. Call Option Enhanced Reverse Convertible bonds

Pennacchi *et al.* (2014) proposed CoCo design addresses the contradictory objectives of the relevant parties; namely regulatory authorities, CoCo investors and of issuers. Although covered in detail in Pennacchi *et al.* (2014), a summary of these design features is given in Table 4.2.

Table 4.2: Summary and comparison of CoCo and COERC design features.

Feature	CoCos	COERCs
Trigger based on	Regulatory capital ratio	Market value capital ratio
Market-based triggers	Unjustifiable conversions because of manipulation or panic avoided because regulatory triggers (not market based triggers) apply	Panic conversions avoided because equity holders have the option to purchase shares from bondholders at conversion price. Thus, shareholders can prevent dilution by subscribing to a rights issue with subscription price = conversion price. Proceeds may be used to repay debt.
Conversion and trigger price	Conversion price close to trigger price – makes valuation difficult Little shareholder incentive to repay debt Higher risk decreases liquidity	Conversion price significantly below trigger price so COERC relatively easy to value Shareholders have a large incentive to prevent dilution and repay debt Low risk should improve liquidity, minimise the likelihood of financial distress, and make it appealing to many risk-averse investors

²⁸ Shortcomings mentioned in the article are among other issues: the notion that CoCo bonds convert to equity on the trigger event leaving the investor with an equity based security and not a fixed-income security, the fact that CoCos may trigger at a point of non-viability when the bank is no longer a going concern, the fact that current investors face share dilution when CoCos are triggered and the fact that some CoCos require regulatory involvement to trigger the conversion.

Regulatory role	Regulators are chief decision makers in the triggering of the conversion	No regulatory involvement
Conversion and debt repayment	No guarantee shareholders will repay debt Because repayment in cash not guaranteed, no guarantee of favourable tax treatment	Because conversion price is significantly below trigger price, shareholders will almost always prevent conversion and repay debt. Should result in favourable US tax treatment (COERC investors will almost always be repaid in cash)
Multiple equilibria problem	High risk because trigger is based on regulatory capital ratio	Avoided because trigger is based on <i>market value</i> capital ratio (sum of [market values of equity + COERCS]/senior debt)
Loss absorption	Yes	Although COERCs are not loss absorbing, they encourage banks to issue equity and repay debt when in financial distress. Commitment is made <i>ex ante</i> , so shareholders benefit through lower borrowing rates and conflicts between shareholders and debtholders are minimised

Source: *Author*.

4.3. Data and methodology

The following section will explore the origin of the data used as well as the methodology behind the empirical quantification of the study.

4.3.1. Data

The data used were simulated, stylised values for a "standard" COERC. No market parameters are required, such as equity or debt levels or market volatility. Details of the stylised example are provided in Tables 4.4 and 4.5 in Section 4.4.

4.3.2. Methodology

COERCs are different from other CoCo structures in the way new equity is issued and the volume of this new equity. This arises from the opposing way new equity is issued as shown in Figure 4.3.

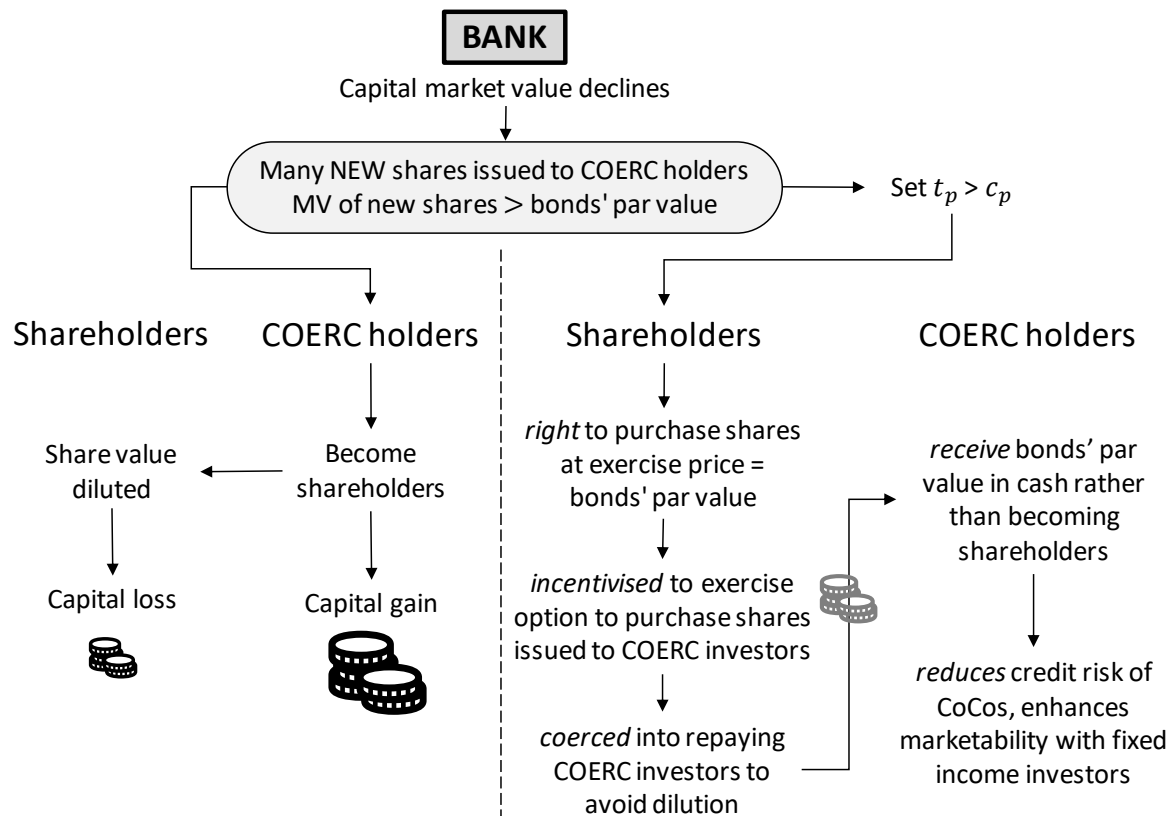


Figure 4.3: Principal benefits of COERCs. The left-hand side represents the naïve scenario, the right-hand side displays the more likely outcome of COERC share conversion.

Source: *Author*.

Criticisms levelled at COERCs have been addressed (Pennacchi *et al.*, 2014). These criticisms and responses are presented in Table 4.3.

Table 4.3: Potential criticisms of COERC issuance and measured responses.

