Lessons learnt from the deficiencies of the Basel Accords as they apply to Solvency II
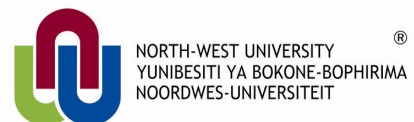
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Thesis submitted in fulfilment of the requirements for the degree *Philosophiae Doctor* in Risk Management at the Potchefstroom Campus of the North-West University

Promoter: Dr GW van Vuuren

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"After climbing a great hill,

one only finds that there are many more hills to climb."

- Nelson Mandela -

Preface

This study was completed in fulfilment with the requirement for the degree of *Philosophiae Doctor* in the published article format in the School of Economics of the Potchefstroom campus of the North-West University under the supervision of Dr Gary van Vuuren.

This study comprises four 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 it has been duly acknowledged in the text. Service providers used for obtaining data have also been duly acknowledged in the text.

The literature study that introduces the main theme of this thesis in Chapter 2 has been published in the *Journal of Economic and Financial Sciences* (JEF), Volume 6 Number 2 (July 2013)[i] and was presented at the conference on *Financial Globalisation and Sustainable Finance: Implications for Policy and Practice* in Cape Town, South Africa from 29 to 31 May 2013. This specific study identifies weaknesses in the Basel Accords that were highlighted by the financial crisis of 2007 to 2010 and relate these weaknesses back to Solvency II.

The study detailed in Chapter 3 on the topic of the cost of capital between countries where developed and developing countries' costs of capital are calculated in order to determine whether financial regulations can achieve their objective of providing level playing fields between different financial institutions (Chapter 3) has been submitted to the *South African Journal of Economics and Management Sciences* (SAJEMS) for publication.

Chapter 4 contains a study on the costs of capital among developing countries and the drivers behind possible discrepancies in their costs of capital. This study was presented at the *10th African Finance Journal Conference* held in Durban, South Africa, from 15 to 16 May 2013. Following the conclusion of the conference, the paper has been submitted for publication in a special conference edition of the *African Finance Journal* (AFJ).

Chapter 5 provides a comparison of the sensitivity of regulatory capital and economic capital in relation to the risk associated therewith. In this study, regulatory capital and economic capital were compared empirically using a dynamic optimisation model. This study has been submitted to the *South African Journal of Economics* (SAJE) for publication.

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Johann R. G. Jacobs   8 August 2013

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[i] The consent of the editor of JEF was obtained for the article to be included in this thesis.

Acknowledgements

I would like to acknowledge that without the contribution, input and support of others, the completion of this research would not have been possible. I draw special attention to the contributions of the following people in particular:

- First and foremost, I wish to extend my heartfelt appreciation to my study leader, Dr Gary van Vuuren. I owe him a great debt of gratitude for his contributions to this study and I would like to thank him for the (literally) hundreds of replies to e-mails, his invaluable comments and suggestions, his knowledge and insights into the subject matter, his patience with me and all my questions, his unparalleled work ethic, and all the administrative support he provided. This PhD has been an extraordinary one in many ways, but the fact that it has been completed almost in its entirety with him in London and me in Pretoria, and the two of us having only ever spent about two hours around the same table, makes this truly remarkable. I would further like to extend a special thanks to Dr van Vuuren for his unwavering belief, enthusiasm and support during this entire study.

- I would like to thank the North-West University for favourably considering some of my requests and for bending some of the administrative processes slightly to accommodate me. In particular, I would like to thank Professors Jaco Pienaar, Andrea Saayman and Wilma Viviers for their assistance and contributions in this regard.

- I would also like to thank Herco Steyn for proofreading my thesis and for his valuable suggestions toward improving the language and style thereof.

- My examiners and anonymous referees whom I wish to thank for their valuable comments and helpful suggestions.

- During the course of this study it has often been difficult spending such a significant amount of time on something that I cannot easily explain to others, and which would most likely simply not interest anyone else. I would therefore like to thank everyone who has been supportive of me in taking on this challenge and those that showed an interest in what I have been doing. In particular, I would like to thank those individuals who listened to me explaining my research topic despite not necessarily always fully understanding or finding it interesting. Their interest and support provided me with a much-needed outlet and it meant more to me than they may have realised.

Abstract

Topic: Determining the extent to which weaknesses in banking regulations have been carried over into insurance regulations; the ability of financial regulations to achieve their objectives; a comparison of the cost of capital between countries; and an empirical analysis of the risk sensitivity of regulatory capital and economic capital.

Key terms: *Basel, Solvency II, financial regulations, objectives of financial regulations, financial crisis, cost of capital, regulatory capital, economic capital.*

Solvency II is the new European Union (EU) legislation which will replace the capital adequacy regime for the insurance industry. Considering that the banking sector has experienced a similar change through the different Basel Accords (Basel), there is an opportunity for the insurance industry before the implementation of Solvency II to learn from the weaknesses and shortcomings in Basel to ensure that the design of Solvency II will, as far as possible, compensate for these.

The financial crisis of 2007 to 2010 highlighted certain weaknesses and shortcomings of Basel and there is accordingly an opportunity for the insurance industry to learn from these deficiencies and to strengthen Solvency II to help prevent similar events in the insurance industry. This thesis investigates these weaknesses in Basel in an attempt to determine the extent to which these are inherently included in Solvency II.

The first research problem of this thesis examines these weaknesses in Basel and relates them back to Solvency II to determine which, and to what extent, some of them may have been included in Solvency II.

The second research problem leads from the first and critically explores an objective of financial regulations, namely to provide financial institutions with equal competitive conditions (the so-called 'level playing field') from a regulatory perspective. To achieve this objective, there is an implicit assumption that the cost of capital between countries is equal. Investigation into the cost of capital between both developed and developing countries using a modified weighted average cost of capital model indicates that the cost of capital between developed and developing countries differs and that regulations based on capital requirements tend to favour developed countries. This means that current financial regulations cannot achieve this objective as intended.

The third research problem investigates the cost of capital between various developing countries to determine firstly whether similar competitive distortions exist among such countries, while secondly exploring the drivers behind the cost of capital in such countries through linear regression analyses.

The results indicate similar distortions between developing countries while the major driver behind the cost of capital for developing countries is equity market volatility, and not credit risk as might have been expected.

Finally, the fourth research problem relates to another objective of financial regulations: to reflect the risks that financial institutions face. The risk sensitivities of economic and regulatory capital for credit risk are investigated empirically using a dynamic optimisation model in one of the first studies of its kind. Results show that economic capital is a superior risk measure to regulatory capital from a systemic- and institution-specific risk perspective. This, along with calls to strengthen Pillar 2 disciplines following the financial crisis, leads to a suggestion that economic capital could be considered as a Pillar 1 capital requirement, replacing the current forms of Pillar 1 regulatory capital.

Opsomming

Onderwerp: Om vas te stel tot in watter mate swakhede in banksektor-regulasies oorgedra is na versekeringsektor-regulasies; die vermoë van finansiële regulasies om hul doelwitte te bereik; kapitaalkoste tussen lande; en 'n empiriese analise van die risiko-sensitiwiteite van regulatoriese en ekonomiese kapitaal.

Sleutelterme: *Basel, Solvency II, finansiële krisis, finansiële regulasies, doelwitte van finansiële regulasies, kapitaalkoste, regulatoriese kapitaal, ekonomiese kapitaal.*

Solvency II is die Europese Unie (EU) se nuwe regulatoriese kapitaalwetgewing wat die huidige kapitaalvereistes in die versekeringsbedryf gaan vervang. Die banksektor het 'n soortgelyke verandering ondergaan met die implementasie van die verskeie Basel Akkoorde (Basel). Met Solvency II wat nog geimplementeer moet word bestaan daar gevolglik die geleentheid vir die versekeringsektor om te leer uit die swakhede en tekortkominge in Basel om sover moontlik daarvoor te kompenseer tydens die ontwerp van Solvency II.

Die finansiële krisis van 2007 tot 2010 het sekere swakhede en tekortkominge in Basel beklemtoon en die geleentheid bestaan dus om lesse te leer van hierdie tekortkominge. Solvency II kan sodoende moontik versterk word om te help dat soortgelyke gebeure in die versekeringbedryf verhoed word. Hierdie tesis ondersoek die swakhede om vas te stel tot in watter mate hulle ook inherent in Solvency II is.

Die eerste navorsingsprobleem ondersoek die swakhede van Basel met betrekking to Solvency II om vas te stel watter, en tot in watter mate, die swakhede ingesluit is in Solvency II.

Die tweede navorsingsprobleem volg op die eerste en ondersoek krities een van die doelwitte van finansiële regulasies: om, vanuit 'n regulatoriese perspektief, finansiële instellings met gelyke kompeterende omstandighede (die sogenaamde 'gelyke speelveld') te voorsien. Om hierdie doelwit te bereik is daar 'n implisiete aanname dat die kapitaalkoste tussen verskillende lande gelyk is. 'n Ondersoek rondom die kapitaalkoste tussen onwikkelde en ontwikkelende lande deur gebruik te maak van 'n aangepaste geweegde gemiddelde kapitaalkoste model dui daarop dat die kapitaalkoste tussen lande verskil en dat regulasies wat gebaseer is op kapitaalvereistes ontwikkelde land baat ten koste van ontwikkelende lande. Dit beteken gevolglik dat huidige finansiële regulasies nie hierdie doelwit kan bereik nie.

Die derde navorsingsprobleem ondersoek die kapitaalkoste tussen ontwikkelende lande om eerstens vas te stel of soortgelyke kompeterende ongelykhede tussen sulke lande bestaan terwyl tweedens die

drywers van kapitaalkoste in ontwikkelende lande deur 'n lineêre regressiewe analise ondersoek word. Die uitslae dui dat soortgelyke kompeterende ongelykhede tussen sulke lande bestaan en dat aandele-mark-volatiliteit die hoofdrywer van die kapitaalkoste van ontwikkelende lande, en nie kredietrisiko soos verwag nie.

Die vierde navorsingsprobleem hou verband met nog 'n doelwit van finansiële regulasies: om die risikos waaraan finansiële instellings blootgestel word akkuraat te weerspieël. In een van die eerste studies van die soort word die risiko sensitiwiteite van ekonomiese- en regulatoriese kapitaal vir kredietrisiko empiries ondersoek deur 'n dinamiese optimaliseringsmodel te gebruik. Uitslae dui dat ekonomiese kapitaal 'n beter aanduiding van risiko is as regulatoriese kapitaal uit beide sistemiese- en instelling-spesifieke perspektiewe. Die bevinding, tesame met versoeke rondom die versterking van Pilaar 2 disiplines na die finansiële krisis, lei tot 'n voorstel dat ekonomiese kapitaal, in plaas van die huidige vorms van Pilaar 1 regulatoriese kapitaal, as 'n Pilaar 1 kapitaalvereiste oorweeg moet word.

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List of acronyms and abbreviations

BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BPS	Basis points
CAPM	Capital asset pricing model
CEA	European Insurance and Re-insurance Federation
CEBS	Committee of European Banking Supervisors
CEC	Commission of the European Communities
CIFP	Center for Insurance and Financial Planning
COC	Cost of capital
CR	Country risk
CRA	Credit rating agency
ECB	European Central Bank
EIOPA	European Insurance and Occupational Pensions Authority
EMBI	Emerging Markets Bond Index
EU	European Union
FCIC	Financial Crisis Inquiry Commission
FRED	Federal Reserve Bank of St Louis Economic Data
FSA	Financial Services Authority
G8	Group of 8 countries
GDP	Gross domestic product
HKMA	Hong Kong Monetary Authority
ICAAP	Internal capital adequacy assessment process
IRB	Internal ratings-based
LGD	Loss given default
MCR	Minimum capital requirements
MEA	Middle East and Africa
MSCI	Morgan Stanley Capital International
O5	Outreach 5 countries
ORSA	Own risk and solvency assessment
PD	Probability of default
RBC	Royal Bank of Canada
RIMS	Risk and Insurance Management Society
SCR	Solvency capital requirements
SFRC	Shadow Financial Regulatory Committees
VaR	Value-at-risk
WACC	Weighted average cost of capital

Chapter 1

Introduction

Introduction

"We conclude widespread failures in financial regulation and supervision
proved devastating to the stability of the nation's financial markets."
Financial Crisis Inquiry Commission (FCIC), (2011:*xviii*).

1.1. Introduction and background

Solvency II is the new European Union (EU) legislation that will be used to review the capital adequacy regime for the insurance industry (European Insurance and Re-insurance Federation (CEA), 2007:3). The current solvency requirements for the insurance industry were established in the 1970s and introduced capital requirements for insurers by setting out capital requirements for solvency margins (CEA, 2006:10). However, given the fact that these requirements and measures had become outdated, they were reviewed to produce the new Solvency II legislation which will be implemented from 2014.[i]

Considering that the banking sector had gone through a similar change through the implementation of the Basel Accords (Basel), before the implementation of Solvency II there is an opportunity for the insurance industry to review the measures, weaknesses and potential shortcomings of the Basel regime in order to learn from these and ensure that the implementation of Solvency II will, as far as possible, compensate for these. Although banks and insurers differ in many ways ranging from their economic functions, services offered, operating models, balance-sheet structures, and indeed their regulatory regimes, the fundamental principles and objectives of their regulatory regimes, namely Basel and Solvency II, are essentially the same, which similarity essentially allows for this study. These principles and objectives of financial regulations are highlighted briefly in section 1.1.1 below.

1.1.1. Fundamental principles and objectives of Basel and Solvency II

Financial regulations, i.e. Basel and Solvency II, are based on similar principles in that both are based on a three-pillar approach and both set out to achieve the same broad objectives.

More specifically, both sets of regulations use regulatory capital as its primary regulatory tool (Pillar 1 requirements) with other supplementary measures under their Pillar 2 requirements, including so-called 'internal capital adequacy assessment processes' (ICAAPs) for banks and 'own risk and solvency assessments' (ORSAs) for insurers (Bank for International Settlements (BIS), 2006:158; EU,

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[i] Solvency II was due for implementation in January 2014, but has since been delayed and much uncertainty exists regarding its implementation date.

2009:4), and Pillar 3 requirements that focus on disclosure and reporting. The three-pillar approach of Basel and Solvency II is shown in Figure 1.1.

Figure 1.1: The three-pillar approach of Basel and Solvency II
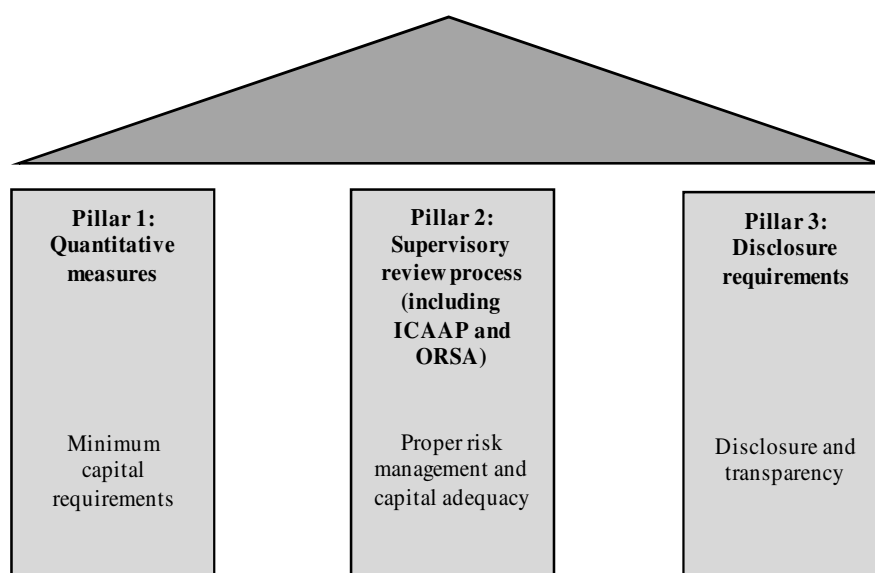
Source: Adapted from BIS (2006:6) and Lloyd's (2010:5).

The three major objectives that both sets of regulations set out to achieve are to contribute to financial stability; to level playing fields among financial institutions in terms of regulatory costs; and to be based on measures and tools that are risk sensitive, i.e. ones that are reflective of the risks faced by financial institutions (BIS, 1999:9; Shadow Financial Regulatory Committees (SFRC), 1999:2; De Carvalho, 2005:7-8; Gordy & Howells, 2004; Horcher, 2005:257; Lind, 2005:28; Tiesset & Troussard, 2005:65; van Roy, 2005:7; BIS, 2006:6; CEA, 2006:5; Koch & MacDonald, 2006:312; Commission of the European Communities (CEC), 2007:3; Sandström, 2007:12; van Duffel, 2008:9; EU, 2009:3; Lloyd's, 2010:4-8; Clutterbuck, 2011:8; Ho, 2012:2; Jacobs & van Vuuren, 2013a, 2013b; van Laere & Baesens, 2012).

In brief, financial regulations set out to achieve the following objectives:

- **Financial stability objective.** The first objective is sought through the implementation of capital requirements for all financial institutions that will lead to a perceived improved financial safety net which can contribute to global financial stability (Milne, 2001:8; Financial Services Authority (FSA), 2006:7; Atik, 2011:740-741).
- **Levelling of playing fields objective.** The second objective involves, through the introduction of capital requirements, eliminating potential competitive advantages that some institutions may enjoy over others because of them maintaining lower capital ratios.

- **Regulatory capital requirements to be risk sensitive.** The third objective is one of the major aims of both Basel and Solvency II: to introduce regulations based on capital requirements that would be risk sensitive, essentially meaning that financial institutions exposed to higher risks would have to hold more capital (Gordy & Howells, 2004; BIS, 2006:2; CEA, 2006:5; Ho, 2012:2). Risk sensitive regulatory capital requirements serve the purpose of discouraging financial institutions to invest in risky assets and instruments because these would bear higher capital requirements and also to replace previous crude regulatory capital requirements with more sophisticated ones (Milne, 2001:13-14).

The fact that both sets of regulations are based on the same principles and given that both aim to achieve the same objectives provide the basis for this study. With this in mind, it is important to investigate and understand weaknesses in Basel that were highlighted by the financial crisis of 2007 to 2010 (financial crisis) to be able to relate them back to Solvency II. The following section briefly describes such weaknesses.

1.1.2. Weaknesses highlighted by the financial crisis

In addition to both sets of regulations aiming to achieve the same broad objectives, the financial crisis highlighted major weaknesses and failures of Basel which had partly contributed to the crisis and some of which were exploited during the financial crisis. Atik (2011) argues that Basel did not only contribute to providing the conditions for the crisis, but that it was in fact a major cause thereof, while Lall (2009) adds that Basel failed to achieve any of its stated objectives. Many factors ultimately contributed to the crisis and the FCIC found that one of the contributing factors to the crisis was "*a widespread failure in financial regulation and supervision*" (FCIC, 2011:*xviii*). By describing the events leading up to the financial crisis and the events around the crisis itself, the weaknesses and failures of Basel become apparent and, in turn, can be applied to Solvency II while keeping in mind its specific characteristics to gain an understanding of the prevalence and extent of such possible weaknesses and failures in Solvency II.

Many of the contributing factors to the financial crisis are interrelated, but seeing as regulatory failure was recognised as one of them, the following obvious weaknesses from Basel can be identified:

- **Generic international regulatory standards do not necessarily work.** For a variety of reasons it can be argued why generic international regulatory standards may not necessarily be successful in what they set out to achieve.
- **The procyclicality of capital and capital requirements.** International regulatory standards have adopted capital as the cornerstone for its regulation. However, capital is inherently procyclical, meaning that it will be scarcer in times when it is required most.

- **The assumption that micro-prudential regulation will achieve macro-prudential objectives.** International regulatory frameworks have up to now focused on regulating individual banks while assuming that if each bank is safe and sound, the financial system as a whole will also be safe and sound.

- **Overreliance on financial models.** Financial modelling has become the international standard for various risk management and other uses over recent decades as a result of the complexity and advancements that have been made in financial markets and financial institutions. There is, however, a risk that it may have led to an overreliance on the results of these models to make decisions.

- **Potential incentives to 'cheat'.** Some banks employ teams of quantitative analysts and lawyers that analyse opportunities to optimise their banks' capital, whether through regulatory arbitrage, structuring of new products, taking certain assets off-balance sheet, or simply misrepresenting information.

- **Failures in Pillar 2 disciplines.** From the financial crisis it may be argued that many of the factors that contributed to the crisis could have, and possibly should have, been picked up in the Pillar 2 processes of Basel.

- **Overreliance on credit rating agencies (CRAs).** This was highlighted as one of the contributing factors to the financial crisis and is an inherent feature of Basel.

Once each of the weaknesses is discussed from both a Basel and Solvency II perspective, it poses the following research questions that will be researched further based on the objectives of the Basel and Solvency II financial regulations:

- whether the cost of capital differs between countries and whether a global regulatory standard based on capital requirements truly levels playing fields as it sets out to do; and

- whether current regulatory capital requirements are reflective of the risks that financial institutions face.

The cost of capital between countries and the risk sensitivities of regulatory and economic capital are researched empirically in an attempt to answer these secondary research questions.