COERC CRITICISMS	RESPONSES
Hard to value	With the appropriate trigger mechanism, multiple equilibria are avoided COERCs are designed to be nearly default-free – relatively easy to value
Unattractive to traditional fixed-income investors	Applies mostly to CoCos with regulatory capital ratio triggers and/or regulator discretion – not unique to COERCs COERCs have less credit risk than other proposed CoCos, making them more attractive to risk-averse fixed-income investors
Banks can manipulate regulatory accounting, regulators' decisions subject to political pressure	COERCs with market value triggers are less exposed to regulatory risk Shareholders can undo any conversion that results from manipulation or unjustified panic Since no regulators are involved, uncertainty due to regulatory discretion is avoided

Credit rating agencies reluctant to rate them	Although timing of conversion is hard to predict, since COERC investors almost always receive their bonds' par value in cash should qualify them for high-quality credit ratings
Investors may not wish to become bank shareholders, especially when the bank is in financial distress	COERCs are designed to prevent all undesirable conversions because initial shareholders have pre-emptive rights to buy all new shares issued to COERC investors. COERC investors receive bonds' par value in cash, not shares. COERC investors have little incentive to hedge investments by shorting bank's shares when capital market value approaches trigger, unlike investors in standard CoCos who become shareholders after triggering event
Capital markets divided into fixed-income/equity investors: little demand for COERCs, raising issuing banks' costs	COERCs do not encourage manipulation by short-sellers nor do they transfer wealth from shareholders to bondholders during a market panic Existing shareholders preserve their pre-emptive rights over bondholders COERCs are quasi-equity, i.e. they are typically converted, not repaid

Source: *Author*.

The mathematics governing the pricing of COERCs is covered in detail by Pennacchi *et al.* (2014). The valuation of a COERC may be undertaken using a simple comparative example. This is detailed in Section 4.4, using a simple, stylised-but-realistic, numerical example.

4.4. Results and discussion

All figures in this section stem from the stylised example assumptions set out in Table 4.4 for CoCos and then moving on to Table 4.5 which sets out numerical assumptions governing COERCs.

Table 4.4: Assumptions underlying a numerical CoCo example.

Parameter	Symbol	Value
Assets	A	1 100
Liabilities (senior debt)	D	1 000
CoCo bond par value	B	30
Current share price	S_0	10
Number of shares outstanding	n_0	7
On reaching trigger, CoCo converts to	Common stock shares	6
Current common shareholders' equity	$MV_0^E = S_0 \times n_0$	70
Market value of CoCo bond	$V = B$ (par value)	30
Market value of total capital	$S \times n_0 + V$	100

Source: *Author calculations*.

Assume at time t that S_0 has fallen to 5 – the trigger price – so $S_t = 5$.

Scenario 1: Conversion price (c_p) = trigger price (t_p) = 5

MV_0^E falls to $S_t \times n_0$, so $MV_t^E = 35$ and the CoCo is triggered, converting into 6 additional shares. The total amount of shares outstanding, $n_t = n_0 + 6 = 13$.

If CoCo investors realise that the true value of the firm's assets is still 100, then they know that the combined value of CoCo investors' and shareholders' stakes is 100. The fundamental stock value per share is thus $\frac{100}{13} = 7.69$ and the consequent *gain* to CoCo investors is $7.69 \times 6 - 30 = 16.15$ (a gain of 54% relative to the bond's market value of 30 prior to conversion).

This gain comes at the expense of the original shareholders who now own 7 shares trading at 7.69 rather than 10, i.e. a *loss* of 16.15.

Scenario 2: $c_p(5) < t_p(8)$

If investors again believe that CoCos will convert into 6 shares, the number of shares will again increase to 13, implying a stock price of $\frac{100}{13} = 7.69$.

As the 8 trigger is reached, conversion occurs and the 10 stock price is no longer a unique equilibrium price. At 7.69, the 6 shares owned by CoCo investors represent a wealth transfer of $7.69 \times 6 - 30 = 16.15$ at the expense of the original shareholders. This value transfer makes the stock price fall below the trigger price. Two stock prices are thus possible, 10 and 7.69. this has also been discussed in Liebenberg, van Vuuren & Heymans, (2016).

Table 4.5: Assumptions underlying a numerical COERC example. Missing values in Table 4.4 are assumed identical to those in Table 4.3.

Parameter	Symbol	Value
COERC par value	B	30
On reaching trigger, COERC converts to	Common stock shares	30
Market value of COERC	$V = B$ (par value)	30

Source: *Author calculations.*

Scenario 1: At time t , S_0 has been *manipulated* down to 5 – the trigger price – so $S_t = 5$.

The consequence of the conversion rate is that the COERC implied conversion price is significantly below the trigger price: i.e. 1 rather than 5.

The COERCs convert into 30 new shares. Combined with the 7 shares owned by initial shareholders, the number of shares outstanding is now $30 + n_0 = 37$. This results in a fundamental (non-manipulated) share value of $\frac{100}{37} = 2.70$.

Shareholders have the *right* to repurchase these shares at R1 (so that the total payment to COERC investors is 30) so they will do so. Were shareholders *not* to invoke this right, their wealth would fall from $7 \times 10 = 70$ to $7 \times 2.70 = 18.90$: a loss of 51.10 (73%). This loss may be recovered by

repurchasing the 30 shares at 1 from bondholders (which, at 2.70 per share is a *gain* of 51.10). the result is that COERC investors are paid their bonds' par value.

Scenario 2: At time t , S_0 has *justifiably* fallen to 5 (t_p), so $S_t = 5$.

This implies a fall in market value of equity from 70 to $S_t \times n_0 = 35$. COERC bondholders will convert into 30 shares. The fully diluted value per share is now $\frac{30+35}{37} = 1.76/\text{share}$. Shareholders will again exercise the option to repurchase the shares back at R1, so that COERC investors continue to receive their bonds' par value.

Shareholders will always repay COERC bondholders until the fully diluted stock price = 1. This will be the case when the combined value of COERC bonds and initial shareholders' equity = 37. As COERCs are repaid 30, equity is worth 7 and total value of the assets = 1 000 + 37 = 1 037. So, provided the total value of the firm > 1 037, COERC investors are repaid their par value.

This explains why a larger proportion of shares are issued to COERC investors renders them less credit-risky. Suppose, instead, that only 6 shares were issued to COERC investors at conversion (as with CoCos, Table 3), so that conversion and trigger prices are both 5. Shareholders would not purchase the six shares from COERC investors for a total sum of 30 unless the fully diluted stock price were 5. For this to be the case, the total firm asset value must be $1\,000 + 13 \times 5 = 1\,065$.

If $A < 1\,065$, shareholders will not exercise the option and COERC investors will retain 6 shares worth less than 5 (thus, realising a loss from their bonds' par value). With a 1 conversion price so that 30 shares are issued to COERC investors, they would become shareholders only if firm value falls < 1 037. Lowering the conversion price thus *reduces* a COERC's credit risk.

Figure 4.4 compares COERC versus straight debt payoff profiles, assuming conversion and the option to repurchase only occurs at the COERC bond's maturity. The bond payoff (par value 30) and shareholders payoff as a function of the firm's total asset value at the bonds' maturity date are presented. The firm has senior debt of 1 000, so other claims are rendered worthless if firm value < 1 000. The solid line indicates payoffs for non-convertible bonds and the dashed line shows the payoff for COERCs.