1.2. Problem statement and research objectives

The financial crisis highlighted some of the deficiencies that were present in Basel. Although several factors contributed to the financial crisis, the failure of financial supervision was highlighted as a prominent shortcoming and various deficiencies in financial regulatory theory and practice subsequently came to the fore. This study therefore critically assesses aspects of financial regulations in general, specifically banking (Basel) and insurance regulations (Solvency II), in order to determine not only which of the weaknesses that were present in the Basel Accords were carried over into Solvency II (which will be implemented from 2014 while risking that some of these exact frailties may

be exploited further upon its implementation), but also the extent to which both sets of financial regulations can achieve their objectives.

The high-level objective of this study is to determine to what extent the weaknesses of Basel are inherently present in Solvency II with the core objectives being to:

- determine which of the weaknesses of Basel that were highlighted by the financial crisis are prevalent in Solvency II;

- evaluate whether global regulatory standards based on capital truly level playing fields as they set out to do and whether they contribute to unequal competitive conditions among developing countries; and

- research the risk sensitivity of regulatory and economic capital requirements empirically in an attempt to establish the plausibility of regulators placing greater emphasis on economic capital numbers for both Basel and Solvency II.

Following the objectives, the outline of this study is arranged per chapter as follows:

- To determine which of the weaknesses of Basel that were highlighted by the financial crisis are prevalent in Solvency II. Chapter 2 explores this objective and sets out to:

  o Provide a background on the development of Basel, its objectives and main features (including new features introduced in Basel III).

  o Provide a background on the development of *Solvency II*, its objectives and main features to *gauge possible similarities from a principle point of view* between the two regulatory regimes.

  o Provide a *brief history of the build-up* and occurrence of the financial crisis along with the *most prominent contributing factors* leading to the crisis.

  o Relate the contributing factors back to Basel to identify its possible *weaknesses and deficiencies that were highlighted by the crisis*.

  o From the weaknesses and deficiencies in Basel, discuss each weakness or deficiency in relation to the financial crisis from a Basel perspective before *applying each to Solvency II to gauge its prevalence*.

- To evaluate whether global regulatory standards based on capital truly level playing fields as they set out to do. This objective is investigated in Chapter 3 which sets out to:

  o Briefly explain the historical development of Basel and Solvency II and to highlight similarities shared between the two regulatory regimes.

  o Explain the calculation methods of the cost of debt, cost of equity and weighted average cost of capital.

- Use three calculation methods to calculate the cost of capital for a sample set of countries.

- Using these three methods, calculate the cost of capital for fifty-four institutions across seventeen countries divided between developed and developing countries.

- Compare the results of the calculations and present findings and conclusions.

- Relate the results and findings of the cost of capital calculations back to what Basel and Solvency II require and attempt to achieve.

- Explore whether capital as regulatory tool can truly achieve one of the major objectives of financial regulations, i.e. one of providing financial institutions with level playing fields.

- Based on the previous objective, investigate whether financial regulations based on capital requirements contribute to unequal competitive conditions among developing countries. This investigation takes place in Chapter 4 which:

  - Based on the results and findings from the previous point, explain how capital requirements might contribute to unequal competitive conditions among developing countries based on their respective costs of capital.

  - Use three calculation methods to calculate the cost of capital for different developing countries.

  - Using these three methods, calculate the cost of capital for fifty-four institutions across twenty developing countries divided into four geographical regions.

  - Based on the results of the cost of capital calculations, conduct a regression analysis to determine possible drivers of such discrepancies.

  - Compare the results and present the findings and conclusions.

  - Relate the results and findings of the cost of capital calculations back to what Basel and Solvency II requires and attempts to achieve.

  - Explore whether capital requirements contribute to unequal competitive conditions among developing countries.

  - Present results on possible driving factors behind cost of capital discrepancies between developing countries.

- To research the risk sensitivity of regulatory and economic capital requirements empirically in an attempt to establish the plausibility of regulators placing greater emphasis on economic capital numbers for both Basel and Solvency II. Chapter 5 investigates this objective and aims to:

  - Provide a high-level description of financial regulations and their major objectives.

o Provide an explanation of the Pillar 2 disciplines for each of the Basel and Solvency II financial regulations and what they set out to achieve.

o Briefly explain the failures of the Pillar 2 disciplines under Basel during the financial crisis while considering how the effectiveness of Pillar 2 can be improved in future.

o Consider similarities between Basel's and Solvency II's Pillar 2 disciplines, especially around the respective ICAAPs and ORSAs, and the supervisory processes between them.

o Explain the differences between economic capital and regulatory capital in terms of their characteristics and purposes, as well as the implications of these.

o Provide a comprehensive literature review on previous research regarding the sensitivity of capital.

o Investigate the risk sensitivity of economic capital and regulatory capital requirements for credit risk[ii] on a comparative basis from a systemic- and institution-specific perspective and, based on these results, assess whether current regulatory capital requirements are truly representative of the risks financial institutions face.

o Investigate the plausibility of regulators placing a heavier reliance on economic capital given these results and calls to strengthen Pillar 2 disciplines in the aftermath of the crisis.

• Summary of the weaknesses of Basel II that were found to be present under Solvency II. This summary is provided in Chapter 6.

o In the concluding chapter of the study, the weaknesses of Basel II that were investigated in the study that are considered to be present in Solvency II will be summarised in terms of findings, implications and recommendations.

1.3. Thesis outline

From the outset, it is important to highlight that financial regulations for banking (Basel) and insurance (Solvency II) are based on the same fundamental principles and objectives. These are, as already mentioned:

• **Both are based on a similar three-pillar approach.** Each of the pillars are designed to be mutually reinforcing so as to create a comprehensive regulatory framework for the banking and insurance industries respectively. In both cases the three pillars are further based on the same principles: Pillar 1 describes minimum capital requirements and the calculation thereof; Pillar 2 invokes the supervisory review process and the calculation of internal capital ade-

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[ii] Although only capital for credit risk is used in this study, it is noteworthy to point out that credit risk, as a proportional percentage, typically makes up more than 85% of total risk-weighted assets. This is illustrated by data obtained from the Banker Database (2013).

quacy requirements; and Pillar 3 requires enhanced transparency, public disclosure, and market discipline (BIS, 2006:6; Lloyd's, 2010:8; van Duffel, 2008:9).

- **Both set out to achieve the same broad objectives**, namely levelling the playing fields between financial institutions, striving to provide worldwide financial stability, protecting depositors and policyholders, promoting improved risk management, and being more risk sensitive (CEA, 2006:5; EU, 2009:3; Horcher, 2005:257; Koch & MacDonald, 2006:312; Lloyd's, 2010:4; Sandström, 2007:12; van Roy, 2005:7).

Therefore, in the analysis and investigation of much of Basel in this study, the lessons, results and conclusions are considered to be applicable to *both* sets of financial regulations.

Chapter 2 presents a comprehensive literature study in an attempt to compare certain characteristics of Basel and Solvency II, to explain the financial crisis, and to help identify the weaknesses in Basel and their prevalence in Solvency II. Although Solvency II has not been implemented or tested, the weaknesses identified in terms of Basel serve as a warning as Basel was rigorously tested during the financial crisis. From this, more questions arise that form the basis for the rest of this study.

As part of the weaknesses identified during the implementation of Basel, an argument can be made why generic global regulatory standards may not necessarily work. Strong arguments exist in favour of standardised international regulatory standards, one of them being that as a result of globalisation and technological advances, financial institutions' operations and exposures are intertwined to such an extent that it is preferable to have a standard regulatory base from which to work. Because banks and insurers are directly exposed to the failure of another bank or insurer in a faraway jurisdiction, it provides some level of comfort in knowing that the institution in the foreign jurisdiction is subject to the same capital requirements as in the home jurisdiction (Atik, 2011:740-741).

A couple of weaknesses with such an approach are that although it is relatively flexible, it introduces a variety of complications. The introduction of capital adequacy standards to level playing fields may not necessarily be workable because capital adequacy is not the only source from which financial institutions in foreign jurisdictions may enjoy a competitive advantage. There are certain country-specific characteristics and macroeconomic factors that give certain financial institutions and markets a competitive advantage over others, including macroeconomic factors, specific domestic regulatory environments, and the *cost of capital between countries may not be the same*.

Considering this argument that countries' cost of capital may differ and considering that one of the major objectives of both Basel and Solvency II is to *achieve level playing fields* among institutions (Koch & MacDonald, 2006:312; Clutterbuck, 2001:8), this levelling of playing fields may not necessarily be achievable. Chapter 3 therefore continues this study by explaining, calculating and analysing the cost of capital between different countries before attempting to relate the results back to the capital-based requirements of Basel and Solvency II to explain whether capital-based regulations can truly

achieve level playing fields. In exploring this, this study will firstly compare the results of a cost of capital analyses between a group of developed and a group of developing countries in order for it to determine whether capital requirements may favour either one of these two groups.

In a continuation of this angle of inquiry, Chapter 4 builds on what was done in Chapter 3 by conducting an analysis on the cost of capital among developing countries only in order to determine whether capital requirements might lead to distortions in terms of competitiveness among developing countries. In addition to these cost of capital analyses, Chapter 4 attempts to, based on possible discrepancies in the cost of capital between developing countries, determine and highlight major driving factors behind such discrepancies through a regression analysis. The identification of such driving factors may lead to interesting results and conclusions about the relative strength or weakness that some of these might have in contributing to countries' overall cost of capital.

Regulatory capital as a tool of financial regulations has come under scrutiny following the financial crisis of in terms of its ability to achieve the major objectives of the Basel and Solvency II financial regulations, i.e. contributing to financial stability and providing equally competitive regulatory conditions for financial institutions. This topic is highlighted in Chapters 2 to 4.

As mentioned earlier, a third objective of financial regulations is to ensure that regulatory capital requirements are risk sensitive, meaning that they are reflective of the risks faced by financial institutions. A further contributing factor to the financial crisis was failures of the current supplementary Pillar 2 disciplines of financial regulations. Under these disciplines, for both Basel and Solvency II, banks and insurers are required to calculate, *inter alia*, their own internal economic capital requirements, and report their results to regulators.

Therefore, with the third objective of financial regulation and the apparent failure of Pillar 2 disciplines in mind, Chapter 5 investigates:

- the risk sensitivity of economic capital and regulatory capital requirements empirically on a comparative basis from a systemic- and institution-specific perspective and, based on these results, assess whether current regulatory capital requirements are truly representative of the risks financial institutions face; and
- the plausibility of regulators placing a heavier reliance on economic capital numbers given these results and calls to strengthen Pillar 2 disciplines in the aftermath of the financial crisis.

Chapter 5 therefore explores some of the apparent weaknesses of current regulatory capital in terms of achieving this third objective of financial regulations and proposes economic capital as an alternative measure for regulators to consider using as primary regulatory tool. While the empirical analysis of the relationship between regulatory capital and economic capital remains largely unaddressed in academic literature (Jacobson, Lindé & Roszbach, 2006), Chapter 5 employs a dynamic optimisation

model to compare empirically the risk sensitivities of economic capital and regulatory capital in one of the first studies of its kind.

Given these results as well as calls to strengthen Basel's Pillar 2 disciplines in the aftermath of the financial crisis, Chapter 5 also presents a case for regulators to place a greater reliance on Pillar 2 disciplines and economic capital in particular. These results provide a distinct indication of the risk sensitivity of regulatory capital requirements prescribed in Solvency II and present an argument for the insurance regulatory regime to place a heavier reliance on insurers' economic capital numbers.

Chapter 6 provides concluding thoughts on the studies presented in this thesis while highlighting some potential future research opportunities emanating from this work.

1.4.   Conclusion

Regulatory capital as a tool of financial regulations has come under scrutiny following the financial crisis in terms of its ability to achieve the major objectives of financial regulations, i.e. contributing to financial stability, providing equal competitive regulatory conditions for financial institutions and ensuring that regulatory capital requirements are risk sensitive, i.e., they are reflective of the risks faced by financial institutions.

In critically assessing the ability of current financial regulations to achieve these objectives before the implementation of Solvency II, there is an opportunity for the insurance industry to review measures, weaknesses and potential shortcomings of the Basel regime in order for it to learn from these and to ensure that the implementation of Solvency II will, as far as possible, compensate for these identified weaknesses and shortcomings.

Although banks and insurers differ in many ways ranging from their economic functions, services offered, operating models, balance-sheet structures, and indeed their regulatory regimes, the fundamental principles and objectives of their respective regulatory regimes, namely Basel and Solvency II, are the same, which essentially form the basis of this study.

The conclusions presented in this thesis are based on the ability of current financial regulations to achieve the objectives they set out to achieve.

Chapter 2

Applying lessons learnt from deficiencies in the Basel Accords to Solvency II

Applying lessons learnt from deficiencies in the Basel Accords to Solvency II[i]

Johann Jacobs[ii] and Dr Gary van Vuuren[iii]

Abstract

Solvency II is the new European Union (EU) legislation that will review the capital adequacy regime for the insurance industry. Considerable progress has been made in the banking sector with the implementation of the Basel Accords (Basel). The implementation of Solvency II, therefore, brings with it an opportunity for the insurance industry to assess the successes, weaknesses and shortcomings experienced by the banking sector's implementation of Basel so as to learn from them and ensure that Solvency II's implementation duplicates the successes and avoids the failures of Basel's. This article critically explores weaknesses and failures of Basel which were exacerbated and/or exploited by the financial crisis of 2007-2010 and provides advice on how these might be mitigated or avoided in the implementation of Solvency II.

Keywords: Basel, banks, regulatory capital, Solvency II, financial crisis, insurance, regulation.

JEL classification: G01, G18, G28, G21, G22, G32.

1. INTRODUCTION

The insurance sector is yet to implement Solvency II, so an opportunity exists for the insurance industry to review measures, weaknesses and potential shortcomings of the Basel Accords ('Basel') in order for them to learn from these and ensure that the implementation of Solvency II will, as far as possible, compensate for these. When referring to the Basel Accords, this article refers to all the Basel Accords, including Basel III, although it is important to keep in mind that Basel III was not yet in force at the time of the financial crisis.

Although banks and insurers differ in many ways ranging from their economic functions and services offered, operating models, balance sheet structures, and indeed their regulatory regimes, this article illustrates that the fundamental principles of Basel and Solvency II are fundamentally the same which allows for such a study. The objective of this article is therefore to explore the weaknesses and failures of the Basel Accords which were highlighted and/or exploited by the financial crisis of 2007-2010, while attempting to consider the extent to which such failures and weaknesses may have been included in Solvency II.

Section 2 provides a brief literature study on the history and development of Basel and Solvency II as well as similarities in their principles and objectives.

Section 3 briefly describes the contributing factors of the financial crisis which are related back to Basel in an attempt to identify seven major weaknesses and/or failures of Basel that were highlighted by the crisis. Each of these are then discussed from a Basel perspective (including new measures introduced under Basel III to address each of the weaknesses and/or failures), while relating each back to Solvency II to gain an understanding of whether these weaknesses are prevalent in Solvency II before Section 4 provides a short conclusion.

2. BRIEF HISTORY OF AND SIMILARITIES BETWEEN BASEL AND SOLVENCY II

Financial regulation has developed over the past 40 years for the banking and insurance industries and resulted in Basel III ('Basel') and Solvency II respectively, which are the most recent sets of regulations for each of their respective industries. The development of these two sets of regulations took place in two completely separate streams while also being conducted by different bodies. This section provides a brief history of the development of Basel and Solvency II respectively before highlighting the two major principles which are similar in both.

2.1. Basel

During the early 1980s the Basel Committee on Banking Supervision (BCBS) became concerned that the capital ratios of the main international banks were deteriorating just when international risks, particularly those in comparison with heavily indebted countries, were growing (Styger and Vosloo, 2005:1).

The result was a broad consensus on a weighted approach for the measurement of risks for both on- and off-balance-sheet activities and the identification of the need for a multinational accord for the implementation thereof (Styger and Vosloo, 2005:1). This led to the development of the first accord entitled 'International Convergence of Capital Measurement and Capital Standards' (Bank for International Settlements (BIS), 1988). Over subsequent years and as a result of developments and innovations in financial markets and instruments, an amendment was included to the 1988 Accord in 1996 which was designed to incorporate market risk to the original Accord (Dowd, Hutchinson, Ashbey and Hinchliffe, 2011:8). The BIS (2007:3) adds that the refinement of this proposal concluded in the release of the comprehensive version of the new accord in June 2006 – 'International Convergence of Capital Measurement and Capital Standards', or the Basel II Accord (BIS, 2006). The financial crisis that shook global financial markets from 2007 highlighted some of the major shortcomings of Basel II and led to the BCBS adding supplementary requirements and measures to what was set out in Basel II in an attempt to address these. This became known as Basel III which began to be implemented in a phased approach from 2011-2019 in its entirety with different phases for liquidity and capital ratios, respectively (BIS, 2011).

2.2. Solvency II

Solvency II is the new European Union (EU) legislation that will review the capital adequacy regime for the insurance industry (European Insurance and Re-insurance Federation (CEA), 2007:3). The current solvency requirements were introduced in the 1970s and introduced capital requirements for insurers by setting out capital requirements for solvency margins (CEA, 2006:10). The first sets of insurance regulations were introduced in 1973, 1979, 1988, and 1992 (EU, 1973; EU, 1979; EU, 1988; EU, 1992). Meanwhile, risk-based capital systems were being introduced in the 1990s in the USA, Canada, Australia, Japan, and Singapore and the European Commission embarked on a review of all insurance regulations for the 20-year period up to and including the third Directive (Sandström, 2007:4).

The outcome of the working group was a report titled 'Report: Solvency of Insurance Undertakings', or the 'Müller Report' whose main conclusion was that the insurance system that was created in 1973 and 1979 had proved itself based on empirical evidence of financial difficulties occurring in insurers in the EU. From that, in principle, it was concluded that there was no need to revise it completely (Müller, 1997:3). Following the findings and suggestions set forth by the Müller Report, 2002 saw the introduction of the new Directive which later became known as Solvency I, in which the necessary adjustments were adopted (EU, 2002).

During the review process that led to Solvency I in 2002, certain weaknesses were identified that called for further reform in a report titled: 'Prudential Supervision of Insurance Undertakings' or the 'Sharma Report' (Sharma, 2002) and ultimately Solvency II.

2.3. Two major similarities in Basel and Solvency II and their relevance to this study

It should be stated from the start that banks and insurers operate in completely separate worlds in terms of economic functions they fulfil as well as products and services provided, balance sheet structures, and operating models. Al-Darwish, Hafemann, Impavido, Kemp and O'Malley (2011:6-17) and CEA (2010) provide useful discussions and descriptions of these differences between banks and insurers. Basel and Solvency II share some similarities in terms of the principles upon which they are based, these being that:

- Both are based on a similar three-pillar approach. The pillars are meant to be mutually reinforcing in order to create a comprehensive regulatory framework for the banking and insurance industries respectively. In both cases the three pillars are further based on the same principles where Pillar 1 describes minimum capital requirements and their calculations; Pillar 2 involves a supervisory review process and internal capital adequacy requirements calculations; and Pillar 3 involves itself with enhanced transparency, public disclosure, and market discipline (BIS, 2006:6; Lloyds, 2010:8; and van Duffel, 2008:9); and

- Both set out to achieve the same broad objectives, namely levelling the playing fields between institutions, providing worldwide financial stability, protecting depositors and policyholders, promoting improved risk management, and being more risk-sensitive (CEA, 2006:5; EU, 2009:3; Horcher, 2005:257; Koch and MacDonald, 2006:312; Lloyds, 2010:4; Sandström, 2007:12; van Roy, 2005:7).

The remainder of this article is based on these fundamental regulatory principle similarities while differences in calculation methods and other technicalities such as balance sheet structures, capital compositions, and operating models between banks and insurers are ignored.

3. DISCUSSION

In 2007, the financial world was shocked by events that continued for years where financial institutions failed, had to be bailed out by taxpayers and/or had to be taken over by other financial institutions. By looking back at the causes and consequences of these events, it may be possible to identify weaknesses in Basel that contributed to or exacerbated the crisis while considering that the same weaknesses may have been carried over into Solvency II, as it is broadly based on the same principles that underpin Basel, as were highlighted in Section 2.3.

Although Solvency II has not been implemented or tested, the weaknesses discussed here serve as a warning taken from lessons learnt when Basel was severely tested during the financial crisis.

Following the financial crisis, the Financial Crisis Inquiry Commission (FCIC) published a report that highlighted all the contributing factors to the crisis in detail, two of which were 'failures in financial regulation and supervision' and 'failures in corporate governance and risk management' (FCIC, 2011:xviii). Many of the contributing factors are interrelated, but seeing as regulatory failure was recognised as one of the contributing factors to the financial crisis, the following obvious weaknesses from Basel can be identified:

- international regulatory standards do not necessarily work;
- the pro-cyclicality of capital and capital requirements;
- the assumption that micro-prudential regulation will achieve macro-prudential objectives;
- the potential for an overreliance on financial models;
- potential incentives to 'cheat';
- failures in Pillar II disciplines; and
- overreliance on credit ratings agencies (CRAs).

Some of these weaknesses contributed directly or indirectly to the crisis and are subsequently discussed while also attempting to illustrate the relevance that these weaknesses might have for Solvency II.

3.1. International regulatory standards

Two of the major objectives of Basel were to 'level playing fields in international banking' and 'promote international safety and soundness in the banking sector' (Koch and MacDonald, 2006:312; van Roy, 2005:7). The achievement of these objectives was sought through the introduction of minimum capital adequacy ratios.

From a safety and soundness perspective, strong arguments exist in favour of international regulatory standards, one of them being that, as a result of globalisation and technological advances, banks' operations and exposures are intertwined to such an extent that it is preferable to have a standard regulatory base to work from. Because a bank is directly exposed to the failure of a bank in a faraway jurisdiction, it provides some level of comfort to know that the bank in the foreign jurisdiction is subject to the same capital requirements as this one (Atik, 2011:740-741).