The value V of Non-convertible bonds is worth 30 provided the total firm asset value, $A > 1\,030$. If $1\,000 > A > 1\,030$, shareholders lose everything, and bondholders receive $A - 1\,000$ (i.e. the value of equity, $MV^E = \max[A - 1\,030, 0]$).

In the case of convertible bonds with $c_p = 1$ when $S_t = 5$ or whenever firm value > 1 065, equity holders exercise the call option and repay the bonds at par (provided the fully-diluted stock price > 1, or provided total firm value > 1 037. Until that point is reached, nothing changes compared to the case where the debt was *not* convertible.

When the firm's value $< 1\,037$, shareholders will not bail out COERC bondholders, who now end up with $\frac{30}{37}$ of $\max[A - 1\,000, 0]$ i.e. < 30 . Shareholders obtain the residual $= \frac{7}{37}$ of $\max[A - 1\,000, 0]$. A fundamental change is that now shareholders seek to preserve $1\,000 < \text{firm value} < 1\,037$ as a direct consequence of the fact that the COERC investors must share the value of the firm with the equity holders whenever $1\,000 < \text{firm value} < 1\,037$.

By allowing the conversion price to be low (1) COERC bondholders' risk is only marginally higher than that of non-convertible bonds. For c_p and $t_p = 5$, shareholders would refuse to repay debt when $\text{firm value} < 1\,065$, not when $\text{firm value} < 1\,037$. In that case, bondholders' risk would have been higher.

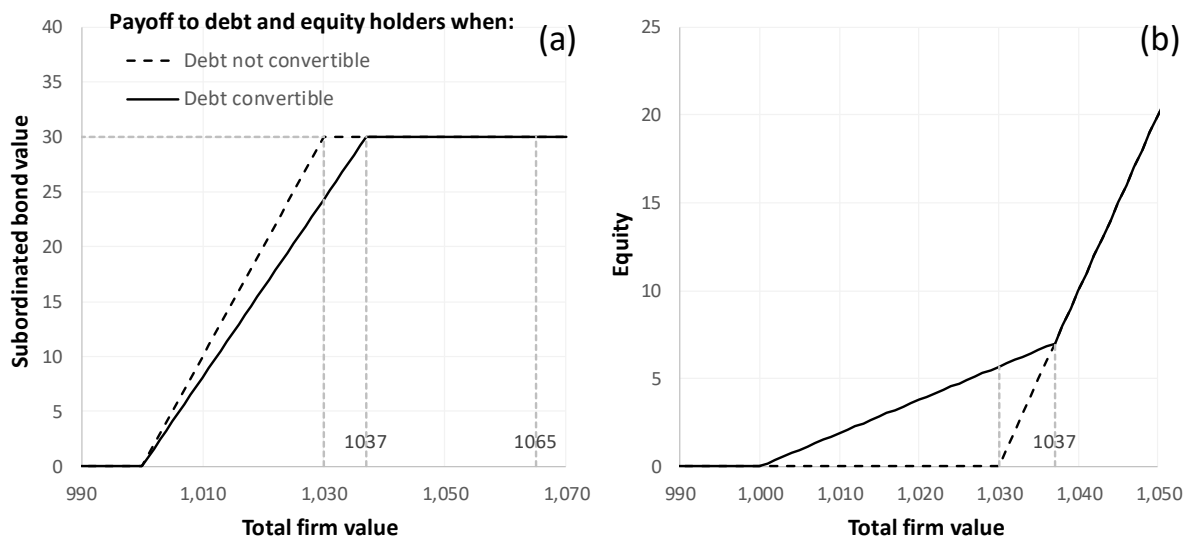


Figure 4.4: Comparison of COERC and straight debt payoff profiles.

Source: Pennacchi *et al* (2014).

The market value of equity as a function of the share price is shown in Figure 4.5(a), the number of shares issued as a function of the share price in Figure 4.5(b) and the fundamental stock value as a function of the share price in Figure 4.5(c).