The second argument is that, by introducing minimum capital adequacy standards, all banks compete from the same regulatory cost base and, therefore, compete on equal footing or level playing fields. Previously, banks with weaker safety nets could hold less capital and, in doing so, grow at a faster pace than banks with higher capital requirements in that they could attract deposits and funding at lower rates.

Although flexible, a capital adequacy approach to achieving level playing fields introduces a variety of complications as capital adequacy is not the only source from which banks in foreign jurisdictions may enjoy a competitive advantage. There are country-specific characteristics and macroeconomic factors that give certain banks and/or markets a competitive advantage over others. Three arguments why this may be this case are:

- Macroeconomic factors. Every country has its own unique macroeconomic characteristics, challenges and objectives that make it more challenging to adopt global regulatory standards. Standardised regulations might not be reflective of domestic market conditions and it might not tie in with a country's overall macroeconomic, social and/or political policy objectives; or the implementation costs associated with adopting an international regulatory standard might simply be too high.

- Domestic regulatory environments. The extent of countries' own specific regulatory considerations depends on many factors, including the liquidity and maturity of markets, possible barriers to entry into markets, volatility of and vulnerability to external shocks,

etc., which all affect the extent to which global regulatory standards can be adopted. This relates to the next point.

- The cost of capital may differ between countries. The major assumption of Basel introducing capital adequacy requirements to level playing fields between banks from a cost perspective was that the cost of capital between countries is the same. This assumption holds true only when global financial markets are fully integrated, which is not the case. Despite globalisation and regulatory advancements, financial markets remain segregated and large imbalances that prevent markets from integrating completely exist.

Despite these arguments, with the introduction of Basel III, the principle of having a global regulatory standard for banking remains.

Since Basel and Solvency II have the same objectives, and although they are entirely different frameworks, these same arguments as to why an international regulatory standard for insurers will never completely level playing fields and achieve its objectives are valid when considering Solvency II, including country-specific macroeconomic factors, certain domestic regulatory nuances, and differences in the cost of capital between countries, as mentioned above.

In fact, the introduction of Solvency II potentially introduces new factors that should be considered, such as that the treatment for the same risks in Basel III might differ completely from their treatment under Solvency II (Al-Darwish *et al*., 2011:41). It firstly opens a greater possibility for regulatory arbitrage, but it will also give certain companies distinct advantages over others depending on their legal structures. There has been an increase in the so-called bancassurance industry, or simply put, financial institutions that offer both banking and insurance products and services over recent years (Center for Insurance and Financial Planning (CIFP), 2007:1). Bancassurance companies may find that they will save on capital requirements, giving them a competitive advantage over banks and insurers (ECB, 2007:35), although the introduction of Basel III attempts to address such arbitrage opportunities. For different reasons there can never truly be harmonised standards across banking and insurance institutions, but the differences in these regulations open many opportunities for financial groups. There are many ways for financial institutions to move into bancassurance, including through mergers, acquisitions, joint ventures, etc. (CIFP, 2007:6-7). Changing a company's legal structure is by no means a trivial exercise, but the introduction of Solvency II may well see an increase in mergers and acquisitions as companies prepare to take advantage of the

differences in regulations, although, as mentioned, the introduction of Basel III attempts to address such arbitrage opportunities. Such increased mergers and acquisitions also introduce their own risks into the financial system.

3.2. Capital requirements are inherently pro-cyclical (and a weak cornerstone)

Financial regulation is inherently pro-cyclical in nature and it was known that the use of capital as Basel's cornerstone could exacerbate this weakness (Daníelson, Embrechts, Goodhart, Keating, Muennich, Renault and Song Shin, 2001:3). In other words, capital tends to be less scarce when times are good, but that, when most needed in tough times, it tends to be even scarcer than usual and hard to come by. In a sense it is contradictory to what a regulatory capital regime such as Basel aims to achieve, as capital is the primary protective barrier against unexpected losses when times are tough. Atik (2011:751-752) adds that this problem is compounded further in that when banks do need to raise capital, it will be during tough financial times when the cost of capital would have been driven upward simply because it will then be scarcer, while the other way to raise capital, i.e., the selling of assets, would be as difficult because banks will then be attempting to sell them when asset prices are depressed already.

This is essentially exactly what happened from a capital point of view during the years building up to the crisis and during the crisis itself. In the years preceding the crisis when macroeconomic conditions were favourable for growth and capital expansion, capital was used on expansion projects and also in the origination of new credit assets while still being able to service their capital and generate handsome profits. With the occurrence of the financial crisis, asset and capital values adjusted downward quite dramatically and banks were left over-leveraged based on asset originations that took place in preceding years, while they also had to scramble to raise new capital and attempted to sell assets at heavily deflated prices, highlighting the procyclical nature of capital requirements.

Ideally, capital requirements should be anti-cyclical (Dowd, *et al.*, 2011:22). Although the pro-cyclical nature of capital requirements and their potential weakness were well-known long before the implementation of Basel II (Gordy and Howells, 2004), the BCBS has, subsequent to the crisis, attempted to make its capital requirements more anti-cyclical by introducing so-called forward-looking provisioning, capital conservation and liquidity ratio requirements as part of Basel III. Despite the introduction of these new supplementary measures, the fact is that the basis for regulation remains capital requirements that will

remain pro-cyclical along with any additional buffers required. Repullo and Saurina (2011) found that the additional capital buffers introduced under Basel III might even exacerbate the pro-cyclical nature of capital requirements and suggest a rule-based smoothing of capital requirements based on gross domestic product (GDP) growth. Capital as the cornerstone of regulations, and not necessarily its inherent pro-cyclical nature, can even be considered as a weakness upon which Basel has been based.

Capital requirements imposed by regulators on insurers differ from those imposed on banks, yet the instrument of regulation, i.e., capital, is the same and the characteristic of it being pro-cyclical remains valid.

Solvency II does have a short enabling control in place to take into consideration specifically the pro-cyclical nature of equity prices under its market risk module (EU, 2009:6-7). It is, however, not nearly enough to compensate for the pro-cyclical nature of capital as an instrument. This is an inherent feature of capital and the only way to truly compensate for its inherent characteristic is to use another instrument with completely different characteristics or other supplementary instruments.

For now though it seems that the global standard of regulation relates to a 'capital standard' and that it will continue for the foreseeable future. Until such time that another standard is adopted, the pro-cyclical nature inherent to capital will remain a major weakness of global regulatory regimes.

3.3. Assuming that micro-prudential supervision will achieve macro-prudential goals

The underestimation of systemic risks was mentioned as one of the causes of the financial crisis and one of the major deficiencies inherent in a regulatory framework such as Basel is that it assumes that the micro-prudential regulations and requirements it introduces will achieve macro-prudential goals and even systemic stability as stated by one of Basel's main objectives. This weakness also relates to the cyclicality of capital requirements in that this characteristic of capital is determined by macro-factors which should be taken account of (Hanson, Kashyap and Stein, 2011:1). The financial crisis partly emphasised the growing need to have macro-prudential regulatory measures in place along with the current micro-prudential measures (Davis and Karim, 2009:8).

As stated above, if banks across different jurisdictions are subject to the same individual regulatory capital requirements, it does contribute to a perceived improvement of a safety net. While capital requirements strive to be risk-sensitive and to reflect closely the true risks that

banks are exposed to, it simply does not show potential risk build-ups across an industry – and even less so across borders. This point is accentuated by the fact that prior to the economic crisis banks were well-capitalised and stress tests showed that banks had sufficient capital to withstand large shocks (Mohan, 2009:10). The BCBS has now recognised the role that financial leverage and liquidity risk played in the crisis and attempts to address these concerns with the new measures in Basel III. Despite this, it will still not be able to provide meaningful information on a macro-level, as the measures introduced by Basel III seemingly attempts to address this weakness by again introducing micro-prudential measures on individual institutions through limits, ratios, capital requirements and incentives in order to achieve systemic stability. Although these measures are well-intended and might add some resilience to individual banks to be able to withstand financial shocks better, micro-prudential measures on their own will find it difficult to insulate the financial system from excessive leverage that may be found anywhere in the financial system as a whole (Hanson *et al.*, 2011:27-28).

As with Basel, Solvency II will rely on individual measures and requirements on insurance companies while setting out to achieve its goal of greater policyholder protection which, in broader terms, translates to an improved safety net perception and ultimately greater financial stability.

The financial crisis revealed that to some extent, although imposing regulatory requirements on individual institutions might have useful benefits, it cannot be assumed that a system is as strong as its weakest parts. In addition, Basel has reactively taken measures to address this weakness by introducing new requirements in Basel III while Solvency II has seemingly not reviewed this potential weakness, as it will be based on the same principle.

While not discounting the usefulness of micro-prudential regulatory measures and the principles that a system is only as strong as its weakest link, regulators run the risk of getting lost in the details and losing sight of the bigger picture. Banking and insurance regulators should therefore adopt a holistic approach to regulation where the stability of the entire financial system is monitored, i.e., macro-prudential regulation, and be aware of other macro-financial and political indicators for macro-prudential surveillance, such as international capital flows, exchange rate movements, lending policies and practices, distance to defaults, financial system value-at-risk (VaR), etc. Davis and Karim (2009) further argue that micro-prudential regulatory requirements might have the consequence of creating intricate webs of risk exposures and that the current regulatory regime is missing a so-called forth Pillar:

Macro-prudential regulation. Regulators must find a means of monitoring systemic risks along with the micro- or institution-specific factors specified in Basel and Solvency II. The macro-financial and political indicators referred to do not imply using aggregated figures of non-additive measures such as capital requirements, leverage ratios and capital buffers across the banking sector, for example. Until such time that regulators adopt a more macro-prudential approach, this weakness will remain.

A further consideration is that the implementation of Solvency II might add some macro-prudential risks to the financial system, whether by way of regulatory arbitrage opportunities or increased mergers and acquisitions although, as mentioned earlier, Basel III attempts to address such potential arbitrage opportunities. These new and unique systemic risks will need to be identified, monitored and managed on a holistic basis and there are already concerns that banks and insurers might be more interconnected than before (Al-Darwish *et al.*, 2011:48). The European Central Bank (ECB) (2007:2,40) echoes this and states that there are growing interlinkages between banks and insurers through bancassurance which may pose a potential threat to the banking system and that the expected longer-term financial stability it will add might come at a cost of short-term financial stability risks.

In addition to adopting a more macro-prudential approach to regulation, banking and insurance regulators should therefore become truly integrated in terms of information shared (across sectors and across borders (Persaud, 2009:7)), objectives, and activities in order for them to achieve a truly macro-prudential regulatory framework which would ensure real systemic stability.

This is a major point that should be taken note of and the scale and complexity of achieving this remains unanswered which leaves a potentially alarmingly large risk unaddressed by the current (and seemingly future) approach of regulating financial institutions on a micro-prudential basis.

3.4.   Overreliance on financial models

One of the major concerns about Basel II was the possibility of increased model risk (ANZ, 2006:13). With the unfolding of the financial crisis it became apparent just how excessive the reliance of banks and other financial institutions had become on financial modelling to calculate their capital requirements for market risk (Lall, 2009:21).

Financial modelling has become a standard of risk management over the past two decades, ever since the introduction of VaR models by JP Morgan in the mid-1990s (Horcher,

2005:209). Though it undoubtedly has a place in risk management, it seems that financial institutions may have reached a point where too much reliance is placed on the outputs generated by these quantitative models. This may be because of the implicit assumption of Basel and Solvency II that more advanced approaches to risk measurement reflect financial institutions' true risks more accurately (see **FIGURE 1**), leading to lower capital requirements because the conservativeness of the standardised approaches is removed (van Duffel, 2008:14).

Models cannot and should not be considered as anything more than useful tools, as results are subjective and dependent on a wide array of inputs, parameters and assumptions, any of which can be manipulated and/or not be applicable to get the 'best' results (Lall, 2009:17; Dowd, *et al.,* 2011:8). Outputs generated by financial models, such as VaR numbers for market risk, for example, should always be questioned in terms of parameters, assumptions and data used, because financial models give only hypothetical representations of the real world. VaR models can be used as an example here, they are useful as long as markets are fairly stable with ample liquidity, strong correlations and relationships, and relatively stable volatilities – they tend to unravel completely when there are changes in these parameters (Dowd, *et al.,* 2011:10) and therefore tend to underestimate the probability of extreme events (Lall, 2009:7). This point on model inputs and assumptions applies to financial models in general and, because of this characteristic, they may contribute to economic destabilisation and even induce crashes when they would not have occurred normally (Daníelson, *et al.*, 2001:3). With such model characteristics in mind, financial models as a basis for a regulatory regime may be described as 'flimsy' (Dowd, *et al.*, 2011:3).

As financial models are subjective, it is possible that results are manipulated to support agendas, obtain decisions, or simply to hide true risks from regulators or even committee structures within financial institutions (Al-Darwish *et al.*, 2011:41). This idea is further enforced in that complicated models are not necessarily more accurate and can be abused for decision-making, making them potentially dangerous instruments (van Duffel, 2008:25).

The financial crisis highlighted the complete lack of understanding of VaR-type, or probabilistic financial models, and their weaknesses (Reavis, 2009:10; Dowd, *et al.*, 2011:8). In addition to the lack of understanding, it also showed that the results of financial models were being used to make decisions on pursuing risk based on the assumptions that these results were sufficient and reliable enough to base such decisions on (Risk and Insurance Management Society (RIMS), 2009:5). Senior management in financial institutions should

therefore have a thorough understanding around financial modelling in order for them to be able to correctly interpret results, question inputs and parameters, and make the correct decisions using financial model results as supplementary information. The same applies to regulators in that they should thoroughly understand financial institutions' internal models in order to grant approval to use them for regulatory capital calculations, but regulators should also be able to understand the results, parameters and assumptions behind them.

The reliance on financial models to fulfil various functions is not limited to banks: insurers have also always relied on financial and other models that essentially supported their businesses to ensure that they remained profitable by modelling pure insurance risks such as mortality risk, longevity risk, morbidity risk, and persistency risk.

The risk of overreliance on financial models under Solvency II is as valid as it is for the banking world under Basel. Solvency II is based on VaR-type calculations to determine its capital requirements while insurers will also be permitted to use their own internally developed models to calculate their risk capital requirements once regulatory approval is obtained. The basis for Solvency II's capital requirement calculations is a probabilistic VaR-type model requiring insurers to calculate their minimum capital requirements (MCR) and solvency capital requirements (SCR) based on a given confidence interval over a given time period. To this end, probabilistic financial models will be used extensively in insurance companies under Solvency II. This introduces the same risks to the insurance industry that were highlighted by the effects that the financial crisis had on banks. The prevalence of the assumption of the accuracy of internal models' results to reflect insurers' true risks is indicated by **FIGURE 1**, a figure widely used in Solvency II literature.

The pyramid diagram contains the following labels from top to bottom:

True risk profile

Future

SCR Internal models

SCR Standard approach

Current situation

Rating agency models

Current Solvency 1

Range of Solvency measures

Increasingly accurate link to true risk profile
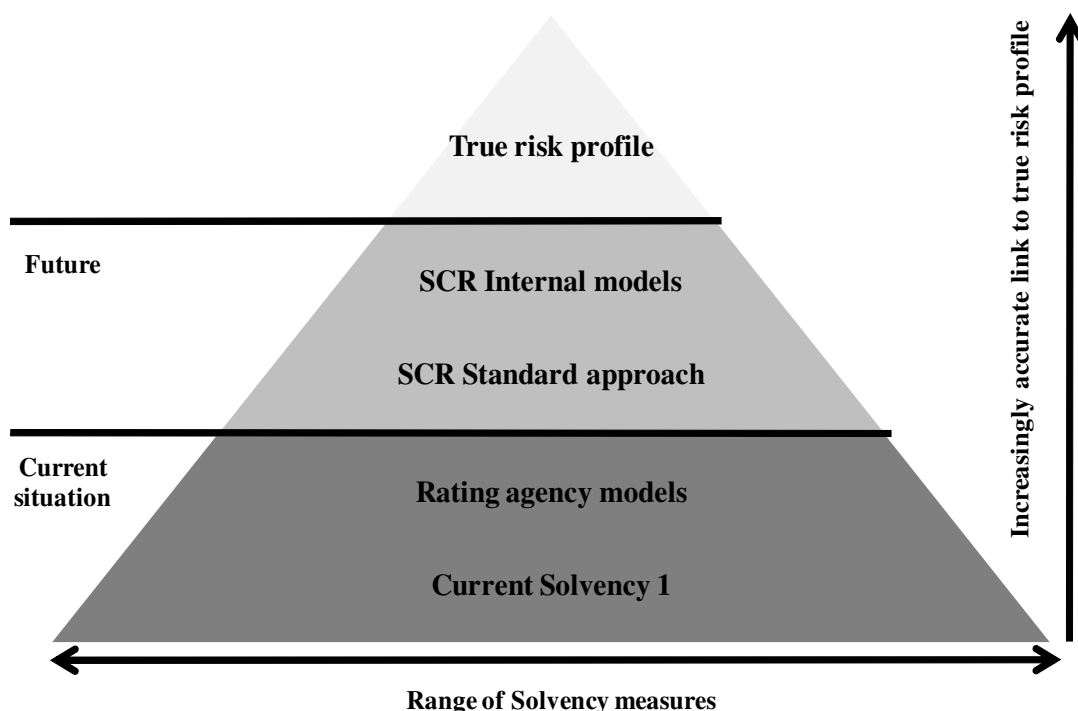
FIGURE 1: Assumption of increasing models accuracy.

Source: CEA (2006:5)

The possible overreliance on financial models is not something that can be expected to be addressed by any regulatory measures, so this risk/weakness remains in the future despite the introduction of Basel III and Solvency II. It is something that should be taken note of and considered seriously way ahead of introducing new punitive ratios and measures while such overreliance may still be prevalent. Understanding the input parameters and calculations as well as interpreting the results of financial models are key for any decision-maker, whether investment banker, risk manager, senior management and/or regulator. In gaining such insights, the impacts of potential future crises might be lessened or even avoided completely if informed decisions are made, while also not inhibiting risk-taking and the opportunities that go with it.

3.5. Potential incentives to 'cheat'

As much as Basel II incentivises banks to improve their risk management capabilities by introducing sophisticated internal models approaches that can be used to calculate their regulatory capital requirements, there is also a built-in incentive to 'cheat the system' and the FCIC (2011:xxii) found a systemic breakdown in accountability and ethics to be one of the major reasons for the financial crisis. By attempting to level playing fields between

internationally active banks, Basel also unintentionally forces banks to seek out ways in which they can save on capital requirements and be more competitive than other banks, or to conduct regulatory arbitrage (Jones, 2000). Banks are under constant pressure where profits, performance and incentives related to these largely determine corporate behaviour. Shareholders demand performance and banks are under constant pressure to stay ahead of competitors. Banks that are able to save on capital that can, in turn, be used elsewhere in a business to generate higher shareholder returns through increasing the bank's asset base, finance new projects, or returning capital to shareholders in the form of dividends, will have a distinct competitive advantage over their peers (Lall, 2009:4). One of the major reasons for engaging in regulatory arbitrage is therefore to enhance shareholder value (Jones, 2000:37).

One of the contributing factors to the financial crisis was banks' attempts to reduce or even bypass capital requirements completely through regulatory arbitrage (Norgren, 2010:24). Concerns about potential regulatory arbitrage were raised years ahead of the implementation of Basel II and Jones (2000:37) argued that absent measures to reduce incentives for regulatory arbitrage could potentially even undermine a system of capital requirements. However, banks will constantly look into ways of reducing their capital requirements and/or how to circumvent them to gain a competitive edge over other competitors. It is perhaps necessary to highlight that, although many of these efforts during the financial crisis were reckless and perhaps even unethical, they were in most cases compliant with the letter of the law (Fleischer, 2010:3). There is an ever-expanding variety of ways of doing so and the financial crisis illustrated some ways of doing so, including:

- structuring of new products: during the financial crisis, banks innovatively used products that had been used in financial markets for years, but new products and complex structures are being developed on a daily basis designed for a variety of purposes, of which reducing capital requirements and enhancing returns are only two (Jones, 2000:44, 47-48),

- moving certain transactions off balance sheet: related to the point above, banks moved some of their credit exposures off balance sheet through securitisation vehicles in order for them to save on capital requirements (Dowd, *et al.*, 2011:24),

- pure regulatory arbitrage: again, in an attempt to gain a competitive advantage over competitors, banks employ teams of people with the purpose of exploring how and where exposures can be classified in order for them to save on capital requirements, and

- misrepresentation of information: in order to save capital, banks are indirectly incentivised to calibrate their internal models in ways which would result in lower capital requirements. This point relates back to the potential overreliance on financial models as well as a lack of in-depth understanding of them.

Much as is the case with Basel for banking, so will be the case under Solvency II for insurers. From an economic performance and profits point of view, insurance companies find themselves under the same pressure as banks to service their capital and provide returns to shareholders and will constantly be looking at opportunities to free up capital to be used elsewhere in the business where it can be employed to generate returns.

A further dimension that Solvency II introduces to this equation is possible regulatory inconsistency between risk treatments and possible costs of capital between Solvency II and Basel (Al-Darwish *et al.*, 2011:41,44), which might introduce further regulatory arbitrage opportunities as was indicated in earlier sections.

Prescriptive regulatory regimes will always open one door as soon as they close another and Fleischer (2010:4) explains that the practice of arbitrage has been taking place for hundreds of years and will continue to do so. Basel III may have attempted to close some of the gaps that were exploited, but by the time Basel III is fully implemented it would already have been 'figured out' and even the new measures would probably be rendered both insufficient and inefficient. The risk in a system that allows for regulatory arbitrage is that it may lead to the understating of underlying risks, as was shown by the financial crisis. However, perhaps an argument can be made that, over the long term, regulatory arbitrage contributes to more effective regulation in that it contributes to identifying gaps in regulations so that regulations can become more 'airtight' over time.

3.6. Failure of Pillar 2 disciplines

The interaction between Basel's minimum capital requirements (Pillar 1), a supervisory review process (Pillar 2) and market discipline (Pillar 3) is one way to pursue the soundness of banks as well as the stability of the financial system. The maintenance of minimum capital levels is the first device for safeguarding bank stability, but it is not sufficient in itself to carry out the regulatory objectives because of certain risks that are not easily quantifiable and/or risks that are not included in Pillar 1 requirements, for example (van Roy, 2005:7).

Much has been written about contributing factors to the financial crisis and the weaknesses in Basel that were exploited, but not much has been said about the role that the Pillar 2

discipline was supposed to play. It seems that much of the focus has been on Pillar 1 capital requirements and their calculations and reliance on external events and/or sources as contributing factors to the financial crisis, without considering the failure of the Pillar 2 discipline.

Pillar 2 was intended to supplement and strengthen Pillar 1 requirements where there may have been weaknesses. This paper indicated that such weaknesses may include:

- capital requirements may not be the best (or only tool) to supervise banks;
- potential incentives to cheat based on internal models calculations and regulators' understanding of banks' business and financial models; and
- possible overreliance on financial models and external CRAs.

Pillar 2 was designed to bridge all these gaps in order to complete the Basel framework. In other words, during the financial crisis, even risks that were taken off balance sheet or those that were difficult to analyse should at the very least have shown up in the Pillar 2 processes. It therefore reflects that, from what Pillar 2 is meant to contribute, it failed during the financial crisis because many of these risks and/or concerns did not seem to come out in this process that is supposed to capture all risks.

In Basel and Solvency II, the Pillar 2 disciplines provide a platform for financial institutions to measure and report all risks that are not captured fully or those are not captured at all to management and to the supervisor. This specific pillar also provides for the calculation of financial institutions' own internal capital requirements that are supposed to cover all the risks through the internal capital adequacy assessment process (ICAAP) and own risk and solvency assessment (ORSA) for banks and insurers respectively.

Furthermore, regulators are given the opportunity through the Pillar 2 disciplines to understand and really question banks' and insurers' business practices, risk management, capital requirements and essentially anything that is not clear from Pillar 1. This understanding and questioning affords regulators immense additional power in that they have the right to obtain much more information from institutions than what is available through the Pillar 1 disciplines, and in that they can impose additional capital charges on institutions depending on their satisfaction of institutions' Pillar 2 information. The contrary, however, also holds, in that this power comes at the price of regulators having to assume more responsibility in making sure that they thoroughly understand each institution's risk

management framework, all their risks, financial models, governance structures, economic capital requirements, etc.

The importance of the Pillar 2 discipline under Solvency II should not be underestimated, and policymakers and insurers should learn from the failure of the Basel II Pillar 2 disciplines and make sure that they receive sufficient attention under Solvency II from the start. It needs to be pointed out that the Pillar 2 disciplines of Solvency II run the risk of being overshadowed by developments under Pillar 1 even before implementation because of a lack of and delayed lower-level guidance from regulatory authorities on how Pillar 2 will work.

The processes around the ORSA and the information that it will generate could fundamentally enhance risk management in insurance companies provided that it is done correctly and accurately. For the ORSA to truly add the value it is intended to, it should receive sufficient attention throughout insurance companies and not just be seen as a compliance exercise.

3.7. Overreliance on CRAs

One of the major findings of the causes to the crisis was that banks relied too heavily on CRAs to obtain ratings for complex products (FCIC, 2011:xvii, xix, xxv*). *This point relates back to the one on the overreliance on financial models, but it also includes some implicit ethical and governance concerns. The possible overreliance on CRAs was highlighted when Basel II was in its initial development phases, yet it was one of the factors that contributed to the financial crisis (Daníelson, *et al.*, 2001:3).

CRAs were relied upon to produce ratings for highly structured and complex products while banks themselves could not price them, and the reliance on these ratings by regulators and bank employees points to a failure of corporate governance and risk management principles. It has been argued that CRAs were conflicted in that banks paid them to give ratings, meaning that they had to produce some ratings although they could not have given assurance on their accuracy (Dowd, *et al.*, 2011:20). This, along with a lack of liability of CRAs for providing inaccurate ratings meant that banks conveniently relied on these inaccurate ratings because they could not rate these products themselves, essentially passing the buck to the CRAs (Levitin and Wachter, 2012:1234). Cannata and Quagriariello (2009:9-10) provide a discussion on CRAs' interests being conflicted and on methodologies for obtaining credit ratings.

Although CRAs found themselves in a precarious situation, the outcome would not have been any different had banks used their own internal calculation to obtain ratings for these products, simply because no one knew how to rate these 'packaged' loans. The only difference would have been that someone else would have been to blame without truly addressing the methodology of how the ratings were obtained. Although cited by many as one of the causes of the financial crisis, the overreliance on CRAs probably relates more to corporate governance and risk management failures, overreliance of financial models that are simply unable (as yet) to provide accurate ratings on such products (FCIC, 2011:xvii, xix, xxv; Byun, 2010).

From a Solvency II perspective, and considering current credit risk modelling methodologies, the same arguments that were put forward about the modelling methodologies along with the overreliance on CRAs are valid (Byun, 2010; Al-Darwish *et al.,* 2011). Insurers are, however, in a privileged position regarding the modelling of credit risk in that they have been able to see how credit models and CRAs contributed to the unfolding of the financial crisis and learn from those events. As insurers will use the same credit risk models to determine their own ratings and/or used by CRAs to determine theirs, it is imperative that they are aware of the failures and weaknesses of these models. In particular, insurers should be cognisant of such weaknesses that were highlighted by the financial crisis specifically relating to the modelling of complex credit products. Awareness and understanding of these weaknesses can make insurers more vigilant against an overreliance on modelling results and/or the results given to them by CRAs.

Although the measures introduced in Basel III which will help place less reliance on CRAs' ratings will probably spill over into Solvency II and the insurance world, the modelling aspect will be the same and reliance on results should be measured until such time that credit risk models can offer improved results for complex credit products. It also does not mean that all potential conflicts of interest and moral hazard will be eliminated, meaning that insurers should always question CRA results before making decisions based on them.

4. CONCLUSION

The article aimed at identifying possible weaknesses in the Basel Accords that contributed to and/or were highlighted by the financial crisis.

The contributing factors of the financial crisis are related back to Basel in an attempt to identify seven major weaknesses and/or failures of Basel that were highlighted by the crisis.

Each of these were discussed from a Basel perspective (including new measures introduced to address each of them under Basel III) while relating each back to Solvency II to gain an understanding of whether these weaknesses are prevalent in Solvency II.

In each of the seven instances it was found that the specific weakness was present in Solvency II to a lesser or greater extent. Some of the weaknesses that were highlighted raise more questions than answers at this stage while others, such as a definite need for macro-prudential regulation and the pro-cyclical nature of capital as the cornerstone of current financial regulations, calls for potentially significant regulatory reforms. Other weaknesses cannot be addressed by regulatory reform, but there is a need for a better understanding of the workings of financial models while not placing an excessive reliance on them. In addition, there is a need to strengthen Pillar 2 disciplines while ensuring that this is carried out with the necessary urgency and attention in order to ensure that these disciplines fulfil the role of complementing and strengthening the Pillar 1 requirements, which they set out to do from the outset.

With this in mind, this article aimed to highlight the prevalence of these weaknesses in an attempt to foster awareness among insurers, regulators, and other financial market participants of these weaknesses. The purpose of this is to stimulate thinking and debates around possible solutions to these weaknesses so that corrective measures can be taken to ensure that the exploitation of them and increased interconnectedness between insurers and banks do not lead to a potentially more devastating future financial crisis than the 2007-2010 one.

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Chapter 3

Is regulatory capital a legitimate, comparable and objective standard?

Evidence from 51 institutions across 17 countries

Is regulatory capital a legitimate, comparable and objective global standard?

Evidence from 51 institutions across 17 countries[i]

Johann Jacobs[ii] and Dr Gary van Vuuren[iii]

Abstract

Capital as an instrument for financial regulation has come under scrutiny since the financial crisis of 2007 to 2010 highlighted some deficiencies in the ability of capital to absorb unexpected losses and the procyclical nature of capital. This scrutiny arises mainly from the perspective that one of the principal objectives of capital requirements is to promote and contribute to financial stability. However, literature on the topic is scarce almost to the point of non-existence regarding capital's validity as tool to level the playing fields between financial institutions.

The objective of this article is therefore to investigate financial regulations based on capital requirements from the perspective of its goal of providing equal competitive conditions for financial institutions, the attainment of which is based on the assumption that the cost of capital between institutions (and countries) is the same, which might not necessarily be the case. The cost of capital for 51 financial institutions across 17 countries (3 institutions per country) is accordingly calculated in this article using original weighted average cost of capital and capital asset pricing models, as well as modified versions of these to include more country-specific factors.

The objective of this article is sought firstly by determining whether the cost of capital is the same among countries and secondly, based on the results, ascertaining whether financial regulations based on capital requirements can therefore realistically achieve this objective of providing equal competitive conditions for financial institutions.

Keywords: *Capital requirements, cost of capital, banks, Basel, Solvency II.*

JEL classification: F37, F68, G21, G22, G28, O16.

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1.   Introduction

The objective of this article is to assess whether capital, as a regulatory instrument, can level playing fields between countries based on the cost of capital (COC) between different countries. The COC for 51 banking institutions and financial institutions across 17 countries was calculated using three variants of the capital asset pricing model (CAPM) and the weighted average cost of capital (WACC) models.

This article attempts to investigate the ability of providing level playing fields of financial regulations as a whole, i.e. the Basel Accords (Basel) and Solvency II, based on major similarities between the two sets of regulations.

This article is structured as follows: Section 2 introduces the objective of this research. Section 3 provides a literature review covering the major similarities between banking and insurance regulations; the objectives of financial regulations; and a brief discussion on the history and theory of the cost of capital. The calculation and analysis methods employed in this article are discussed in section 4, while the data and assumptions employed are elucidated in section 5. Section 6 discusses the results and findings of this article before section 7 concludes this research.

2.   Objective

The objective of this article is to investigate financial regulations based on capital requirements from the perspective of its goal of providing equal competitive conditions for financial institutions, the achievement of which is based on the assumption that the COC between financial institutions (and countries) is the same, which might not necessarily be the case.

In essence, the introduction of capital adequacy standards alone may not be able to achieve this goal, as a certain percentage of capital required might, for example, cost one institution in Country A more than it costs another institution in Country B.

This objective of this article is sought firstly by determining whether the COC is the same among countries, and secondly, based on the results, ascertaining whether financial regulations based on capital requirements can therefore realistically achieve this objective.

It may be argued that there may be an offset in the COC (which is based on systematic risks) in some countries in financial institutions' actual capital requirements (which are based on idiosyncratic risks), resulting in some financial institutions being required to hold less capital although this capital might cost them more than it would other financial institutions. However, this article does not attempt to relate the cost of capital back to capital requirements of individual financial institutions, but focuses instead on the cost of capital between financial institutions based in different countries. The relationship between idiosyncratic risks (capital requirements) and systematic risks (the cost of capital) falls outside the scope of this article. It can reasonably be expected that capital requirements based on idio-

syncratic risks for financial institutions operating in higher cost of capital environments (based on systematic factors) will not substantially offset higher capital costs because such financial institutions operate in more volatile environments.

3. Literature review

This section provides a brief overview of the relevant literature. First, it explains similarities between banking and insurance regulations; second, it provides a description of the objectives of financial regulations, and finally it provides a brief theoretical background to COC models.

3.1. Similarities between banking and insurance regulations

The development of banking and insurance regulations over the past 40 years took place in two completely separate streams and conducted by different bodies, yet they share numerous similarities. There is an abundance of literature available on the similarity in characteristics between Basel and Solvency II, including literature by the Bank for International Settlements (BIS) (1999:9; 2006:6); Shadow Financial Regulatory Committees (SFRC) (1999:2); De Carvalho (2005:7-8); Lind (2005:28); Horcher (2005:257); van Roy (2005:7); the European Insurance and Re-insurance Federation (CEA) (2006:5); Koch & MacDonald (2006:312); the Commission of the European Communities (CEC) (2007:3); Sandström (2007:12); van Duffel (2008:9); the European Union (EU) (2009:3); Lloyd's (2010:4,8); and Clutterbuck (2011:8), to name but a few. From these, high-level similarities between Basel and Solvency II can be drawn, the major ones being that:

- both are based on a similar three-pillar approach, with Pillar 1 being minimum capital requirements and the basis on which both sets of financial regulations are based; and

- both set out to achieve the same broad objectives, including levelling the playing fields between financial institutions.

The remainder of this article is based around these two major similarities between Basel and Solvency II.

3.2. Levelling of playing fields objective

The three major objectives of financial regulations are contributing to financial stability; levelling playing fields between financial institutions; and to be based on more risk sensitive measures and tools (BIS, 1999:9; SFRC, 1999:2; De Carvalho, 2005:7-8; Horcher, 2005:257; van Roy, 2005:7; CEA, 2006:5; Koch & MacDonald, 2006:312; CEC, 2007:3; Sandström, 2007:12; EU, 2009:3; Lloyd's, 2010:4).

This article focuses on the achievement of the second objective, namely to *level playing fields among financial institutions.*

3.3. The cost of capital: Brief background and theory

For the sake of brevity and because they are widely available in literature, the formulas for calculating the components of COC and the actual COC itself are not included in this article.

The concept of 'COC' has evolved over the past 60 to 65 years and its origins can be traced back to the development of portfolio theory in the 1950s when Markowitz (1952; 1959) and Roy (1952) started to attempt to relate expected returns to risk. The work done by Modigliani & Miller (1958) is considered as the starting point to the literature on COC (Exley & Smith, 2006:230), while from the original work done by Markowitz, the CAPM was introduced independently by Sharpe (1964), Lintner (1965), and Mossin (1966), although their work was predated by unpublished work from Treynor in 1961 and 1962 (French, 2003:60).

Since companies fund themselves through a combination of debt and equity (Ernst & Young, 2011:4), their overall COC is calculated by adding their weighted cost of debt and weighted cost of equity together according to the weights that each component contributes to total capital – this determines the WACC. The objective of companies is to minimise their WACC by determining their optimal capital structure, because in doing so a company will maximise its shareholder value (Brealy, Myers & Marcus, 2001:572). Much research has been undertaken on the topic of companies' optimal capital structures, including work by, among others, Baxter (1967), Opler, Saron & Titman (1997), Exley & Smith (2006) and Ratshikuni (2009).

The **cost of debt** is based on the risk-free rate of the country in which the debt is issued plus a credit risk premium according to the riskiness of the country, which is typically easily observable (Brealy *et al.*, 2001:452; Ross *et al.,* 2003:508; Jenkinson, 2006:3; Madura, 2009:477).

The CAPM is used to calculate the **cost of equity** and expresses the trade-off between risk and expected return (Madura, 2009:475). Since its introduction, many variations to the original CAPM have been introduced, most notably the Ibbotson Associates Modified CAPM (Annin & Falaschetti, 1998) and the Fama-French Three-Factor Model (Fama & French, 2004:25-46).

In contrast, Ross, Westerfield & Jaffe (2003:502) define the **WACC** as the sum of the weighted average of the cost of equity and the after-tax cost of debt.

The CAPM and WACC have some inherent weaknesses in their basic forms and these are widely discussed in literature, most notably in research by Fama & French (2004:13), Perold (2004:16), Jenkinson (2006:7), Sercu (2008:720), Greenen, Kirisits, Chadwick & Hoeveler (2009:3), Sánchez, Preve & Allende (2010:7) and Villarreal & Córdoba (2010:11).

As a result of these weaknesses, certain adjustments need to be made to the original CAPM (Villarreal & Córdoba, 2010:8) and much research has been done on the topic, including research by McCauley & Zimmer (1989), Shoven & Topper (1992), Godfrey & Espinosa (1996), Estrada (2001), Lally

(2004) Lambert, Leuz & Verrecchia (2006), Lambert & Verrecchia (2010), and McMorran (2010). The major research that was considered for this article includes the studies of Erb, Harvey & Viskanta (1996), Koedijk, Kool, Schotman, & van Dijk (1998), Harvey (2004; 2005), Sercu (2008), and Villarreal & Córdoba (2010).

Despite these weaknesses and challenges in their application, the CAPM and WACC remain popular methods to calculate COC (Bruner, *et al.*, 1998:15; Brealey, *et al.*, 2001:572; Ross *et al.*, 2003:543).

The following section explains the approach that was adopted for this study, after which the results are presented and discussed.

4.   Calculation methods and analysis

A comparative analysis of the COC is conducted for various institutions across different regions in an attempt achieve the objective of this article.

Three methods were used to calculate the COC among different institutions across different countries:

- the original CAPM and WACC models;

- the original CAPM and WACC models where an equity risk premium is added to the cost of equity; and

- a modified CAPM and WACC model as explained by Villarreal & Córdoba (2010).

Before providing a brief description of the calculation methods and formulas, it is again necessary to highlight that the calculation of the COC using the CAPM and WACC have some known weaknesses. Two challenges that are often highlighted include the term structure of credit ratings and the time variation of risk premiums (Erb, *et al.*, 1996; Harvey, 2004; 2005). These time-dependencies might be as a result of external events and/or shocks and may impact the calculations of the COC. In pursuing its objective, this paper did not explicitly take into account these time effects through advanced regressions analyses as often prescribed. This paper rather focuses on the results of a model that is applied consistently across a sample set of countries instead of focussing on the effect of time on the calculations of the COC.

Villarreal & Córdoba (2010) explore a consistent approach to calculating the COC in emerging markets and reinforce the need to adjust traditional methods of calculating the COC. Without detailing the deduction of this model, the WACC formula used reflects a hypothetical world where taxes, transaction cost and an additional country risk (CR) component are present, and is shown as Equation 1:

$$WACC = \left[\frac{D}{D+E}\,(1-t)K'_D\right] + \left(\left(\frac{E}{D+E}\right)K_E\right) \tag{1}$$

Where D is the total debt capital of a particular company, E is its total equity capital, $D + E$ its total capital, K'_D the pre-tax cost of debt, and K_E the cost of equity. K'_D is presented by the cost of debt (K_D) (risk-free rate (R_F) plus intermediation spread) plus a *CR* premium:

$$K'_D \;=\; (R_F + intermediation\ spread) + CR \tag{2}$$

Similarly, the original calculation of the K_E for this model is modified to incorporate a country risk premium that is adjusted to incorporate taxes (*CR(1-t)*) and a non-diversified country risk premium (*CR(β_E)*) so that:

$$K_E \;=\; \{[K_D(1 - t)] + [\beta_E(R_M - R_F)]\} + \{[CR(1 - t)] + CR(\beta_E)]\} \tag{3}$$

Where β_U is the beta of a specific equity, R_M the expected market return and therefore ($R_M - R_F$) the market risk premium, and equity beta (β_E), as explained in Equation 5.

From the original CAPM, it is important to point out that beta is estimated by the quotient of the co-variance between the returns of a company's equity returns (R_E) and R_M, and the variance of the market returns (Sercu, 2008:720):

$$\beta_U \;=\; \frac{COVAR(R_E, R_M)}{VAR(R_M)} \tag{4}$$

Villarreal & Córdoba (2010:19) refer to the beta in Equation 4 as 'unlevered beta', or β_U, because it is based on equity data only, i.e. it is assumed that the company's capital structure consists of equity only and does not take into account financial leverage. On the other hand, when referring to β_E, Villarreal & Córdoba (2010) refer to a beta which is adjusted by the debt-to-equity ratio ($\frac{D}{E}$) of a company, and reflects systematic risk given a company's $\frac{D}{E}$. β_E is calculated as:

$$\beta_E = \beta_U \left[1 + (1 - t)\frac{D}{E}\right] \tag{5}$$

In turn, Villarreal & Córdoba's (2010:22-23) explanation of levered beta, or β_L, is the beta of a company where financial leverage is taken into account, or where debt is incorporated into a company's capital structure and is calculated as:

$$\beta_L = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E \tag{6}$$

Where β_D is the beta of debt.

Sometimes the terms 'levered beta', 'unlevered beta', and 'equity beta' are used interchangeably and can lead to much confusion, but for the purpose of this article, the Villarreal & Córdoba (2010) definitions of beta are used throughout.

Now, following from Equation 3, for notational simplicity it is assumed that:

$$CR(1 - t) + CR(\beta_E) = CR^* \tag{7}$$

So that Equation 3 can be re-written as:

$$K_E = \{[K_D(1 - t)] + [\beta_E(R_M - R_F)]\} + CR^* \tag{8}$$

Alternatively, the cost of equity can be calculated using K'_D as a starting point:

$$K_E = K'_D(1 - t) + \beta_E[(R_M - R_F) + CR] \tag{9}$$

From this, a principle of coherence is applied such that the opportunity cost calculation does not depend on the method used and that there must be consistency between the CAPM and WACC so that their CAPM formula is modified as follows (note that β_L is used here):

$$CAPM = K'_D(1 - t) + \beta_L[(R_M - R_F) + CR] \tag{10}$$

With these modifications and the principle of coherence, the results of the WACC and CAPM should be equal and the one can be used to verify the other.