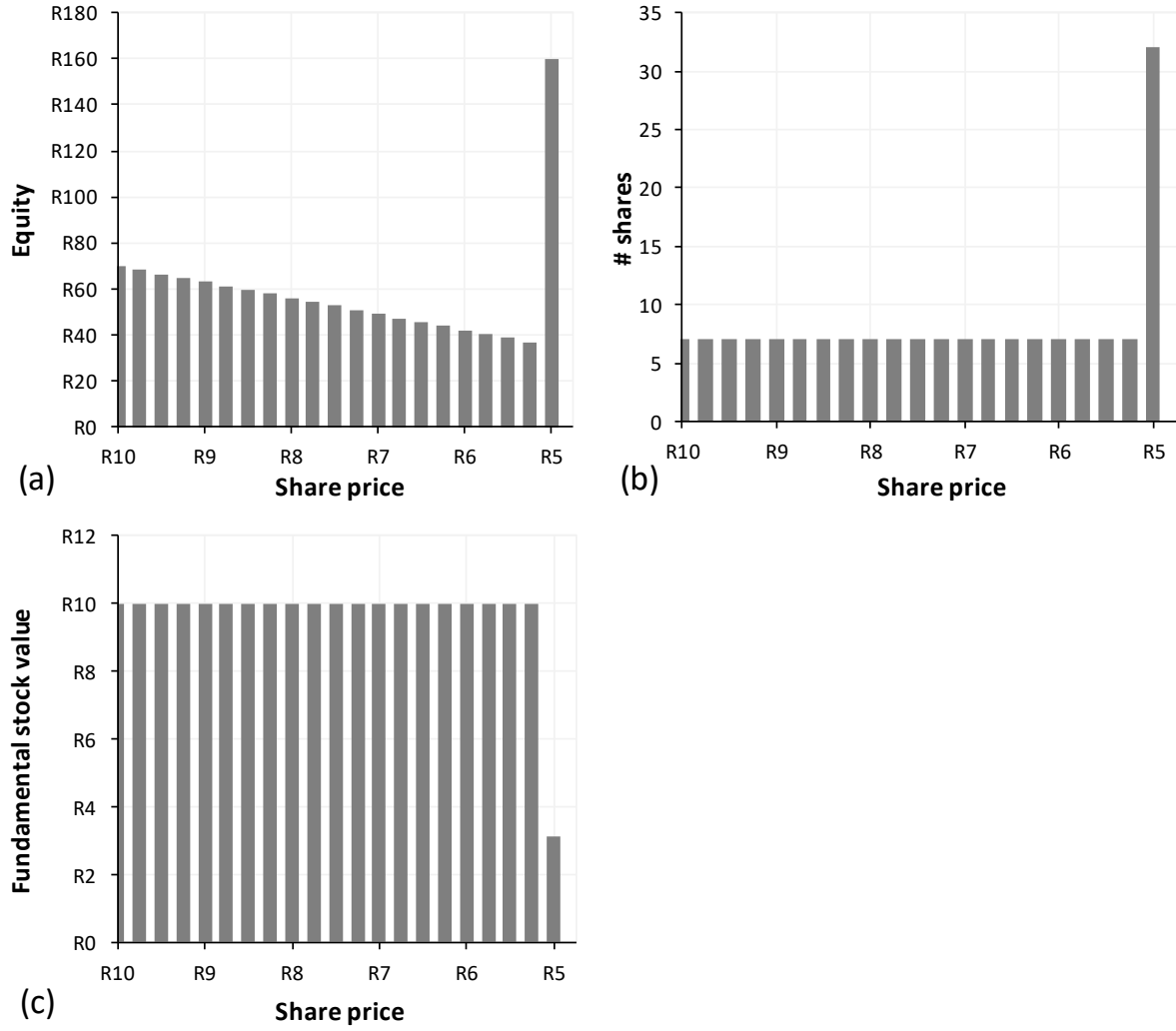


Figure 4.5: (a) Equity value, MV^E , (b) number of shares in issue and (c) fundamental share value, S_t as a function of underlying share price. All descriptive parameters as given in Table 3. $c_p = t_p = R5$.

Source: Pennacchi, et al (2014) and author calculations.

Figure 4.6 (a) through (e) displays 3D results from the stylised example. In each case, the relevant parameter is on the vertical axis as a function of number of shares issued and COERC conversion rate.

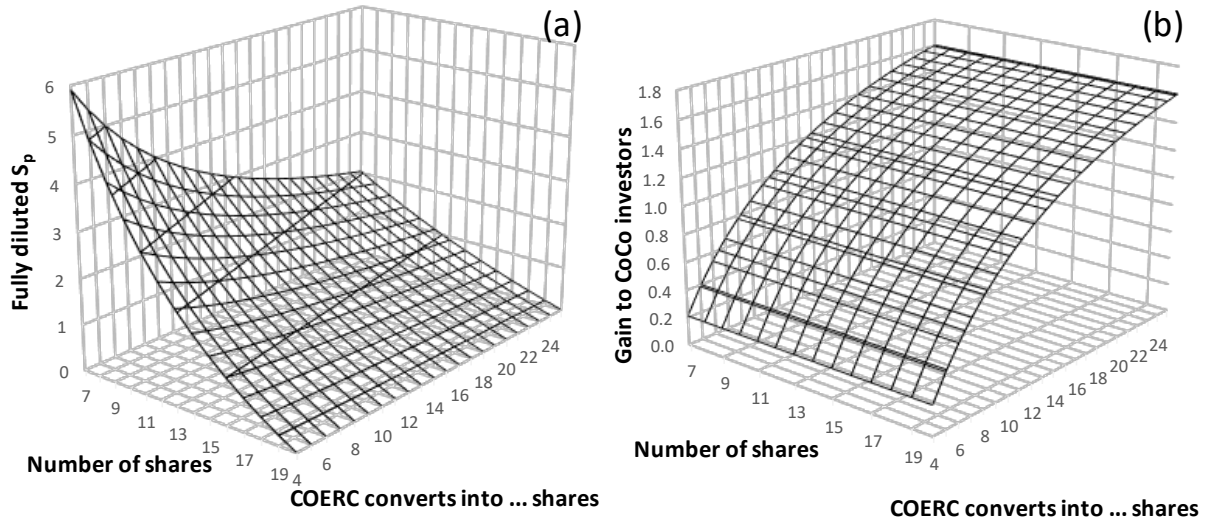


Figure 4.6: (a) Fully diluted share price and (b) gain to COERC investors as a function of the number of shares in issue and the COERC conversion rate.

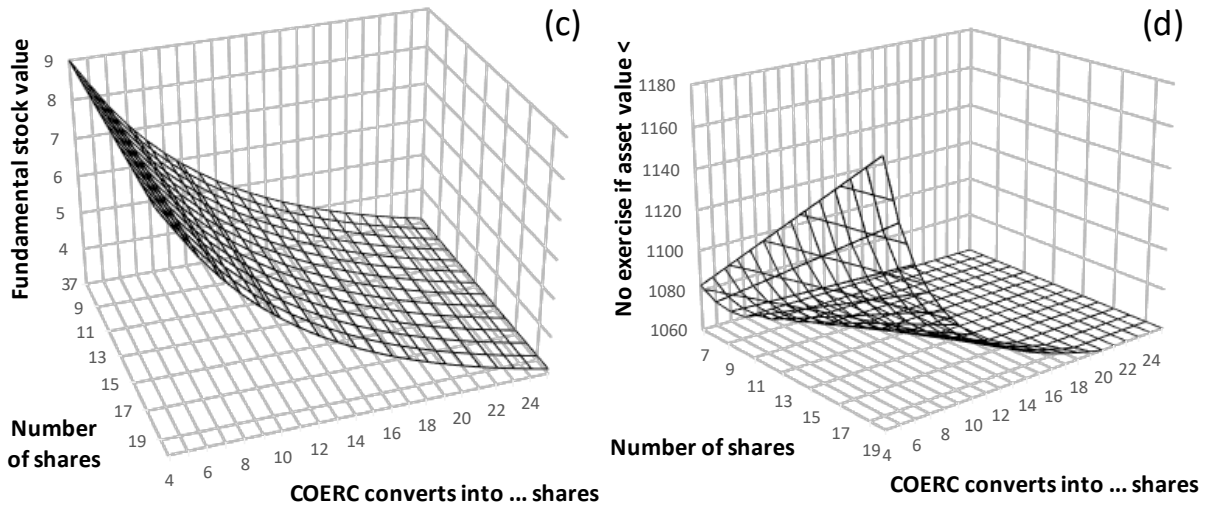


Figure 4.6: (c) Fundamental stock value and (d) option exercise threshold as a function of the number of shares in issue and the COERC conversion rate.

Source: Pennacchi *et al* (2014) and author calculations.

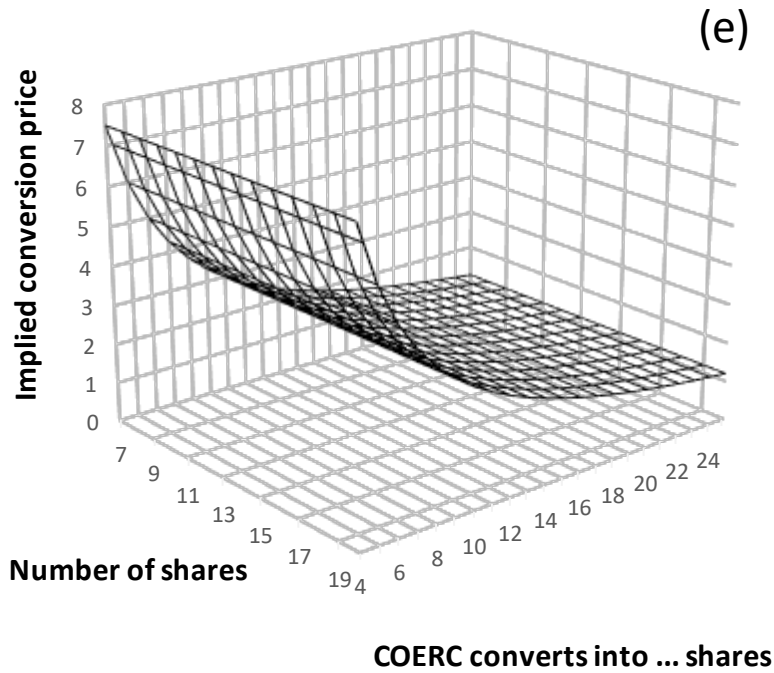


Figure 4.6: (e) Implied conversion price as a function of number of shares and COERC conversion rate.
Source: Pennacchi *et al* (2014) and author calculations.