Although this model was developed with the specific aim of addressing challenges experienced in calculating the COC for developing countries, it will be applied to the entire data set used in this article, including developed countries.

5. Data

Although the data used in this research were for banks only, therefore explicitly showing the costs of capital for banks across different countries, the results could easily apply to insurance companies also because of the similarities between Basel and Solvency II that were highlighted.

Data selected for this article were based on two principles, namely firstly the need to be representative of developed and developing markets; and secondly, in order to keep with one of the major assumptions of the Villarreal & Córdoba (2010) model, these markets had to be efficient with at least some degree of sophistication and integration into global markets.

Sample countries and institutions

The Group of 8 countries (G8) (Canada, France, Germany, Italy, Japan, Russia, USA and UK) and a group of countries considered the most important emerging market economies, the so-called 'Outreach 5' (O5) (Brazil, China, India, Mexico and South Africa) were used. Other developing countries including Indonesia, the Philippines, Poland and Turkey were used in addition to the O5.

From each of these, the largest three banks were selected based on balance-sheet size[iv], all of which can be seen in Appendix A. Financial groups were included in some cases and not purely banks, as the aim of the exercise is not necessarily to calculate the COC among banks only; rather it is to calculate the COC among countries based on banking data.

Time series

The time period for which data were obtained was for the seven years 2005 to 2011, based on the rationale that these were recent; they would be sufficient to provide meaningful results; and that they included benign and challenging economic conditions.

Risk-free rate (R_F)

The average daily United States (US) ten-year Treasury bond rate was used as a proxy for R_F across all countries in this study over the period analysed, i.e. 3.80% (FRED, 2012). This assumption is considered as being rather conservative, considering that most countries that were used in this study will have a higher R_F than the US.

Intermediation spreads

The intermediation spreads in this article are determined from data obtained from the Federal Reserve Bank of St Louis Economic Data (FRED, 2012). The categories of the data that were used are reflected in Table 1 and the average spread is the average daily basis points (bps) spread per category above R_F. Credit rating categories were used in this research, which are illustrated in Table 1. These were applied to each bank as per its credit rating obtained from Fitch Ratings (Fitch, 2012). The US daily average rates per credit rating were applied to all banks that operate in developed countries.

Table 1: Intermediation spreads

Category	Average spread (bps)
US AAA Daily	58
US AA Daily	89
US A Daily	148
US BBB Daily	216
Emerging markets AAA-A	134
Emerging markets BBB-B	257
Emerging markets BB	490

Source: FRED (2012).

[iv] In some cases banks not representing the three largest balance sheets in a specific country were selected based on data availability. In this regard, according to banks' size, for Mexico numbers 1, 3 and 4 were used; for Russia 1, 2 and 6; for Turkey 1, 2 and 4; and for Germany 1, 4 and 6.

Country risk (*CR)* spread

To estimate the CR premium, data were used from Damodaran (2012), who uses credit ratings as a starting point. In this information, local currency credit ratings were used to obtain a default spread in bps above the US Treasury bond rate using historical credit data of US corporates and country bonds. This default spread is illustrated in Table 2:

Table 2: Estimated default spreads by credit rating

Moody's rating	Fitch Rating	Default spread (bps)
Aaa	AAA	0
Aa1	AA+	25
Aa2	AA	50
Aa3	AA-	70
A1	A+	85
A2	A	100
A3	A-	115
Baa1	BBB+	150
Baa2	BBB	175
Baa3	BBB-	200
Ba1	BB+	240
Ba2	BB	275
Ba3	BB-	325
B1	B+	400
B2	B	500
B3	B-	600
Caa	CCC	700
Ca	CC	850
C	D	1,000

Source: Modified from Damodaran (2012).

Damodaran (2012) then adds this default spread to a local market risk premium of 5.5% for each country multiplied by an equity-to-bond market volatility factor of 1.5. This represents the total equity market premium for that country. The country risk premium is obtained by subtracting the original market risk premium from this number.

In this article, the same methodology was employed in estimating the country risk premium but for some modifications and additions. Instead of assuming a flat 5.5% local market risk premium for all countries, data were obtained from a survey conducted by Fernández, Aguirreamalloa & Corres (2011), which obtained the market risk premia used by different stakeholders across 56 countries. From this, the average market risk premia for the countries used in this article are indicated in Table 3.

Table 3: Average market risk premia per country

Country	Average local market risk premium used	Number of respondents
Brazil	7.7%	35
Canada	5.9%	36
China	9.4%	31
France	6.0%	45
Germany	5.4%	71
India	8.5%	28
Indonesia	7.3%	14
Italy	5.5%	76
Japan	5.0%	14
Mexico	7.3%	56
Philippines	5.6%	6
Poland	6.2%	28
Russia	7.5%	37
South Africa	6.3%	34
Turkey	8.1%	25
UK	5.3%	112
USA	5.5%	1503

Source: Adapted from Fernández *et al.* (2011:3).

Bps default spreads were also used in this article (Table 2), but each country's credit rating as measured by Fitch was obtained so that the default spread used for each country was as shown in Table 4.

Table 4: Country default spreads

Country	Country rating	Default spread (bps)
Brazil	BBB	175
Canada	AAA	0
China	A+	115
France	AAA	0
Germany	AAA	0
India	BBB-	200
Indonesia	BBB-	200
Italy	A-	115
Japan	A+	115
Mexico	BBB	175
Philippines	BB+	325
Poland	A-	115

Russia	BBB	175
South Africa	BBB+	200
Turkey	BB+	325
UK	AAA	0
USA	AAA	0

Source: Fitch (2012), Damodaran (2012).

For equity-to-bond market volatility spreads, individual country spreads were calculated using the returns for each country's equity market using each country's Morgan Stanley Capital International (MSCI) index as a proxy for equity returns and the Emerging Markets Bond Index (EMBI) for bond market returns in the developing countries in this article. The Royal Bank of Canada (RBC) Global Corporate Bond Fund[v] was used as a benchmark for developed markets' bond market returns. The relative volatilities for each of the countries' stock market returns against these bond market return proxies were calculated and used for this input into the model and the results are presented in Table 5. The results obtained did not differ much from the original 1.5 value as per Damodaran (2012) and the overall average was 1.66. For the purpose of this study the average for each of the groups is used, i.e. 1.75 for emerging markets and 1.50 for developed markets.

Table 5: Equity-to-bond market volatility spreads

Emerging markets	
Brazil	1.33
China	1.80
India	1.91
Indonesia	1.23
Mexico	1.53
Philippines	1.78
Poland	2.01
Russia	1.74
South Africa	2.00
Turkey	1.21
Average: Emerging markets	**1.75**
Developed markets	
Canada	1.82
France	1.21
Germany	1.55
Italy	1.28
Japan	1.31

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[v] RBC Global Corporate Bond Fund (the Fund) is an open-end fund incorporated in Canada. The Fund seeks to provide a high level of interest income with the potential for modest capital growth by investing primarily in global corporate bonds. The Fund will invest in investment grade corporate debt securities from anywhere around the world.

UK	1.44
USA	1.90
Average: Developed Markets	**1.50**
Average:	**1.66**

Source: Bloomberg (2012).

The country risk rating was obtained as explained earlier, i.e. by subtracting the local market risk premium from the total equity risk premium, the results of which are shown in Table 6:

Table 6: Country risk premia

Country	Local market risk premium	Default spread	Equity-to-bond-market volatility	Total equity risk premium	Country risk premium
Brazil	7.70%	175	1.75	16.54%	8.84%
Canada	5.90%	0	1.50	8.85%	2.95%
China	9.40%	115	1.75	18.46%	9.06%
France	6.00%	0	1.50	9.00%	3.00%
Germany	5.40%	0	1.50	8.10%	2.70%
India	8.50%	200	1.75	18.38%	9.88%
Indonesia	7.30%	200	1.75	16.28%	8.98%
Italy	5.50%	115	1.75	11.64%	6.14%
Japan	5.00%	115	1.50	9.23%	4.23%
Mexico	7.30%	175	1.75	15.84%	8.54%
Philippines	5.60%	325	1.75	15.49%	9.89%
Poland	6.20%	115	1.75	12.86%	6.66%
Russia	7.50%	115	1.75	15.14%	7.64%
South Af-	6.30%	200	1.75	14.53%	8.23%
Turkey	8.10%	325	1.75	19.86%	11.76%
UK	5.30%	0	1.50	7.95%	2.65%
US	5.50%	0	1.50	8.25%	2.75%

Source: Adapted from Damodaran (2012) and Fernández *et al.* (2011), data from Fitch (2012) and Bloomberg (2012).

Betas (β_U, β_E, β_L)

β_U was calculated using the standard variance-covariance approach (Equation 4) in which each bank's monthly equity returns over the period were used to calculate the beta relative to each country's MSCI index described above. β_E and β_L were derived from these using the formulas highlighted in Equations 5 and 6 respectively.

Debt-to-equity ratios ($\frac{D}{E}$), total debt (*D*) and total equity (*E*)

For banks' ($\frac{D}{E}$), *D* and *E* data were obtained from Bloomberg (2012), which is where these ratios are calculated.

These data set out above were used as the inputs into calculating the COC according to the three chosen methods explained in section 4. The results and findings are presented in section 6.

6.   Results and findings

The results are presented in the following sections with each section highlighting the method employed and the results obtained. The first calculation of the COC was done by employing the original WACC while the second calculation was done on a similar basis but for an equity market risk premium that was added to the original WACC calculations. These results are denoted by 'WACC$_1$' and 'WACC$_2$' respectively both in Table 7 and in the results in Appendix A. Some inputs and the full set of results are attached in Appendix A. The averages of the countries' COC obtained are illustrated in Table 7.

Table 7: Results: Average COC

Average COC	WACC$_1$	WACC$_2$	WACC and CAPM
Brazil	3.55%	5.40%	10.28%
China	2.36%	6.20%	11.65%
India	2.77%	5.86%	12.06%
Indonesia	1.91%	7.16%	14.67%
Mexico	3.42%	4.88%	10.45%
Philippines	1.95%	5.12%	13.84%
Poland	2.05%	4.34%	10.08%
Russia	3.10%	5.71%	11.67%
South Africa	2.37%	5.93%	12.19%
Turkey	3.11%	5.72%	15.60%
Emerging markets	**2.66%**	**5.63%**	**12.25%**
Canada	2.81%	4.65%	5.59%
France	3.11%	3.49%	5.51%
Germany	3.27%	3.86%	5.61%
Italy	2.84%	3.62%	8.03%
Japan	2.71%	3.33%	6.02%
United Kingdom	2.89%	3.75%	5.66%
United States	2.06%	3.03%	4.72%
Developed markets	**2.81%**	**3.68%**	**5.88%**
All	**2.72%**	**4.83%**	**9.62%**

Source: Compiled by the author.

6.1. Original WACC (WACC₁)

Using this calculation method, the cost of debt is calculated by adding a risk premium to the risk-free rate and is denoted by K'_{DI} in Appendix A. In this case, the intermediation spread was added to the cost of debt while the country risk spread was ignored. The original CAPM was employed to calculate the cost of equity (K_{EI}) and the WACC was calculated by aggregating the weighted averages of these.

In using these CAPM and WACC models, the average COC was found to be 2.7% across all the countries and the COC between emerging-market countries and developed markets was closely aligned, with an average COC of 2.7% and 2.8% respectively.

These results highlight some of the weaknesses of the original CAPM and WACC where it is assumed that all countries' financial markets are integrated while ignoring country-specific risk and taxation. These assumptions drive the relative alignment and low costs of capital between countries, specifically between emerging markets and developed countries.

6.2. WACC plus equity market premium (WACC₂)

The second set of results (WACC₂) was obtained using the same methodology as was used with WACC₁, but for an equity market risk premium, as per Table 3, that was incorporated into the CAPM calculation of the cost of equity (K_{E2}). This addition not only increased the COC (as would be expected), but this increase for emerging markets was incrementally more than that of developed markets.

The WACC in emerging markets increased from the previous average of 2.7% to 5.6% while the WACC for developed markets increased from 2.8% to 3.7%. This incremental increase in emerging markets' COC is due to the perceived higher risk in their equity markets, also indicating the effect on the COC where markets are not fully integrated globally. The results of WACC₂ indicate that, if country-specific factors are considered, the COC between countries differ and that there is a larger difference between the COC of developing countries and that of developed countries.

6.3. Villarreal & Córdoba models (WACC and CAPM)

Villarreal & Córdoba (2010) argue that the results of the WACC and the CAPM should be equal if their principles of intermediation spreads, country risk, taxation, and different betas used are applied correctly, which was the case in this article (WACC and CAPM were verified as per Appendix A).

The cost of debt used in these models is denoted as K'_D and the cost of equity used as K_E in Appendix A. CR and CR^* are used as the country risk spreads as explained in Equations 7, 8, and 9.

The results obtained with these models show that an even larger gulf in the COC between developed countries and emerging markets develops as more factors are considered for COC calculations as illustrated in Figure 1.

Figure 1: Increasing COC for emerging markets
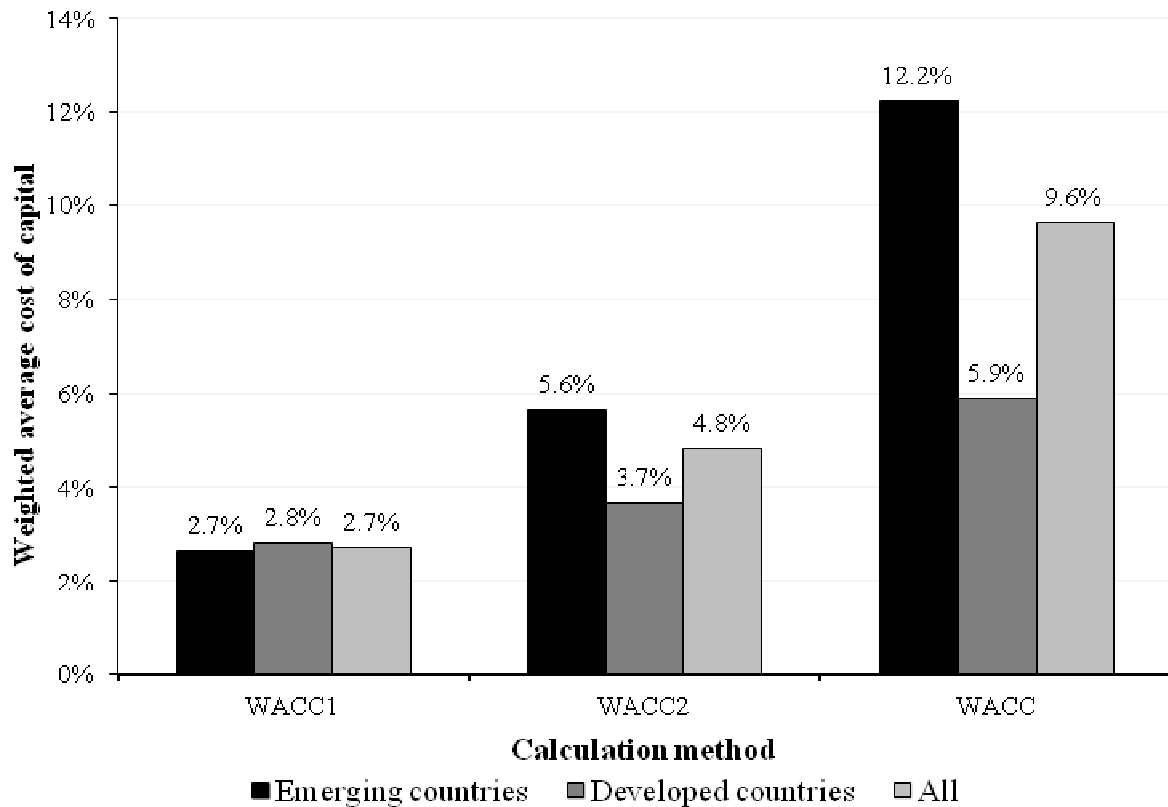
Source: Compiled by the author.

The average COC of emerging markets more than doubled from 5.6% to 12.3%, while the COC for developed countries increased from 3.7% to 5.9%. Again, it may be deduced from the results that emerging markets are still not fully integrated into global financial markets and that they are more risky than developed markets. The COC among developing countries remained relatively closely aligned when using this model.

The conclusions that can be drawn from these results are discussed in the following section.

7.   Conclusions

From the results obtained, a clear pattern emerged, namely that the COC increased significantly more in emerging markets than in developed countries when additional country-specific factors were included in the calculations. This provides further results from which certain conclusions can be drawn.

7.1. Different COC between emerging markets and developed markets

The results obtained from the COC calculations indicate that the COC increases at an increasing rate between developed countries and emerging markets as more country-specific factors are used as inputs to the models.

This illustrates the well-known fact that emerging markets are not fully integrated into global markets and that there is a difference between the COC between emerging markets and developed markets. The results in this article may even understate the extent of this because there may be a potentially infinite list of factors that could be included as additional country-specific factors which may accentuate this gap in the COC.

7.2. Unequal benefits

Based on the results, an argument can be made that financial regulations based on capital requirements are biased towards developed-market economies. Financial regulations are designed in developed countries mainly for the developed world where financial markets are closely integrated (and, from the results in this article, their COC) while nuances in developing countries are not taken into account. Developing countries are often socially and politically relatively worse off than developed countries already. Accordingly, in complying with financial regulations that do not apply to them or that do not consider nuances in their domestic markets, developing countries may find themselves being disadvantaged compared to their counterparts in developed countries.

Therefore, financial regulations based on capital requirements may be a useful tool to ensure equal footing among financial institutions in developed countries, but not across all markets. Essentially, as long as certain markets pay more for their capital than others, financial regulations, which aim to ensure no competitive advantage among financial institutions through using capital requirements, cannot fully realise this objective.

7.3. Capital as regulatory instrument

Following the financial crisis, the ability of capital as regulatory tool to contribute to financial stability through acting as a buffer against unexpected losses has been questioned because of its procyclical nature (e.g. Atik, 2011; Dowd, Hutchinson, Ashby & Hinchliffe, 2011).

Adding impetus to the previous finding, the results of this article may further strengthen arguments against capital as an instrument for financial regulation based on its inability to fulfil the objective of levelling playing fields between countries and institutions in addition to the argument from a financial stability perspective.

7.4. Development of financial regulations

The development of financial regulations should take into account more country-specific factors to ensure that countries are not forced into competitive disadvantages in complying with financial regulations. It could therefore be useful to have more emerging-market representation in the design and conceptualisation of financial regulations to take into account certain country-specific factors. Financial regulations should also be flexible enough to allow for emerging markets to simply not comply with certain requirements that may significantly penalise them for factors over which they have no

control. In addition, policymakers in emerging markets should engage with regulatory bodies on nuances where complying with certain regulations might disadvantage them.

The alignment of financial regulations between developed and emerging markets is further complicated in view of the fact that, from a regulatory arbitrage perspective, banks and insurers operate on equal grounds (European Central Bank (ECB), 2007; Al-Darwish, Hafeman, Impavido, Kemp & O'Malley, 2011). It is therefore imperative that in attempting to ensure consistency between Basel and Solvency II, regulators should pay heed to the challenges faced by emerging-market countries when the COC and country-specific factors are considered.

7.5. Relevance to Solvency II

Although the data used for this research related specifically to banks and banking groups, it is reasonable to infer that the results will apply to all financial institutions and not only to banks, as the majority of the inputs used in the models were not bank-specific. In addition, these results, findings and conclusions apply to Solvency II based on the similarities between Basel and Solvency II that were highlighted in section 3.1.

With this in mind and with the implementation of Solvency II being an ongoing task, the opportunity exists for emerging-market countries and their regulators to highlight some of the more specific factors and influences in their markets that might place them at a disadvantage compared to developed countries.

7.6. Usefulness of the Villarreal & Córdoba model

A further finding is not related to the objective of this article and relates to the methodology employed to calculate the cost of capital as suggested by Villarreal & Córdoba (2010). The results affirm earlier work and confirm the theoretical foundations of their work and usability of their models for a study of this nature.

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Chapter 4

The role of cost of capital in regulatory discrepancies among developing countries

The role of cost of capital in regulatory capital discrepancies among developing countries[i]

Johann Jacobs[ii] and Dr Gary van Vuuren[iii]

Abstract

Capital as a regulatory instrument has been shown to contribute to competitiveness distortions between developed and developing countries. There is a dearth of literature that analyses the possibility of further competitiveness discrepancies to which capital requirements may contribute among developing countries.

This article explores whether regulatory capital requirements lead to unequal competitive conditions between developing countries based on their costs of capital. It also attempts to identify drivers of such discrepancies. Data of 52 financial institutions from 20 countries spread across 4 geographical regions are used for the analysis.

Key words: *Capital requirements, cost of capital, developing economies, banks, Basel, Solvency II.*

JEL classification: F37, F68, G21, G22, G28, O16.