Developed economy corporate investment-grade bond yields and sovereign yields remain at historic low levels (e.g. $\approx 2.4\%$ for corporate bonds, $\approx 2.3\%$ for US 10y Treasury yields and $\approx 1.3\%$ for UK 10y gilt yields in November 2017): investors have thus been driven into equities and real estate, fuelling potential bubbles in both asset classes (Bloomberg, 2017). The prevalence of these low interest rates (see Figure 4.7) in the current (2018) *developed-economy* environment (which have persisted for about a decade since the onset of the 2008/9 credit crisis) allows considerable flexibility for COERC issuance (and CoCo issuance in general). The implication of low interest rates is relatively low CoCo coupon rates: banks do not have to attach exorbitant coupons to CoCos to render them more attractive to potential investors.



Figure 4.7: Developed economy bond yields since 2008.

Source: Bloomberg (2017).

In emerging markets, particularly *African* markets, government yields are high by global standards: Figure 4.8 shows these yields for South African and Nigerian government 10y bond yields.

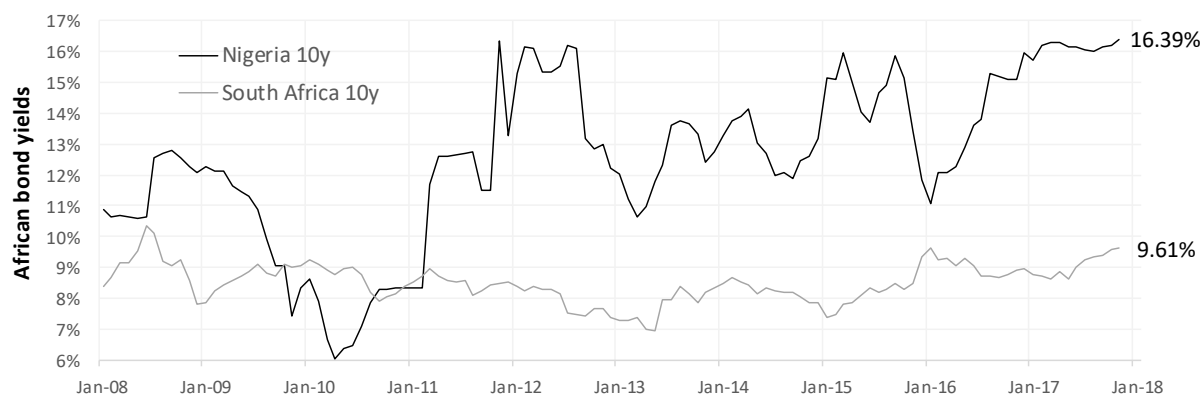


Figure 4.8: South African and Nigerian government bond yields since 2008.

Source: *Thomson Reuters, (2018).*

Corporate bond yields in these African countries are a few percentage points higher still. These attractive interest rates are tainted by low credit ratings (BB- for South Africa and B+ for Nigeria) both countries currently have "junk" credit status (Fitch Ratings, 2017). Large African banks are, however, relatively sophisticated and most are Basel-compliant with strong capital levels. COERCs would provide all the benefits argued for in this article and have the added benefit of offering highly attractive yields. Given the current paucity of global high-yield assets such instruments could even attract foreign investors.

From the examples provided in Section 4.4 it is evident that COERCs hold significant advantages to both investors and existing bank shareholders, as there is an incentive for existing shareholders to repurchase shares that will be issued when the COERC converts. The inherent purpose of CoCos (and COERCs) is to bolster capital levels when the bank suffers financial distress. With this in mind, the COERC coupon could also be designed such that it also assists with the bolstering of the bank's financial position, as the bank's share price decreases towards the trigger share price.

Consider a COERC with a floating coupon mechanism, whereby the COERC pays a reduced coupon to investors as the share price approaches the trigger price. As an example, assume the COERC was issued with a coupon rate of 8%, at a market share price of 50 and a trigger price of 25. Assume the mechanism is constructed to decrease by 10 basis points at a share price of 38, and a further 10 basis points for every decline of 1 of the share price. In this scenario, once the price reaches 30 (coupon strike price), coupon payments will have been reduced to 0, even though the COERC has not yet been triggered. Conversely, should the share price rise, coupon payments could restart using the same approach (an increase of 10 basis points in the coupon payment for a share price of 21, with an increase of 10 basis points for every increase of 1 above the level of 21 – up to a ceiling level of 8% at a share price of 28 and upward. This structure could provide even further assistance to banks in financial distress and may

even (depending on the volume of COERCs that have been issued) assist the bank to avoid a COERC trigger entirely. Such a mechanism would only work in a relatively high interest rate environment (and in which the coupon rate at the upper end of the range was 'attractive' to investors) – i.e. perfectly suited for current African markets.

Another example of a COERC with a floating coupon design could be one with a binary outcome in terms of the coupon rate. Consider a COERC with the same parameters (current share price, trigger share price and coupon rate) as above. The issuers may add a property to the coupon such that once the bank share price reached a level of 38 (coupon strike price), all coupon payments would become 0%. In such a scenario, a time-based contingency on the re-instatement of the coupon payment could be installed, e.g. resuming coupon payments after a set period such as six months, or the issuers could determine that coupon payment will resume as normal once the share price reaches a pre-determined level (ideally higher than the coupon strike price) such as 45.

Both examples of floating coupons for COERCs above would aid in the objective of issuing a security which is countercyclical in nature as banks would avoid having to pay coupons in times of distress. In the volatile financial markets throughout Africa, this may prove to be a vital addition to the existing benefits which COERCs offer to banks. In considering the various stakeholders of a COERC, this design would also have benefits to all parties involved. For a COERC investor, apart from the attractive credit spread, the security will almost never convert to equity which makes it a feasible option of institutional fixed-income investors. From the perspective of the bank, the floating coupon is an attractive mechanism as it further bolsters the financial position of a bank in periods of financial distress. Regulators would approve of the fact that the COERC is countercyclical in nature and loss-absorbing and current shareholders would benefit from the fact that their equity would not be diluted if the COERC reached the trigger share price.

From an investor's perspective COERC holders avoid economically unjustified conversions, face no regulatory uncertainty and the quality of the capital is high – i.e. they are (or should be if implemented) considered Tier 1 capital. In addition, interest on COERCs would be tax-deductible.

4.5. Conclusions and suggestions for future work

The changes in regulation brought forth through both Basel II and Basel III indicate the acute awareness that the Basel Committee on Banking Supervision (BCBS) has regarding the ill effects of procyclical capital models which were prevalent within banks preceding and during the financial crisis. Interventions to combat the drainage of capital from banks include measures such as the CCB as well as adjustments to the quantity and quality of capital required from banks. A deeper study into the application of these measures, however, has indicated that in developed economies such as the markets in Africa, the CCB in particular may not be completely adequate (van Vuuren, 2012 and Burra, Wiid,

de Jongh, Raubenheimer and van Vuuren, 2014) as there is a substantial time-lag that should be taken into account before requirements are relaxed.

In addition to the recommendations of the Basel frameworks, CoCos have been considered as an additional measure to promote counter cyclicalities in terms of capital composition in banks. This is because CoCos are loss-absorbing when banks are under financial duress, as a CoCo will convert from a bond into equity when certain pre-defined conditions are met. CoCos have been criticised by academics (Pennacchi *et al.*, 2012), particularly from a trigger mechanism design point of view. Under certain conditions, there may be incentives for speculators to short bank shares and artificially drive down the share price in order to profit from the conversion to equity when the CoCo triggers. COERCs have been proposed as alternative structure to CoCos as they offer distinct advantages to all stakeholders involved. COERCs are also a viable investment option to fixed income investors who make up a large percentage of institutional investors who purchase the bonds which are issued by banks. COERCs augment previous CoCo proposals (Flannery, 2009a, b) to solve three outstanding problems.

1. COERCs avoid the problem of manipulating the issuing firm's stock price or placing its stock in a "death spiral" tailspin because of stock dilution concerns by providing shareholders an option to repurchase the shares from COERC investors at the conversion price.
2. If CoCo investors are exposed to considerable risk, there will be few buyers. To reduce these risks, the relevant security must be so designed as to force shareholders to repay when financial distress becomes considerable. COERCs set conversion prices very low, below the stock price that triggers conversion. Not repaying COERC investors dilutes shareholder stock value substantially and transfers wealth to COERC investors which then reduces COERC credit risk
3. COERCs eliminate the problem of multiple equilibria (Bond, Goldstein and Prescott, 2010) by basing the conversion trigger on the market value of total capital to senior debt ratio, rather than the stock price.

Because COERCs have low credit risk, they lower direct and indirect costs of financial distress. This does however come at a trade-off to the bank as COERCs (as CoCos) pay a higher yield to the investor and as such are more expensive for the bank to issue. It must also be noted that although COERCs exhibit signs of lower credit risk than CoCos they may not be cheaper to issue due to the fact that there is a call-option attached to the security. Standard CoCos and non-convertible bonds have higher default risk than COERCs: COERCs' lower default risk mitigates the excessive risk-taking incentives typically present in levered firms. COERCs reduce the possibility of wealth transfers between investors and shareholders and thus assists in the solution of the high leverage 'debt overhang' problem (Myers, 1977). Reductions in agency costs make COERCs attractive investments for corporations. Also, while unsecured bonds, for example, default *sans* any security for bondholders (by definition), COERCs

mandatorily convert into equity after a triggering event so the risk of a default (which in this case, since the conversion is not considered a "default", never occurs), is lower for COERCs than unsecured bonds.

Regulatory authorities are not required to be part of the process of monitoring and managing COERCs, and they force equity holders to repay debt to prevent dilution. This anticipated commitment benefits shareholders through lower COERC yields that convert to equity in times of financial distress.

We propose, in addition to the above, that the coupon payment mechanism of the COERCs issued by banks in Africa be altered so that they either cease to pay a coupon to investors or reduce the amount (and burden) of coupon payments as the share price of the bank deteriorates. This alteration may prove to be a significant addition to the already-attractive countercyclical and loss absorbing properties which are inherent to COERCs.

In addition to the countercyclical nature of COERCs, further studies need to investigate the quantum and optimal level at which coupon rates should be altered. An investigation into the inverse scenario where the coupon rate of a COERC increases as the share price falls may also yield useful results as this could make COERCs attractive to investors, who would receive a higher yield at times when there is a higher risk attached to the security. In addition, further research into the impact on the liquidity position of the bank because of lowered and/or ceased coupon payments may also yield valuable results.

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Chapter 5

Conclusions and suggestions for future research

5.1. Summary and conclusions

This chapter details conclusions and future research opportunities arising from the work described in the previous chapters. This thesis aimed to resolve unanswered questions relating to African bank contingent capital, its construction and assembly, measurement and design. Ultimately, this work points research in new directions regarding this important financial problem of inherent procyclicality in financial instruments.

Banks play a very important role in the African market as they provide stability in the monetary system, economic stability and continuity, are a source of growth to the economy and facilitate economic activity and trade. The 2008 credit crisis was devastating to banks across the globe, leaving markets in turmoil and forcing banks to liquidate. To prevent a similar crisis, banks need to become more resilient against economic downturns through the implementation of more and better quality of capital reserves. Many proposals have been suggested and implemented such as the Countercyclical Capital Buffer (see Chapter 3) and as an inherently countercyclical capital instrument CoCos are the logical next step to be explored and potentially implemented. CoCos are important considerations for African banks as they are largely absent from African markets at the time of this study, however, their introduction should be encouraged as they are ideally suited to the high volatility, high interest rate and high credit spread in African markets (see Chapter 2 and Chapter 4). Chapter 2 explores the pricing mechanisms of CoCos and how CoCos should be priced in the African markets. The risks as well as countercyclical properties of CoCos are explored in more detail in Chapter 3. The alternative structures for CoCos, foremost the COERC, is explored in Chapter 4 with proposals offered as to alternative constructs for elements of the design of these instruments in order to make them more attractive.

This study ultimately made a few important contributions to the literature: it was the first to suggest CoCos as a supplementary countercyclical capital instrument in Chapter 3 for African markets. The importance of countercyclical capital was explored and ultimately the quality of CoCos as countercyclical instruments were presented as possible tools to combat procyclicality. African banks pose a unique set of attributes in terms of their size, correlation to the market performance of the economies in which they operate and also because of the higher volatilities experienced in the markets in which they operate. This adds to the challenge of designing CoCos in a unique way which would render them to remain robust from the investor's point of view but also be loss absorbing in times of economic stress from the bank's point of view. Chapter 2 explored the various elements of CoCos and also how they should be priced in the African market. The trigger mechanism of CoCos should be effective in the sense that these bonds should be triggered while the bank is still a going concern. This poses a challenge,

as markets can move rapidly in volatile times. The study found that the pricing of African CoCos would require a trigger mechanism higher than would be normally set in a similar CoCo in a developed economy (such as the US or UK) and would offer a substantial yield due to the large impact that the volatility of the African markets has on the pricing of the CoCo (see Chapter 2). The high volatility in the African markets could result in CoCos that are very expensive to issue due to the high-risk present in the African markets. As such, alternative structures to CoCos (as proposed in Chapter 4) should be considered for the African market. This study concludes by being the first in literature to explore COERCs as the best structure for CoCo bonds in African markets as COERCs avoid the problems with market-based triggers (e.g. sell offs and death spirals) due to panic and market manipulation. Banks that issue COERCs have less incentive to choose investments which may be subject to large losses and disincentive problems associated with the replenishment of shareholder's equity after market declines (also known as debt overhang) are also avoided.