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1. Introduction

This article aims to build on previous work done by Jacobs & van Vuuren (2013) by further investigating capital requirements as a regulatory tool and assessing whether these requirements can achieve their objective of providing level playing fields (specifically with regard to the cost of capital) between countries. Financial regulations as a whole (specifically the Basel Accords (Basel) and Solvency II) are used as the basis for the inquiry. The article also explores possible drivers of any significant discrepancies (if any) between developing countries' cost of capital (COC).

This article is structured as follows:

Section 2 introduces the objectives of this research before section 3 provides a brief overview of relevant literature. The methodology, data, and assumptions employed in this article are described in section 4 while the results and findings are presented in section 5. Section 6 concludes.

2. Objective

Jacobs & van Vuuren (2013) showed that the COC differs between countries and that it increases considerably between developing countries compared with developed economies as more country-specific factors are factored into the calculation. As a result, international capital requirements, which are generic and thus assume that the COC between countries is equal, as the basis for financial regulation do not provide for an equal competitive footing for all. On the contrary, the results show that financial institutions in developing countries are disadvantaged relative to those in developed countries. Figure 1 shows a COC comparison for different economies and the increase in the COC between developed countries and developing countries as more country-specific factors are added can be seen. The results denoted as 'WACC$_1$' were calculated using the original calculation methods for the cost of debt, the cost of equity and the weighted average cost of capital (WACC), while for WACC$_2$ the same calculation methods were employed as for WACC$_1$, but a country risk premium was added to the cost-of-equity component. WACC refers to results obtained using a model by Villarreal & Córdoba (2010). These calculation methods are explained in detail by Jacobs & van Vuuren (2013:7-15, 21-23).

Figure 1: COC comparison for different economies
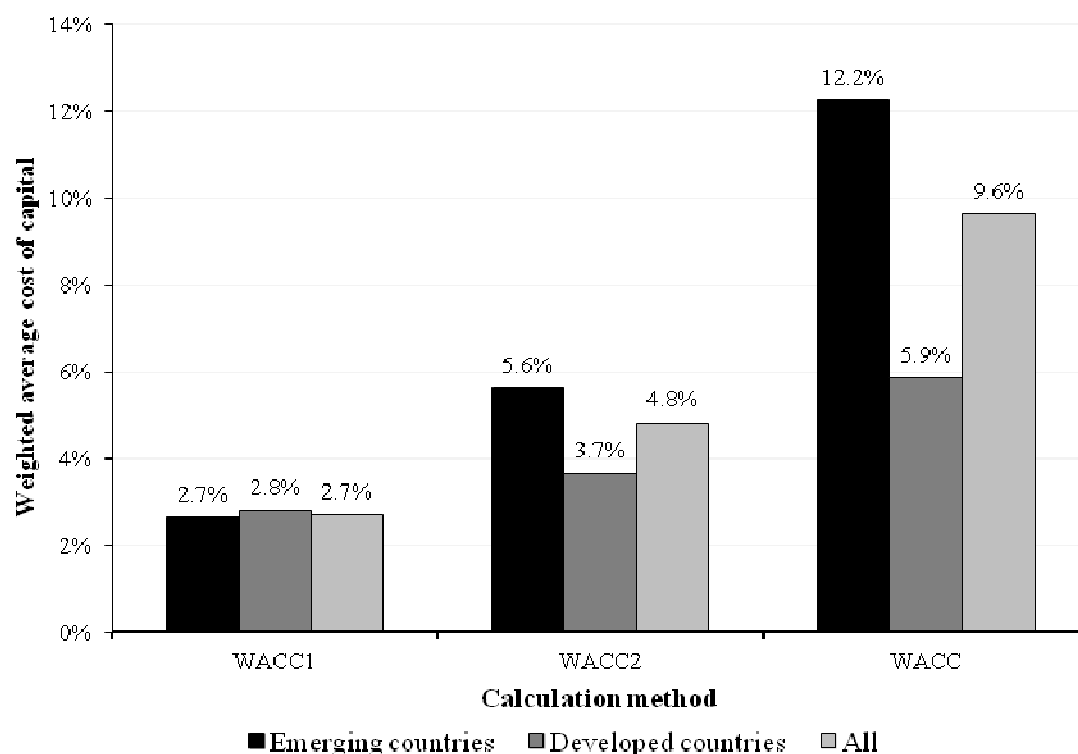
Source: Jacobs & van Vuuren (2013).

Figure 1 shows the COC of groups of developed and developing countries based on three different calculation methods for obtaining the WACC, with each group using more country-specific factors as inputs. For developing countries, the results indicate that the comparative COC between developed and developing countries increases at an increasing rate as more country-specific factors are considered.

From this, the question thus arises whether the COC between developing countries may provide the basis for even further competitive distortions as a result of regulatory capital requirements and, if so, what might contribute to such inter-group discrepancies?

This article therefore further explores whether capital requirements as a regulatory tool can achieve their objective of levelling playing fields between countries, specifically with regard to their COC. An attempt will also be made to establish the drivers of discrepancies (if any) between developing countries' COC. In considering whether regulations based on minimum capital requirements can provide for equal competitive conditions among financial institutions, it may be argued that there may be an offset in the cost of capital (which is based on systematic risks) in some countries in financial institutions' actual capital requirements (which are based on idiosyncratic risks). In other words, some financial institutions may be required to hold less capital although this capital costs them more than it does other financial institutions. However, as was the case in the study by Jacobs & van Vuuren

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(2013), the relationship between idiosyncratic risks (capital requirements) and systematic risks (the cost of capital) falls outside the scope of this article. This article does not attempt to relate the cost of capital back to the capital requirements of individual financial institutions, but focuses instead on the cost of capital between financial institutions based in different countries.

3.   Literature review

It is important to note that this article explores financial regulations in general, including banking (Basel) and insurance regulations (Solvency II). The basis for this choice is that both sets of regulations share two similarities:

- both set out to achieve the same broad objectives, i.e. to promote and contribute to financial-sector stability; to level playing fields between financial institutions; and to be based on risk-sensitive tools and measures; and

- both are based on similar principles using a three-pillar approach where Pillar 1 involves minimum capital requirements as the cornerstone of both sets of regulations (Bank for International Settlements (BIS), 1999:9; 2006:6; Shadow Financial Regulatory Committees (SFRC), 1999:2; De Carvalho, 2005:7-8; Horcher, 2005:257; Lind, 2005:28; the European Insurance and Re-insurance Federation (CEA), 2006:5; Koch & MacDonald, 2006:312; the Commission of the European Communities (CEC), 2007:3; Sandström, 2007:12; van Duffel, 2008; European Union (EU), 2009:3; Lloyd's, 2010:8).

Background: Levelling of playing fields and expansion of a previous study

The aim underlying the second objective of financial regulations, i.e. the levelling of playing fields between financial institutions, is to eliminate competitive advantages that some institutions might enjoy by holding lower levels of capital by introducing minimum capital requirements (Jacobs & van Vuuren, 2013:4). For the achievement of this objective, the premise is based on the implicit assumption that the COC between countries is the same, since if there *were* discrepancies, this objective would be unattainable. However, Jacobs & van Vuuren (2013) showed that the COC does indeed differ between countries and that it increases considerably for developing countries as more country-specific factors are factored into the calculations. These results indicate that capital as regulatory tool may not fulfil the goal of competitive equality and that developing countries are disadvantaged in comparison with developed countries.

In this article, these findings will be expanded upon by exploring whether the COC between developing countries provide for similar competitive distortions and to determine possible drivers of such discrepancies in the COC between developing countries.

COC literature

Much literature is available on calculating the COC using the WACC by combining the cost of debt and the cost of equity as approximated by the capital asset pricing model (CAPM) (Markowitz, 1952; 1959; Roy, 1952; Modigliani & Miller, 1958; Sharpe, 1964; Lintner, 1965; Mossin 1966; Annin & Falaschetti, 1998; French, 2003; Fama & French, 2004:13; Exley & Smith 2006:230). Although these models have weaknesses (McCauley & Zimmer, 1989; Shoven & Topper, 1992; Godfrey & Espinosa, 1996; Estrada, 2001; Lally, 2004; Lambert, Leuz & Verrecchia, 2006; Lambert & Verrecchia, 2010; McMorran, 2010), they are considered useful in the calculation of COC approximations for countries (Bruner, Eades, Harris & Higgins, 1998:15; Brealey, Myers & Marcus, 2001:572; Ross, Westerfield & Jaffe, 2003:543).

As was the case in the study by Jacobs & van Vuuren (2013), for the sake of brevity and because these are widely available in literature, the formulas for calculating the components of, and the COC, are not included in this article.

There exists an abundance of research on the topic of the COC, the COC between countries, and the COC for developing countries. Research that was considered in this article included those by McCauley & Zimmer (1989), Shoven & Topper (1992), Godfrey & Espinosa (1996), Estrada (2001), Hail & Leuz (2003; 2008), Lally (2004), Exley & Smith (2006), Jenkinson (2006), Lambert, Leuz & Verrecchia (2006), Lambert & Verrecchia (2010), McMorran (2010), Sánchez, Preve & Allende, (2010), Nekrasov (2012). The major research that was considered for this article included those of Erb, Harvey & Viskanta (1996), Koedijk, Kool, Schotman, & van Dijk, (1998), Harvey (2004; 2005), Sercu (2008), Villarreal & Córdoba (2010).

Specifically regarding the COC for developing countries:

- Harvey (2004) explored the components of country risk, i.e. political, economic, and financial risks and the effects that these may have on expected returns based on an implied COC model. Harvey found country risk to be an important driver of expected returns, particularly in emerging markets, because of their segregated nature from global financial markets.

- This research builds on Erb *et al.* (1996), who used alternative measures of calculating expected returns and volatility in developing markets to explore the assumption that it is not appropriate to use the country beta with respect to a world market portfolio as a measure of risk for segregated capital markets. The approach uses country credit ratings as a proxy for the *ex ante* risk exposure for such segregated countries.

- The relative segregation of emerging markets from global markets along with their increased riskiness remain challenges to obtaining more accurate approximations of their cost of equity capital. Although many different theories and approaches to determine more accurate results

exist, there is no uniformity in terms of calculating the cost of equity capital among countries (Estrada, 2001:10).

- Villarreal & Córdoba (2010) explored a consistent approach to calculating the COC in emerging markets and reinforce the need to adjust traditional methods of calculating the COC.

The recurring themes from literature reviewed regarding the calculation of countries' COC are:

- the calculation of the COC between countries remains a contentious subject and, although much research has been, and continues to be done, an accurate universal method of obtaining results remains elusive;

- CAPM and WACC remain a popular base from which the COC is calculated; and

- certain adjustments need to be made to the original CAPM and WACC models for greater accuracy, specifically around developing countries that are less integrated in global markets, where asset returns are not well correlated to world returns, and also for country risk associated with developing countries. However, there is not conformity on the exact nature of such adjustments.

Despite this profusion of research on the topics highlighted, the research in this article builds on previous literature and adds a different dimension to current literature in that it analyses the COC between developing countries with the aim of assessing whether financial regulations based on capital requirements can achieve their objective of providing financial institutions with equal competitive conditions from a regulatory perspective. This article further adds to current literature in that it analyses the major drivers behind the COC in developing countries.

4. Calculation methods and analysis

A comparative analysis of the COC was conducted for 52 financial institutions across 4 different 'developing economy' regions to determine whether capital requirements further distort competitiveness among developing countries.

4.1. Calculation methods

There are various methods to calculate the COC and, depending on the models and assumptions used, results can vary significantly. In addition, calculating the COC for developing countries is challenging because their markets are less integrated into global markets and due to other country-specific factors. This article employs the same calculation methods used by Jacobs & van Vuuren (2013), namely:

- the CAPM and WACC in their original format;

- the original CAPM and WACC where an equity risk premium is added to the cost of equity; and

- the modified CAPM and WACC as explained by Villarreal & Córdoba (2010).

For the purposes of this study, the first calculation method, i.e. the CAPM and WACC in their original format, used the standard CAPM and WACC formulas which are widely available in literature. The second calculation method used the same formulas except for an equity risk premium that is added to the CAPM used to calculate the cost of equity portion of the WACC.

The third calculation method employed, the Villarreal & Córdoba (2010) model, makes certain adjustments to the original models based on three assumptions, namely (i) that spot market prices represent efficient estimators; (ii) that country risk is a non-diversifiable risk and that investors require a premium on returns based on the perception of increased country risk; and (iii) that agency costs (transaction costs, taxes and intermediation spreads) are taken into account in a model. Before providing a brief description of the model along with its formulas, it is again necessary to highlight that the calculation of the COC between countries remains a contentious subject, especially for such calculations among developing countries. Two challenges that are often highlighted include the term structure of credit ratings and the time variation of risk premiums (Erb, *et al.*, 1996; Harvey, 2004; 2005). These time-dependencies might be as a result of external events and/or shocks and may impact the calculations of the COC. In pursuing its objective, this paper did not explicitly take into account these time effects through advanced regressions analyses as often prescribed. This paper rather focuses on the results of a model that is applied consistently across a sample set of countries instead of focussing on the effect of time on the calculations of the COC.

The Villarreal & Córdoba (2010) model considers the COC as an opportunity cost and makes the above adjustments in the WACC and CAPM so that the results obtained by both the CAPM and the WACC should be identical based on the consistent application of the adjustments. This provides an important and useful check on the validity of the consistent application of these principles. According to this model, the WACC formula used includes the principles described above and taxes, transaction cost and an additional country risk (*CR*) component are present. This WACC formula is shown as Equation 1:

$$WACC = \left[\frac{D}{D+E}(1-t)K'_D\right] + \left(\left(\frac{E}{D+E}\right)K_E\right) \tag{1}$$

Where D is the total debt capital of a particular company, $D + E$ the total capital of the company, K'_D the pre-tax cost of debt, E the total equity capital of the company, and K_E the cost of equity. K'_D is presented by the cost of debt (K_D) (risk-free rate (R_F) plus intermediation spread) plus a *CR* premium:

$$K'_D = (R_F + intermediation\ spread) + CR \tag{2}$$

Similarly, the original K_E for this model is modified to incorporate a *CR* premium that is adjusted to incorporate taxes (*CR(1-t)*) and a non-diversified country risk premium (*CR(β_E)*) so that:

$$K_E = \{[K_D(1-t)] + [\beta_E(R_M - R_F)]\} + \{[CR(1-t)] + CR(\beta_E)]\} \qquad (3)$$

Where β_U is the beta of a specific equity, R_M the expected market return and therefore $(R_M - R_F)$ the market risk premium, and β_E, or equity beta, as explained in Equation 5.

From the original CAPM, it is important to point out that beta is estimated by the quotient of the co-variance between a company's equity returns (R_E) and R_M and the variance of the market returns (Sercu, 2008:720):

$$\beta_U = \frac{COVAR(R_E, R_M)}{VAR(R_M)} \qquad (4)$$

Villarreal & Córdoba (2010:19) refers to the beta in Equation 4 as 'unlevered beta', or β_U, because it is based on equity data only, i.e. it assumes that the company's capital structure consists of equity only and does not take into account financial leverage. Sometimes the terms 'levered beta', 'unlevered beta', and 'equity beta' are used interchangeably and can lead to much confusion, illustrated where McMorran (2010:73) states that the beta in Equation 4 inherently includes financial and business risks and is often referred to as 'levered beta', or 'equity beta'. On the other hand, when referring to equity beta, or β_E, Villarreal & Córdoba (2010) refer to a beta which is adjusted by the debt-to-equity ratio, or $\frac{D}{E}$, of a company, and reflects systematic risk given its $\frac{D}{E}$. On the other hand, when referring to β_E, Villarreal & Córdoba (2010) refer to a beta which is adjusted by the debt-to-equity ratio $(\frac{D}{E})$ of a company, and reflects systematic risk given a company's $\frac{D}{E}$. β_E is calculated as:

$$\beta_E = \beta_U \left[1 + (1-t)\frac{D}{E}\right] \qquad (5)$$

In turn, Villarreal & Córdoba's (2010:22-23) explanation of levered beta, or β_L, is the beta of a company where financial leverage is taken into account, or where debt is incorporated into a company's capital structure and is calculated as:

$$\beta_L = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E \qquad (6)$$

Where β_D is the beta of debt.

The Villarreal & Córdoba's (2010) definitions of beta are used throughout this article. Accordingly, following from Equation 3, for notational simplicity it is assumed that:

$$CR(1-t) + CR(\beta_E) = CR^* \qquad (7)$$

So that Equation 3 can be re-written as:

$$K_E = \{[K_D(1-t)] + [\beta_E(R_M - R_F)]\} + CR^* \qquad (8)$$

Alternatively, the cost of equity can be calculated using K'_D as a starting point:

$$K_E \;=\; K'_D(1-t) + \beta_E\big[\big(R_M - R_F\big) + CR\big] \tag{9}$$

From this, a principle of coherence is applied such that the opportunity cost calculation does not depend on the method used and that there must be consistency between the CAPM and WACC so that their CAPM formula is modified as follows (note that β_L is used here):

$$CAPM \;=\; K'_D(1-t) + \beta_L\big[\big(R_M - R_F\big) + CR\big] \tag{10}$$

With these modifications and the principle of coherence, the results of the WACC and CAPM should be equal and the one can be used to verify the other.

This model is employed as the major calculation method in this article as it was developed specifically for calculating the COC for developing countries by taking into account some specific developing country peculiarities and features.

4.2. Data

The data used for this article were for banks only, yet it is assumed that the results obtained by using these data can be applied across financial institutions, including insurance companies, as both Basel and Solvency II use capital requirements as basis and both have similar stated objectives as highlighted by Jacobs & van Vuuren (2013).

This research aims to illustrate the COC among developing countries and the first principle of the data selected was that the data needed to be representative for countries across different regions. However, in keeping with one of the major assumptions of the Villarreal & Córdoba (2010) model, these markets had to be efficient with at least some degree of sophistication and integration into global markets.

Obtaining data for developing countries remains a challenge and the data that were used were driven by a second principle, namely one of data availability.

Sample countries and institutions

The data that were used divided developing countries into four major regions, namely emerging markets: Asia; emerging markets: Europe; emerging markets: Latin America; and emerging markets Middle East and Africa (MEA). The intention was to obtain data from Bloomberg for four countries per region and three banks per country; however, this was not always possible so different sample sizes were used.

Asia's emerging market comprised data from 12 banks (3 from each country including China, India, Indonesia, and the Philippines).

Europe's emerging-market economies posed a challenge and data were used for the following countries (number of banks indicated in brackets): Kazakhstan (1), Poland (3), Russia (3), Slovenia (2), and Turkey (3).

Data for 13 banks from 5 countries were used to create the sample for Latin America. The countries were (number of banks for each country indicated in brackets) Argentina (3), Brazil (3), Chile (2), Mexico (3), and Peru (2).

MEA comprised 15 banks made up of 3 banks from each of the following 5 countries: Bahrain, Kuwait, Nigeria, Saudi Arabia, and South Africa.

As far as possible, the largest banks in each country were selected based on balance-sheet size[iv], all of which can be seen in Appendix B. Financial groups were included in some cases (i.e. not only banks), as the aim was not necessarily to calculate the COC for only banks but rather to estimate the COC among countries based on banking data.

Time series

Selecting a time period over which to conduct the analyses was based on three principles: the data must:

- be sufficient to provide meaningful results,

- include benign and challenging economic conditions; and

- be selected from the recent past.

With these in mind, the time period selected for the analyses was for the seven years 2005 to 2011.

Risk-free rate (R_F)

The R_F that was used was the average daily United States (US) ten-year Treasury bond rate obtained from the Federal Reserve Bank of St Louis Economic Data (FRED, 2012) over the period analysed, namely 3.80%. This assumption is considered as being rather conservative considering that most countries that were used in this study will have a higher R_F than the US.

Intermediation spreads

An intermediation spread is added to the cost of debt and the Villarreal & Córdoba (2010) model calculates a company's interest-coverage ratio in order to obtain its assumed credit rating. For this article, however, the intermediation spread was calculated using the method of Jacobs & van Vuuren (2013). For this, data were obtained from FRED (2012) and in keeping with the composition of the dataset that divides the countries used into geographical areas, the categories of the data that were

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[iv] In some cases banks not representing the three largest balance sheets in a specific country were selected based on data availability. In this regard, according to banks' size, for Indonesia numbers 1, 4 and 8 were used; for Russia 1, 2 and 6; for Turkey 1, 2 and 4; for Chile 1 and 4; for Mexico numbers 1, 3 and 4; for Peru 2 and 5; and for Bahrain 3, 5 and 6 were used.

used are reflected in Table 1 where the average spread is the average daily basis points (bps) spread per category above the assumed R_F.

Table 1: Intermediation spreads

Category	Average spread (bps)
Asia emerging markets	228
Euro emerging markets	280
EMEA emerging markets	404
Latin America emerging markets	353

Source: FRED (2012).

Country risk spread

To estimate the CR premium, data were used from Damodaran (2012), who uses country credit ratings as a starting point to obtain defaults spreads in bps. This information adds this spread to a market risk premium (assumed to be 5.5% for mature financial markets) before multiplying it by a volatility factor (1.5) that represents the equity-to-bond market spread to get to a total equity risk premium. The country risk premium is obtained by subtracting the market risk premium from the total equity market premium.