5.1.1. Paper 1: Pricing contingent convertible bonds in African banks

The BCBS aimed to correct the failures of Basel II through the introduction and phased implementation of a new set of regulations: Basel III. The amount of capital reserved for regulatory purposes, whether under Basel II or Basel III, has always been a focus area and is critical for banks' risk management. The *type* of acceptable, loss-absorbing regulatory capital is equally important: banks' bottom lines are strongly influenced by the choice of permitted instruments, since this impacts key considerations such as liquidity, return on capital and profit margins. "Ideal" regulatory capital, from a bank's point of view, would be a security which generates the highest possible return coupled with the most efficient loss-absorbing capacity, whereas regulatory authorities are more concerned with robustness and liquidity characteristics. These features can be challenging: although they are not mutually exclusive, bank aims and regulatory authority aims are not necessarily perfectly aligned either.

The implementation of the Basel III rules has been a phased process. Since 2011, qualifying banks have gradually and incrementally augmented capital, altered capital constituents, increased liquidity buffers, reported leverage ratios, and revamped market risk rules. The execution of this complex enterprise has not been without its difficulties – for banks in both developed and developing countries. Financial institutions in developing economies are less complex, but more volatile and fragile than their counterparts in developed economies. African banks are often subsidiaries of larger banks in developed countries or are smaller, independent institutions which use standardised risk management tools and are strongly correlated with the performance of the economies in which they operate. South African banks proved to be resilient in stressed economic conditions: losses from the 2008/9 financial crisis were not nearly as substantial as other global banks, but this was due to other, unique regulatory requirements, rather than purely *sufficient* and *acceptable* regulatory capital. It remains the case for African banks, that the type and quantity of capital held by them is crucial, for their economic performance and their viability in stressed economic conditions.

African banks are characterised by unique attributes in terms of size, correlation to local market performance and higher local volatilities. This adds to the challenge of designing and implementing regulatory capital instruments such that they will remain viable, but also be loss-absorbing in times of economic stress.

The international success of CoCos as loss-absorbing, robust capital instruments, suggested that they might be suitable for developing economy banks as well – in particular, *African* banks. Some modifications were necessarily introduced to manage the unique challenges faced by African economies, but research indicated that African banks were well-suited for CoCo use. New features to the existing CoCo framework were proposed and tested. CoCo trigger mechanisms, activated while the bank is still a going concern, posed a challenge, as African markets can be highly volatile. African CoCos thus required trigger mechanisms to be set higher than would normally be selected in developed economies, but simulations showed that the resulting high yield, offered because of the large impact of African market volatility on CoCo pricing, would be extremely attractive to CoCo investors.

This article answered the first of the three research questions: *How are CoCos priced?* Pricing models that could be used to value CoCos were investigated and the optimal approach to pricing CoCos, the equity derivative method, tested. How this pricing model behaves under changing conditions and varying macroeconomic conditions were explored, with chosen conditions closely representing African markets chosen as proxies for the African continent.

Paper 2: Contingent convertible bonds as countercyclical capital measure

Capital procyclicality causes an over-extension of credit in bull markets (fuelling a dangerous spiral of illusory lower default probabilities and less credit risk) and a subsequent dearth of credit in bear markets (when it is most needed). The BCBS acknowledged this problem and dealt with it by introducing, in Basel III, a gradual phase-in of rules governing procyclical buffer accumulation. To avoid capital depletion, the Basel III rules increased both the amount and quality of regulatory capital required under normal economic conditions and introduced the CCB to deal with the procyclicality problem. Adding the CCB to regulatory rules is an attempt to bolster banks' required capital when the economy is overheating, and release it back into the economy when the economy enters a slump. The CCB remains, however, a theoretical exercise as the regulatory implementation of this buffer has not yet been completed (2018).

The majority of research conducted on the CCB and its implications for banks' regulatory credit risk capital has also been largely conducted using developed economies' data. However, the little work that has been done using developing market data (van Vuuren, 2012 and Burra *et al.*, 2014) is promising: early indications show that the build-up and release of CCB capital holds interesting implications for developing economies, such as South Africa. Once the CCB requirements are instituted, significant time-lags must be considered before the regulatory capital requirements are relaxed again. History has

also shown that markets are self-adjusting and may regulate back to their long-run trend after a period of excessive growth: this poses interesting challenges for banks who will be required to keep the additional capital required by the CCB while operating in a market where capital becomes increasingly more expensive and increasingly scarce.

CoCos are designed to absorb losses in severe economic conditions. The inherent mechanism which allows for banks to cease paying bond coupons in economic contractions may afford banks the opportunity to use the additional cash flow to service burgeoning liquidity requirements. Furthermore, in a situation where the conversion trigger mechanism is triggered with the CoCo either suffering a write-down and/or converting into equity, the capital ratio of a bank is immediately boosted.

The CCB has been shown to function as a good countercyclical capital metric in times of economic expansion, however, the absence of the disincentive to increase the capital of a bank in economic contractions does not necessarily imply that the banks will be incentivised to use the extra capital to extend credit into the market, especially as the RWA and PD of the banks will rise under these conditions. The issuance of CoCos, provided that their trigger mechanisms are designed correctly, may prove helpful to banks and the broader financial sector in times of economic contraction through the countercyclical capital properties that manifest through CoCos under these economic conditions.

The results which emerged from this article indicate that South African banks would have benefited considerably from the increased liquidity and capital boosts if they had CoCos in issuance prior to the 2008/9 credit crisis.

This article answered the second of the research questions: *What are the risks associated with CoCos?* How risk is measured in CoCos and how trigger mechanisms may work for CoCos was explored, as well as how the introduction of CoCos may impact African banks' capital and how this capital differed from developed markets.

5.1.2. Paper 3: Exploring contingent convertible bond alternatives for African banks

Changes in regulatory rules which arose from the Basel II and III accords provide an indication of the magnitude of the problem of market procyclicality. Preventing the reduction of bank capital in times of economic stress include measures such as the new CCB metric and an increase in the quantity and quality of capital required from banks. A more detailed investigation into the application of these measures, however, has indicated that in developed economies such as the markets in Africa, the CCB in particular, may be inadequate (van Vuuren, 2012 and Burra *et al.*, 2014) as there is a substantial time-lag that must be accounted for before requirements are relaxed.