Local currency credit ratings were obtained from Fitch (2012) and used to obtain a default spread in bps above the US Treasury bond rate using historical credit data of US corporates and country bonds. Default spreads are shown in Table 2:

Table 2: Estimated default spreads by credit rating

Moody's rating	Fitch Rating	Default spread (bps)
Aaa	AAA	0
Aa1	AA+	25
Aa2	AA	50
Aa3	AA-	70
A1	A+	85
A2	A	100
A3	A-	115
Baa1	BBB+	150
Baa2	BBB	175
Baa3	BBB-	200
Ba1	BB+	240
Ba2	BB	275
Ba3	BB-	325
B1	B+	400
B2	B	500
B3	B-	600
Caa	CCC	700
Ca	CC	850
C	D	1,000

Source: Modified from Damodaran (2012).

Instead of using this flat 5.5%, the same methodology was employed to estimate the CR premium as that used by Jacobs & van Vuuren (2013) in that data were obtained from Fernández, Aguirreamalloa & Corres (2011). The average market risk premia are given in Table 3.

Table 3: Average market risk premia per country

Market	Average market risk premium	Number of respondents	Market	Average market risk premium	Number of respondents
Argentina	9.90%	33	**Nigeria**	6.90%	7
Bahrain	6.97%	5	**Peru**	7.80%	19
Brazil	7.70%	35	**Philippines**	5.60%	6
Chile	5.70%	31	**Poland**	6.20%	28
China	9.40%	31	**Russia**	7.50%	37
India	8.50%	28	**Saudi Arabia**	6.30%	8
Indonesia	7.30%	14	**Slovenia**	6.68%	3
Kazakhstan	7.50%	6	**South Africa**	6.30%	34
Kuwait	6.60%	6	**Turkey**	8.10%	25
Mexico	7.30%	56			

Source: Adapted from Fernández *et al.* (2011:2-3).

For countries where there were five or fewer responses as per the survey used, the averages of the countries' in the group they fall into were used (Bahrain 6.97% and Slovenia 6.68%).

Bps default spreads were obtained from Table 2, but each country's credit rating as measured by Fitch was obtained so that the default spread that was used for each country could, in turn, be obtained. This is shown in Table 4:

Table 4: Country default spreads

Country	Country	Default	Country	Country	Default
Argentina	B	500	**Nigeria**	BB-	325
Bahrain	BBB	175	**Peru**	BBB	175
Brazil	BBB	175	**Philippines**	BB+	240
Chile	A+	85	**Poland**	A-	115
China	A+	85	**Russia**	BBB	175
India	BBB-	200	**Saudi Arabia**	AA-	70
Indonesia	BBB-	200	**Slovenia**	A	100
Kazakhstan	BBB	175	**South Africa**	BBB+	150
Kuwait	AA	50	**Turkey**	BB+	240
Mexico	BBB	175			

Source: Fitch (2012), Damodaran (2012).

For the equity-to-bond market volatility spread, individual country spreads were calculated using the returns for each country's equity markets over the sample period using each country's Morgan

Stanley Capital International (MSCI) index as a proxy for equity returns (where possible) and the Emerging Markets Bond Index (EMBI) for bond market returns for all the countries. Kazakhstan and Saudi Arabia do not have a country-specific MSCI index and the MSCI Europe and Middle East index was used as a proxy for these two countries respectively. This approach differs from that of Damodaran (2012) who used a fixed factor of 1.5 as an input for the equity-to-bond market volatility spread.

The relative volatilities for each of the countries' stock market returns against these bond market return proxies that were obtained are given in Table 5.

Table 5: Equity-to-bond market volatility spreads

Country	Volatility	Country	Volatility	Country	Volatility
Argentina	1.07	**Kazakhstan**	1.12	**Russia**	1.74
Bahrain	2.90	**Kuwait**	1.19	**Saudi Arabia**	1.12
Brazil	1.33	**Mexico**	1.53	**Slovenia**	2.74
Chile	2.26	**Nigeria**	1.76	**South Africa**	2.00
China	1.80	**Peru**	1.95	**Turkey**	1.21
India	1.91	**Philippines**	1.78	**Indonesia**	1.23
Poland	2.01				

Source: Bloomberg.

Finally, the country risk rating was obtained as explained earlier, i.e. by subtracting the local market risk premium from the total equity risk premium. These results are shown in Table 6:

Table 6: Country risk premia

Country	Local market risk premium	Default spread (bps)	Equity-to-bond-market volatility	Total equity risk premium	Country risk premium
Argentina	9.90%	500	1.07	15.89%	5.99%
Bahrain	6.97%	175	2.90	25.29%	18.32%
Brazil	7.70%	175	1.33	12.53%	4.83%
Chile	5.70%	85	2.26	14.79%	9.09%
China	9.40%	85	1.80	18.42%	9.02%
India	8.50%	200	1.91	20.07%	11.57%
Indonesia	7.30%	200	1.23	11.46%	4.16%
Kazakhstan	7.50%	175	1.12	10.33%	2.83%
Kuwait	6.60%	50	1.19	8.45%	1.85%
Mexico	7.30%	175	1.53	13.85%	6.55%
Nigeria	6.90%	325	1.76	17.85%	10.95%
Peru	7.80%	175	1.95	18.64%	10.84%
Philippines	5.60%	240	1.78	14.25%	8.65%

Poland	6.20%	115	2.01	14.76%	8.56%
Russia	7.50%	175	1.74	16.10%	8.60%
Saudi Arabia	6.30%	70	1.12	7.82%	1.52%
Slovenia	6.68%	100	2.74	21.01%	14.33%
South Africa	6.30%	150	2.00	15.64%	9.34%
Turkey	8.10%	240	1.21	12.74%	4.64%

Source: Adapted from Damodaran (2012) and Fernández *et al.* (2011), data from Fitch (2012) and Bloomberg (2012).

Betas ($\beta_U, \beta_E, \beta_L$)

β_U was calculated using the standard variance-covariance approach (Equation 4) in which each bank's monthly equity returns over the sample period were used to calculate the beta relative to each country's MSCI index described above. β_E and β_L were derived from these betas using the formulas highlighted in Equations 5 and 6 respectively.

Debt-to-equity ratios ($\frac{D}{E}$), total debt (D) and total equity (E)

For banks' $(\frac{D}{E})$, D and E, data were obtained from Bloomberg (2012) where these ratios are calculated.

Bank credit support ratings

These ratings are used in a regression analysis (refer to section 5.4.2 for further details in this regard) and they indicate the likelihood that governments will support distressed banks in their jurisdiction. A value of '1' indicates that there is a strong likelihood of the government involved assisting the bank in an attempt to prevent it from failing, while a value of '5' shows that the likelihood of such assistance extended to the bank is low. These ratings were obtained from Fitch (2012).

The data set out above were used as inputs to calculate the COC according to the three chosen methods explained in section 4.1. The results and findings are presented in section 5.

5.   Results and findings

The results are presented in the following sections, each section highlighting the method employed and the results obtained. Some inputs and the full set of results are presented in Appendix B. The averages of the COC per country are illustrated by Table 7. It should be noted that these results form the basis for the linear regression analysis conducted in section 5.4.

Table 7: Results: Average COC

Average COC	WACC$_1$	WACC$_2$	WACC
China	2.78%	6.62%	12.32%
India	2.64%	5.73%	13.30%
Indonesia	1.85%	7.09%	8.26%
Philippines	2.30%	5.47%	11.76%
Average: Asia	**2.39%**	**6.23%**	**11.41%**
Kazakhstan	4.45%	6.15%	7.50%
Poland	3.23%	5.04%	12.88%
Russia	3.21%	5.83%	12.78%
Slovenia	4.38%	5.63%	17.06%
Turkey	3.24%	5.85%	9.07%
Average: Europe	**3.52%**	**5.63%**	**12.15%**
Argentina	2.12%	9.20%	8.96%
Brazil	4.03%	5.88%	8.08%
Chile	4.91%	6.38%	13.36%
Mexico	4.21%	5.67%	9.89%
Peru	4.22%	6.82%	13.14%
Average: Latin America	**3.80%**	**6.82%**	**10.29%**
Bahrain	5.73%	7.72%	26.54%
Kuwait	3.76%	6.63%	7.70%
Nigeria	1.05%	5.90%	16.24%
Saudi Arabia	3.58%	7.71%	6.98%
South Africa	3.02%	6.58%	14.76%
Average: MEA	**3.43%**	**6.91%**	**14.45%**
Overall average	**3.30%**	**8.61%**	**12.18%**

Source: Compiled by the author.

5.1. Original WACC (WACC$_1$)

These results obtained from the traditional calculation method for the WACC is denoted by 'WACC$_1$' in Table 7 and in the results presented in Appendix B. These results were calculated using the original formulas for the cost of debt, the cost of equity using the CAPM, and for obtaining the WACC.

Using this method, the average COC was 3.3% across all observed countries and the COC across the four regions varied by only 1.4%, with Asia averaging the lowest at 2.4% and Latin America the highest at 3.8%. The WACC across all countries is low and there are not significant differences in the WACC mainly because of the assumptions of the traditional models, namely that all markets are fully integrated while ignoring the effects of taxation and country-specific factors.

5.2. WACC plus equity market premium (WACC₂)

The second calculation method employed to calculate the WACC was based on the same formula as the first, but an additional local market risk premium was added to the cost of equity as shown in Table 3. This cost of equity is denoted by 'K_{E2}' and the results as 'WACC₂' in Appendix B.

The second set of results increased substantially across all four regions where the previous average increased from 3.3% to 8.6% on a per-country basis. The average WACC for each of the regions remained closely aligned, with Europe having the lowest average of 5.6% and MEA the highest at 6.9%. These results show that, for developing countries the COC increases substantially across the four regions, yet this increase was still much aligned across all regions with the introduction of a local market risk premium. These results indicate that in determining a local market risk premium for developing countries, most countries are considered as being similar in terms of riskiness.

5.3. Villarreal & Córdoba models (WACC and CAPM)

When applied consistently, the WACC and CAPM under the Villarreal & Córdoba (2010) model should yield the same results and it is therefore important to point out that this is the case for the results obtained in this article (denoted by 'WACC' and 'CAPM' in Appendix B). This means that their principles of intermediation spreads, country risk, taxation, and different betas used were applied correctly in this analysis.

The results obtained from this model show that when more country-specific factors are considered in calculating the COC between developing countries, the COC varies quite considerably even among developing countries. The average WACC varied between 9.5% (Latin America) to 14.5% for MEA. Figure 2 displays the results obtained from the Villarreal & Córdoba (2010) model, where the columns indicate the average WACC for each of the countries selected while the dashed line tracks the averages for each *region*.

Figure 2: Developing countries COC
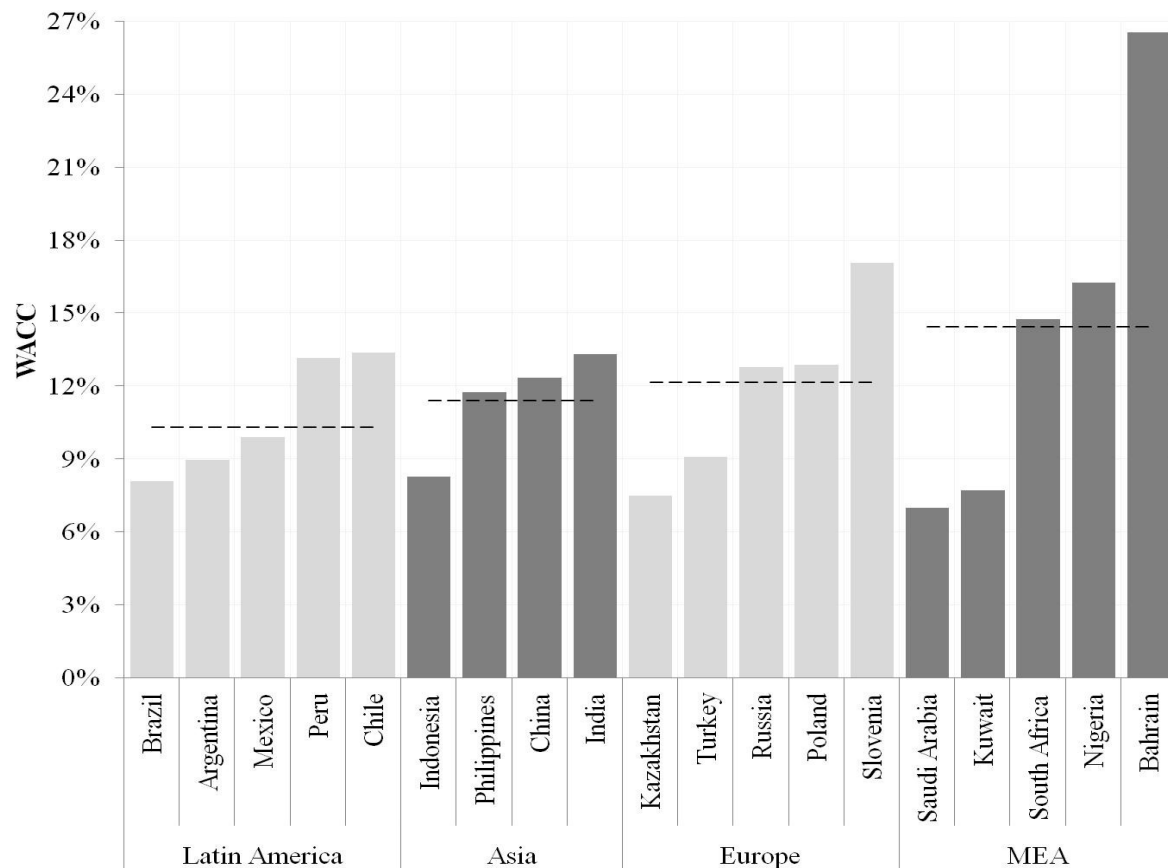
* Dashed lines indicate regional averages

Source: Compiled by the author.

These results show that the COC varies substantially between developing countries when country-specific factors are included in the calculations.

5.4. The driver(s) behind variable WACCs in developing countries

The variability in the results may be explored by ascertaining the driver(s) responsible for the variability in the COC between developing countries. It is clear that, in agreement with Harvey (2004), the country-specific risk factors that were added to the Villarreal & Córdoba (2010) model are involved, but the most pertinent driver(s) remains unidentifiable.

In order to determine possible driver(s) behind the variable WACC across developing countries, a simple linear regression analysis was conducted on much of the data used as inputs to these models as well as on the results obtained. Simple linear regression was used, instead of multivariate regression, to test each of the variables that were to be evaluated individually against countries' overall COC. With the objective of the paper being to identify the key drivers behind the sample countries' COC, a

simple linear regression was considered most suitable for this. Relevant results are presented in this section.

Country-specific factors clearly lie behind this finding simply because these factors are added to the third calculation method employed in this article. To test this assertion, country risk premia that were described previously and presented in Table 6 were used in a linear regression with the WACC results for each of the countries in the sample set. The results of this regression are illustrated in Figure 3.

Figure 3: Country risk premia versus WACC

$$y = 1.016x + 0.040$$
$$R^2 = 0.897$$
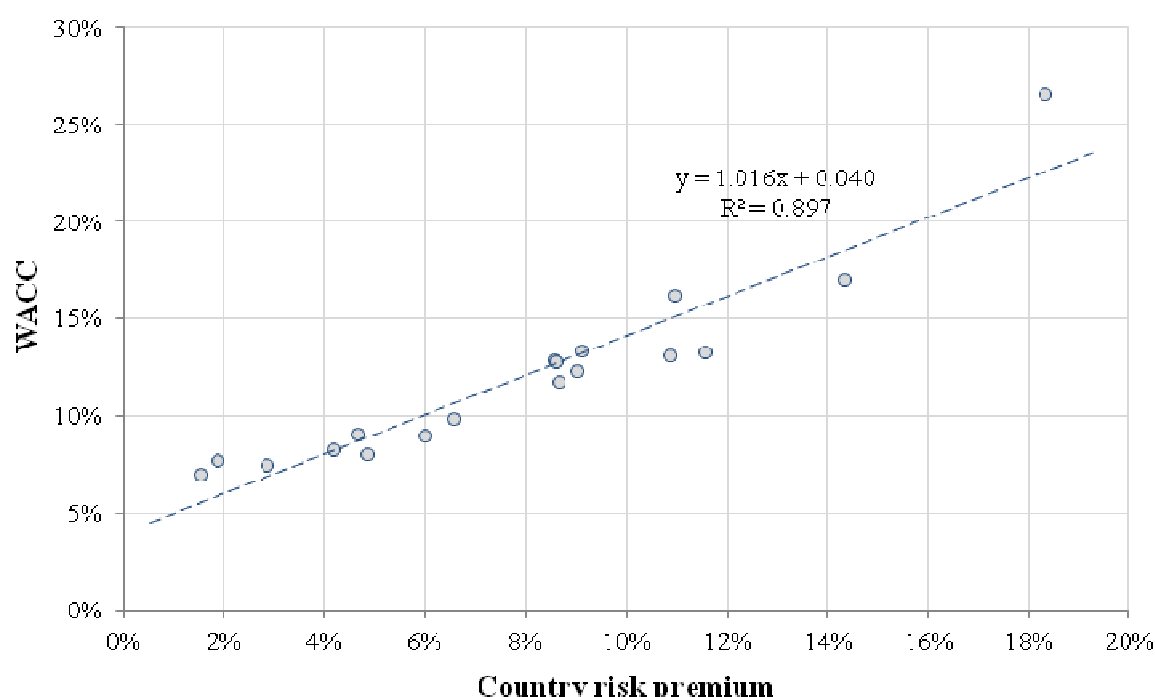
Source: Compiled by the author.

From this regression, there is strong evidence to support the view highlighted above that country-specific factors lie behind developing countries' WACC and that the country risk premia contribute significantly to a country's overall WACC since the regression line has a slope of 1.02 and an R^2 of 0.90.

5.4.1. Credit ratings

This strong relationship and the extent to which the WACC differs among developing countries across the four analysed regions seem to imply that country credit ratings may be involved (i.e. specific country 'factors'). However, from a similar regression analysis of sovereign credit ratings and country risk premia (indicated as round markers in Figure 4), it suggests that credit ratings play almost no role in determining the country risk premium. The slope of the regression line and R^2 values were both

found to be ~0. Associated t-statistics and p values indicate that these values are indeed insignificant at both 99% and 95% confidence levels.

A further regression analysis was performed on sovereign credit ratings versus their overall WACCs. The results were plotted on the same chart and are indicated by the square markers in Figure 4. The results were similar in that they illustrate that credit ratings do not contribute significantly to sovereign WACC. Proceeding from previous evidence, these results confirm the result that sovereign WACC does not depend on relevant sovereign credit ratings: the regression line had a slope and an R^2 of ~0 with associated p values of >> 5%.

Figure 4: Country risk premia and WACC versus credit ratings
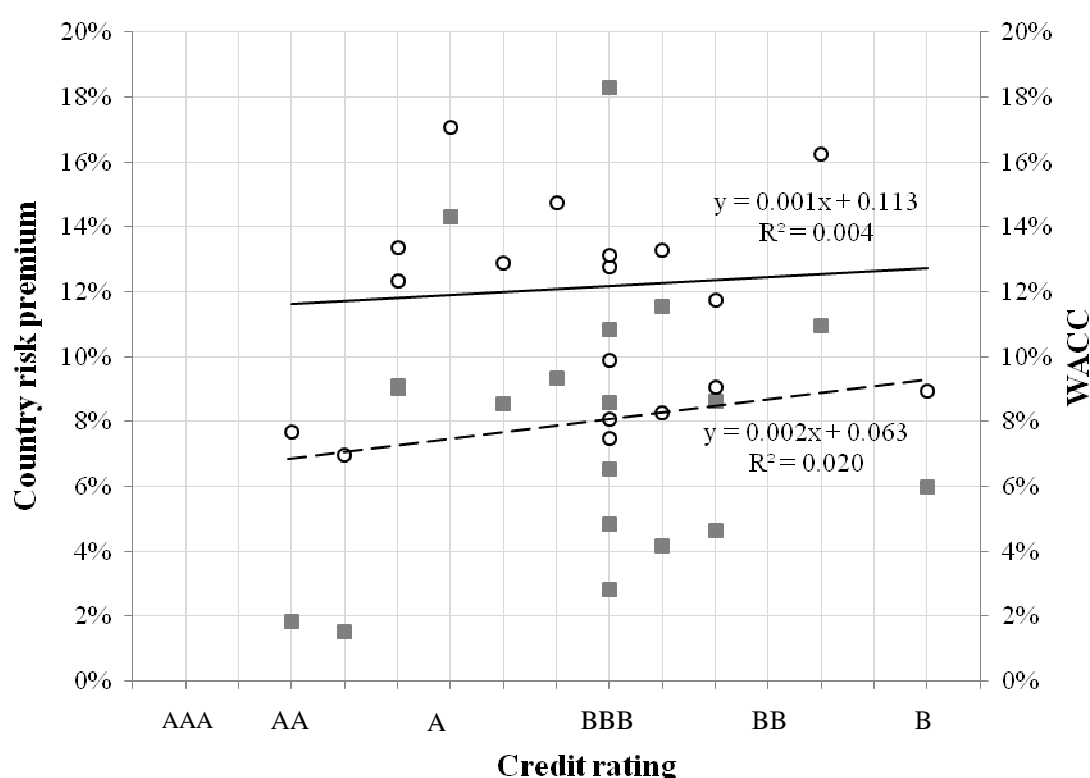
Source: Compiled by the author.