CoCos have been proposed as a means of managing procyclical regulatory capital. CoCos are loss-absorbing when banks are under financial duress (they convert from a bond into common equity when certain pre-defined conditions are met), but they have been criticised for some failings, most notably

the lack of clarity regarding trigger mechanisms (Pennacchi *et al.*, 2012). Under some market conditions, incentives may arise for speculators to short bank equity and in so doing, drive down equity prices to profit from the conversion to common equity when the CoCo is ultimately triggered.

A new instrument, the COERC, has been suggested as a possible alternative structure to CoCos: COERCs add unique new features to CoCos and in so doing, alter payoff profiles to the benefit of all stakeholders. These provide viable investment options to fixed income investors who constitute a large percentage of institutional investors who purchase bank bonds. COERCs augment previous CoCo proposals (Flannery, 2009a, b) to solve three outstanding problems.

1. By providing shareholders with the option to repurchase shares from COERC investors at the conversion price, COERCs avoid the problem of manipulating the issuing firm's stock price or placing its stock in a "death spiral" tailspin because of concerns about possible stock dilution.
2. To reduce the risks associated with CoCos (and so encourage investment in them), alternative securities must be designed to *force* shareholders to repay when the bank enters financial distress. COERCs set conversion prices very low, at a level below the conversion trigger of the stock price. Not repaying COERC investors dilutes shareholder stock value substantially and transfers wealth to COERC investors which in turn reduces COERC credit risk.
3. by basing the conversion trigger on the market value of total capital to senior debt ratio, rather than the stock price, COERCs eliminate the multiple equilibria problem (Bond, Goldstein and Prescott, 2010).

Non-convertible bonds and standard vanilla CoCos have higher default risk than COERCs. COERCs have low credit risk and thus reduce the costs (directly and indirectly) of financial distress. Their lower default risk mitigates excessive risk-taking incentives which typify levered firms. COERCs diminish the possibility of wealth transfers between shareholders and investors and thus help solve the high leverage 'debt overhang' problem (Myers, 1977). COERCs are also attractive investments for corporations as they reduce agency costs.

COERCs are autonomous: regulatory authorities play no role in monitoring and managing them, and, to prevent dilution, COERCs force equity holders to repay debt which benefits shareholders through lower COERC yields that convert to equity in times of financial distress.

This article answered the last of the three research questions: *Will CoCos manage African bank capital procyclicality effectively?* The introduction of countercyclical capital rules to African financial markets will influence regulatory capital but should be sufficient to manage robust capital level in African banks.

It was demonstrated that the distinctive features and advantages of COERCs would be particularly beneficial for developing economy banks – such as African banks. Additional features to COERCs such as floating coupon rates, would also benefit these banks.

It was demonstrated that the distinctive features and advantages of COERCs would be particularly beneficial for developing economy banks – such as African banks. Additional features to COERCs such as floating coupon rates, would also benefit these banks.

This thesis explored problems in the African market by investigating the appropriateness of CoCo and COERC securities as alternative capital instruments in a uniquely developing market environment.

The formulation of CoCo pricing models incorporated uncertainty dynamics, stochastic pricing, Ito calculus and the Black-Scholes methodology. The contribution to the field was the adaptation of these models to be effective in environments that are characterised by high yield spreads, low credit ratings, exchange reserve limitations and substantial illiquidity. The results obtained were robust for capital which is both resilient and loss-absorbing under financial duress.

The countercyclical nature of CoCo bonds under the assumptions in and adaptations of the new pricing models affirms that they may be suitable financial instruments for curbing procyclicality. It has been repeatedly demonstrated in this thesis, that these instruments should be absorbed into developing market bank regulations. The multifarious elements which contribute to the success of these instruments relate *inter alia* to the design of the components and pricing of the issuance both for which COERCs were proven to be the ultimate design choice for use in African markets.

5.2. Limitations

The authors acknowledge that at the time of this study there were no CoCo bonds in issuance in any African market. As such, assumptions needed to be made around designs of CoCo bonds and COERCs in particular. In Chapter 3, the assumption was made that the CoCo conversion to equity is instantaneous for illustrative purposes, however, in practice this may not be plausible, practical or desirable. Similarly, the trend in the projected capital ratio was assumed to remain the same as the underlying capital ratio for the period following the addition to the capital ratio, however, this may not be the case. Furthermore, Modigliani-Miller results are assumed to hold in our COERC simulations in Chapter 3, so financial distress model costs were ignored, which may not be the case in a real-world scenario. Lastly, at the time of this study there had been no record to the knowledge of the authors of a default or trigger of a COERC bond. As such, the theory around the soundness of these bonds under periods of financial duress of the issuer remains untested in practice.

5.3. Suggestions for future research

The regulators who are responsible for guidelines on the type of capital to be used in banks, especially the BCBS, would do well to elaborate on the precise composition of CoCos which would be acceptable

as Tier 1 capital in banks. This is of particular interest to banks which operate in developing economies and would provide clear direction on what is allowed and how to move forward on implementing this type of security. From our investigation, it is evident that the trigger and conversion mechanism of a CoCo are both key aspects in the design of the securities, and as such, we suggest an in-depth investigation into the effect that various embodiments of these design factors will have on CoCos in the African market. One specific element which is impacted by the aforementioned factors is the time which elapses between the trigger event of a CoCo and the point where the CET1 capital ratio is bolstered by the additional capital. This is because banks need to be going concerns upon receiving the capital injection. A clearer understanding of the metrics around the time-lapse period will prove to be beneficial to both regulators and banks alike when designing CoCo bonds.

An element in the design of COERCs in the African context which is still to be considered pertains to the coupon payment mechanism in times of financial duress. It could be argued that in periods of economic distress, the coupon payments of COERCs in the African context should be amended to either cease payments to investors or to reduce the coupon rate according to pre-specified metrics. A study into this design-alteration on COERCs may prove to yield economically useful information and add to the already-significant list of benefits which COERCs hold as loss-absorbing instruments in the African context. Additionally, it may also be useful to determine the optimal coupon rate which COERCs which are issued in African markets should offer to make the security attractive to investors. The coupon mechanism may alternatively be designed in a way which is unconventional when compared to the existing range of securities which has been offered, in the sense that coupon payment of a COERC could be designed to increase as the share price of the bank falls. COERCs thus become more attractive investments as the share price falls and greater returns are offered as the risk of triggering the COERC increases.

The principle upon which COERCs are presented as alternatives to CoCos are predicated in a big way on the underlying call-option which is attached to the security. Further studies should investigate the design of the call-option specifically pertaining to the maturity attached to the call option and the effect that this may have on the performance of the security in market conditions, particularly the African market. The risk attached to a security fluctuates as the time to maturity changes, and this element in the design of COERCs may prove to be useful when considering the design of COERCs for use as loss-absorbing and countercyclical securities in the capital composition of issuing banks.

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