5.4.2. Bank support ratings

Further evidence that a sovereign's risk premium and its WACC are not influenced significantly by sovereign creditworthiness is gleaned from an analysis of bank support ratings. As mentioned earlier, support ratings indicate the likelihood of sovereign support to a distressed bank. Ratings vary from 1 to 5, where a 1 rating represents the highest probability of assistance and 5 the lowest. In comparing these analyses, it is important to note that the support ratings regressions were done on a per-bank basis as opposed to the previous per-country analysis, but the results presented in Figure 4 remain consistent when done on a per-bank basis.

The result of the linear regression on the support ratings of all the banks in the sample set and their WACCs are presented in Figure 5. It was found that, similar to what was found regarding credit ratings, banks' support ratings do not play a significant role in determining their WACCs where the regression returned a small negative slope and $R^2 = 0.01$. Neither of these statistics was significant at the 5% level.

Figure 5: Banks' support ratings versus WACC
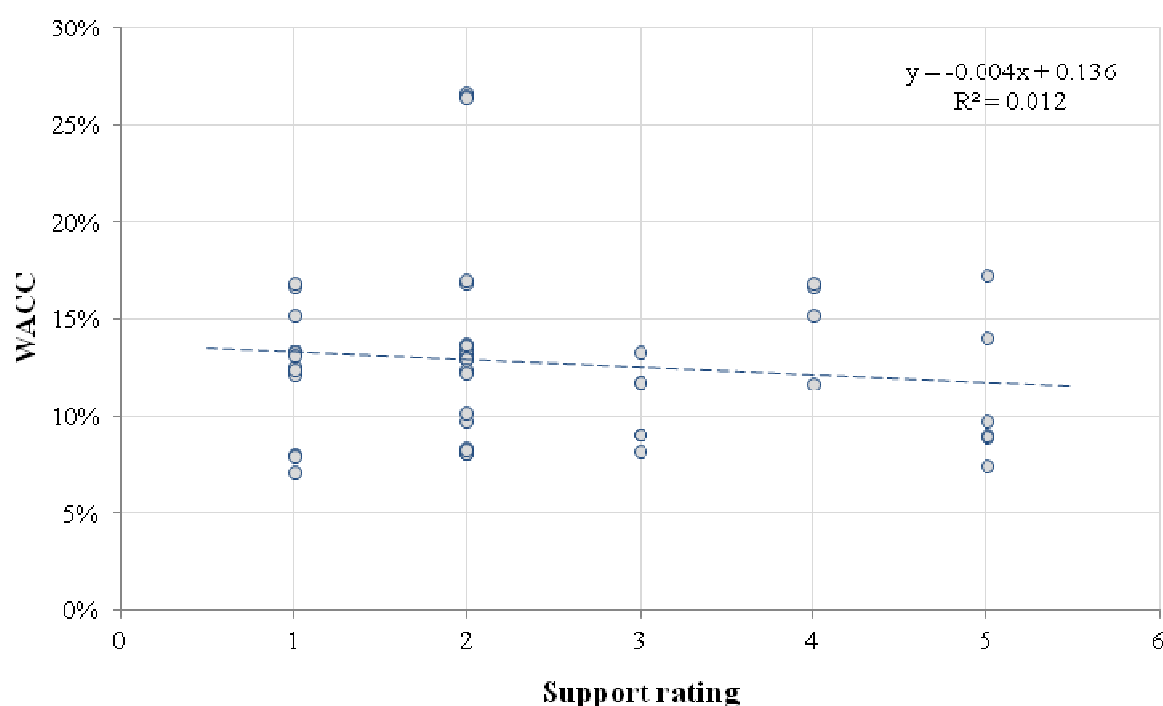
Source: Compiled by the author.

It may thus be concluded that, contrary to expectations, creditworthiness does *not* play a significant part in the determination of developing countries' country risk premia.

The next parameter that will be considered is the local market risk premium, which is used as a basis for the calculation of the country risk premia used in this article as per Damodaran (2012). These local market risk ratings were obtained from a survey conducted by Fernández *et al.* (2011) in which various stakeholders were required to disclose the local market risk premia they used as inputs to their COC models.

5.4.3. Local market risk premia

Local market risk premia were regressed in terms of country risk premia and WACCs. It was found that these local market risk premia did not have strong relationships with these variables. The results in this regard are shown in Figure 6.

The regression analysis where countries' assumed local market risk premia were compared with their country risk premia is shown by the round markers in Figure 6 and it indicates that there is not a strong relationship between the two variables.

Similar to these results, the regression analysis where countries' local market risk premia were compared with their WACCs shows that these two variables do not share a significant relationship as indicated by the square markers in Figure 6.

Figure 6: Country risk premia and WACC versus local market risk premium
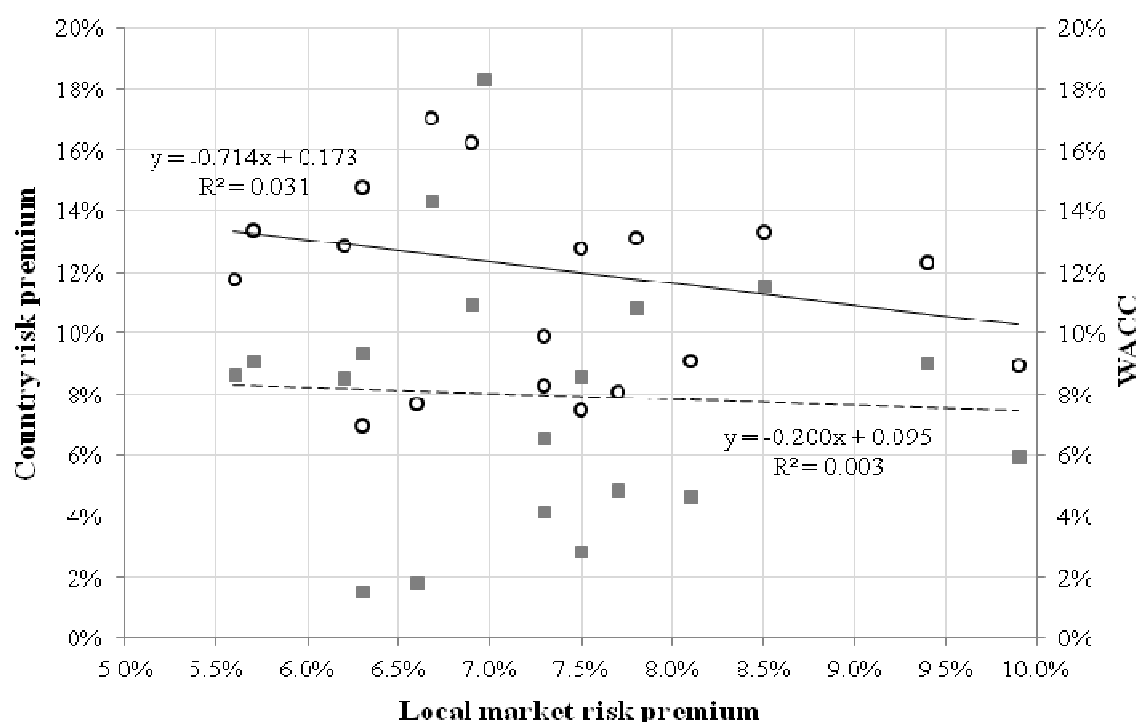
Source: Compiled by the author.

Figure 6 shows that the average local market risk premia that are used in practice according to the study by Fernández *et al.* (2011) do not have a positive relationship with the country risk premia of the developing countries used in this sample. This could indicate that the market risk premia that are assumed in practice are based on judgement and perceptions that may not necessarily consider scientific facts and evidence regarding the riskiness of these countries.

5.4.4. Equity risk premia

Sovereign total equity risk premia in this article were calculated using the local market risk premium to which a credit risk spread in bps was added. This was subsequently multiplied by an equity-to-bond market volatility spread ratio. A linear regression analysis was accordingly conducted on sovereign equity risk premia and country risk premia versus WACCs. It was found that both countries' country

risk premia and their WACCs are largely based on their equity risk premia, which in turn are largely driven by the equity-to-bond market volatility ratios. The results are shown in Figures 7 and 8.

Figure 7: Equity risk premium versus country risk premium
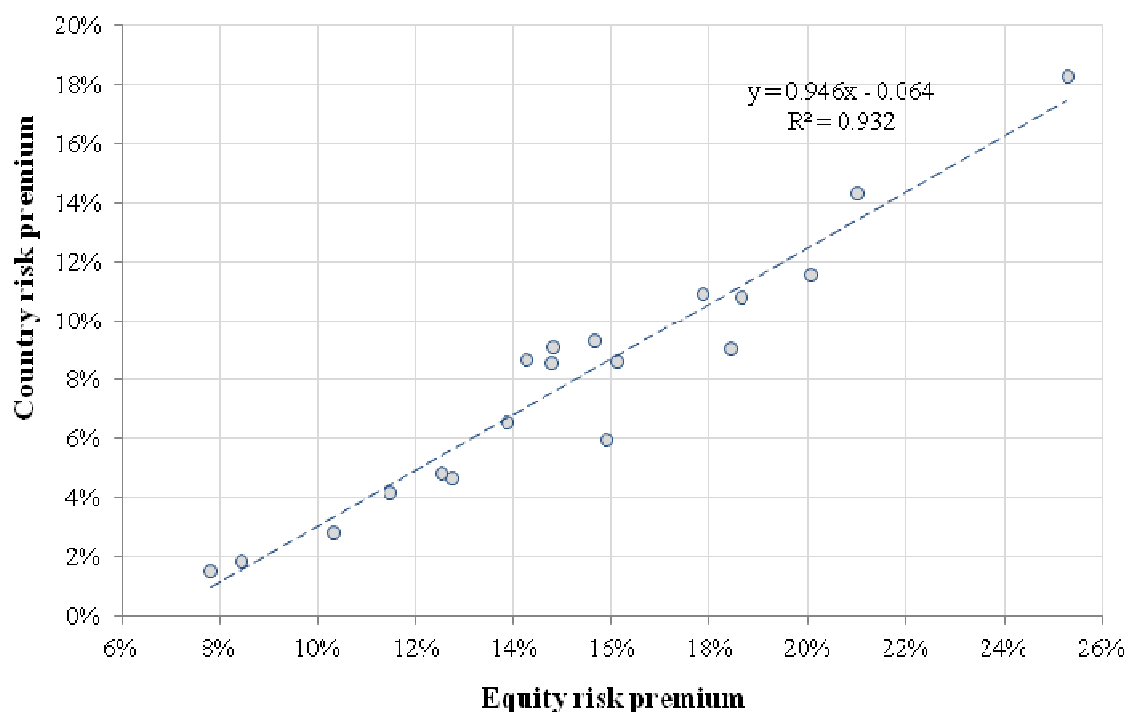
Source: Compiled by the author.

The regression analysis conducted on countries' equity risk premia compared with the country risk premia found that the two variables are nearly unitarily related. The regression analysis also yielded a regression line slope of 0.95 and an $R^2 = 0.93$, meaning that countries' country risk premia are almost solely determined by their equity risk premia.

Figure 8: Equity risk premium versus WACC
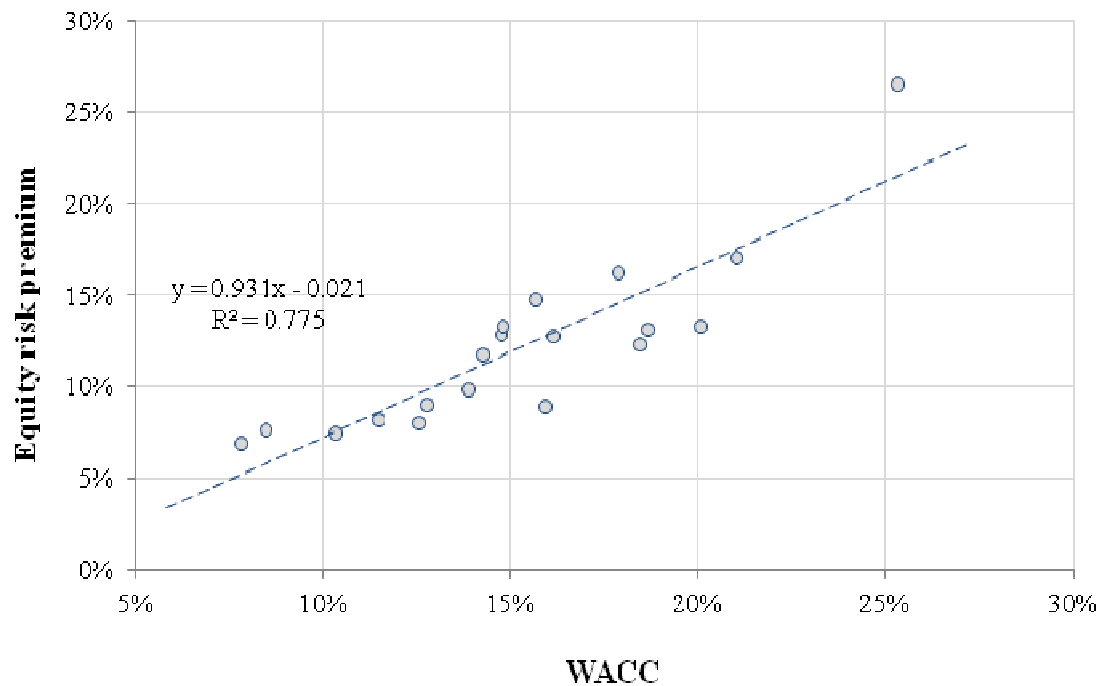
Source: Compiled by the author.

Following the evidence in Figure 3, where it was shown that countries' WACC is closely related to their country risk premia and that countries' risk premia are closely related to their equity risk premia, the expectation would be that countries' WACC would therefore also be largely determined by its equity risk premia. This was found to be the case as per the data presented by Figure 8.

Following further analysis of the possible drivers behind countries' equity risk premia, a regression analysis was done on their equity-to-bond market volatility spreads, their country risk premia and their equity risk premia respectively. It was found that the two variables are strongly related to the equity-to-bond market volatilities as shown in Figure 9. The results of the regression of the country risk premia and the equity-to-bond market volatilities are shown by the round markers in Figure 9, while the regression of the equity risk premia with the equity-to-bond market volatility spreads are shown by the square markers.

Figure 9: Country risk premia and total equity risk premia versus equity-to-bond market volatility spreads
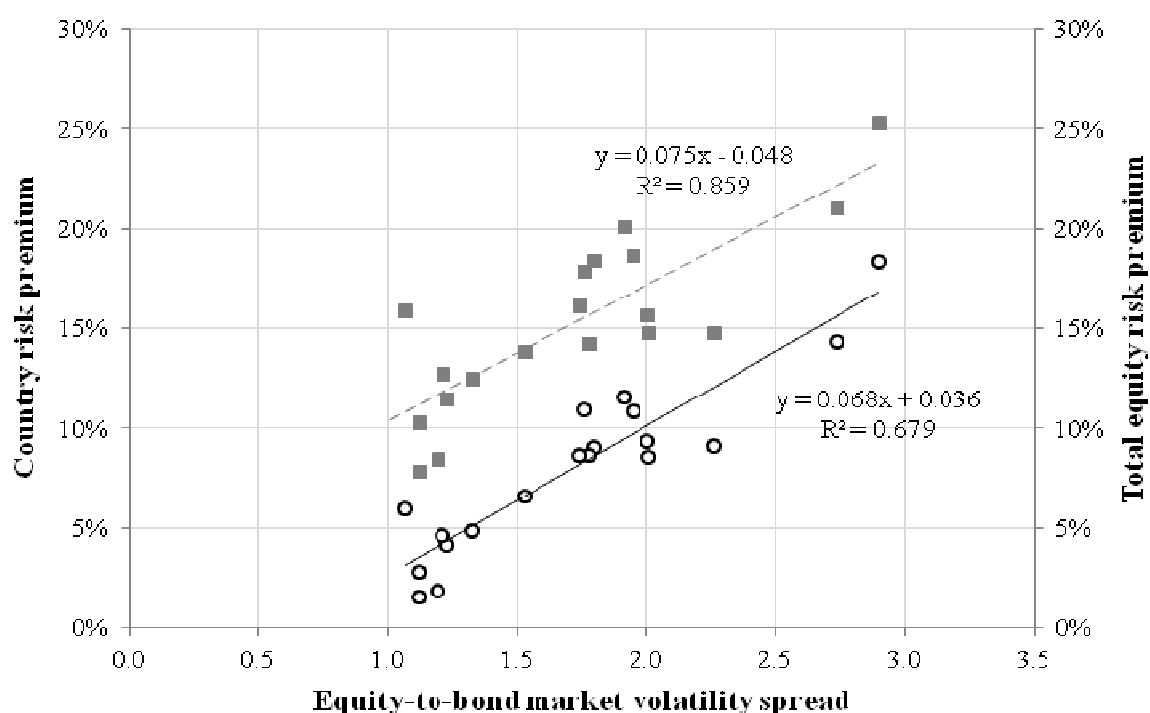
Source: Compiled by the author.

The regression analysis results presented regarding countries' equity risk premia indicate that country risk premia are largely based on countries' equity risk premia, which in turn are seemingly largely driven by equity market volatilities as expressed by the equity-to-bond market volatility ratio spreads.

6.   Conclusions

Jacobs & van Vuuren (2013) showed that the COC between developed countries and developing countries increased incrementally for developing countries as more country-specific factors are considered. This, in turn, indicates that capital requirements might cause unequal competitive conditions, leading to the question of whether such inequalities may also be created between developing countries. This article explored this question and determined whether capital requirements, as a regulatory tool, contributed to unequal competitive conditions among developing economies based on the COC between them.

From the COC analyses' results and findings, this article examined driving factors behind such developing economies' capital cost discrepancies by conducting regression analyses.

From these analyses and results, conclusions can be drawn, which are outlined in this section.

6.1. Variable COC between developing countries

COC calculations conducted in this article indicate that the COC between developing countries differ substantially as more country-specific factors are considered in the calculations. These conclusions are in agreement with those of Jacobs & van Vuuren (2013) and confirm not only that the COC differs between developed and developing markets, but also that it differs *between* developing countries.

6.2. Capital requirements as regulatory tool

The results strengthen Jacobs & van Vuuren's (2013) finding that as a regulatory tool, capital requirements cannot achieve a primary regulatory objective i.e. that of providing financial institutions with equal competitive footing. As long as the COC differs between countries, financial institutions in certain countries will enjoy an advantage over others as long as capital requirements regulations are subscribed to. It is important to again point out that although this analysis was based on banking data, it can reasonably be assumed that the findings will apply to financial institutions in general, including insurance companies. This assumption is based on the fact that the regulatory regimes of both the banking and insurance industries are based primarily on capital requirements.

6.3. Country-specific factors largely drive the cost of capital (COC)

Since there was no clear pattern that emerged in terms of certain regions having lower costs of capital than others, the results imply that the COC for developing countries is driven principally by country-specific factors which are not related to their geographical locations.

This notion was confirmed by conducting a regression analysis based on the COC results and country risk premia and it was found that country risk premia are the major contributor to higher costs of capital among the developing countries analysed. This also further enforces the increasing COC as more country-specific factors are considered in calculating the COC for countries. This finding coincides with the findings of Harvey (2004).

6.4. Credit ratings as indicators of country risk and transparency

Since country risk premia were found to be the biggest drivers behind countries' COC, countries' credit ratings were considered as a possible contributor to their COC. Credit ratings were found not to play a significant role in determining countries' COC nor were they found to contribute significantly to countries' country risk premia. Initial expectations that credit ratings would be aligned closer with these two factors proved to be false.

The fact that credit ratings do not appear to play a meaningful role in determining the riskiness of countries or in their COC leads to the conclusion that credit ratings are perhaps not accurate measures of countries' risks and that credit ratings alone should not be considered when analysing the riskiness of a country. In addition, it alludes to the need for credit ratings agencies to be more transparent in

disclosing how credit ratings are determined and what factors are taken into account in producing them.

Markets tend to rely heavily on credit ratings for various reasons and objectives. Moreover, credit quality movements, i.e. upgrades and/or downgrades, have major implications for financial markets and institutions across the globe. This introduces two dangers for financial institutions that place too heavy a reliance upon ratings: that, due to a lack of transparency in ratings' determination, they firstly do not understand the underlying methodologies in the determination of ratings, and secondly ratings that do not necessarily provide an accurate reflection of reality.

6.5. Local market risk premia used globally

A further conclusion that can be deduced from this study is that as with credit ratings, local market risk premia do not provide an accurate reflection of inherent risks of countries. Local market risk premia that are used globally do not relate well to either country risk premia or the COC used in this study, indicating that these local market risk premia are determined inconsistently and that they may be determined intuitively based on perceptions, rather than on a more analytical, and thus objective, basis.

6.6. Market risk versus credit risk considerations

Equity risk premia were found to be the largest contributor to country risk premia and therefore countries' COC. Again, related to the point made above about credit ratings that do not seem to reflect country risk factors accurately, it was found that equity risk premia are largely based on volatilities observed in countries' equity markets.

Country risk premia were found to be largely driven by countries' equity risk premia and almost not at all by credit risk factors as reflected by countries' credit ratings. Although volatile markets do pose a higher risk and should be considered as one of the determents of a country's riskiness, these results indicate that there might be a danger in markets placing an overreliance on market risk factors and not enough reliance on credit risk factors. This, in turn, might be as a result of one of either one or a combination of two factors, namely that credit ratings are seen as unreliable and/or there is a lack of understanding in their determination; and market risk factors are easier to analyse and quantify because of an abundance of data.

Much has been written about the overreliance on credit ratings and credit rating agencies as they have their own difficulties in assessing the credit risk of some of the more exotic products. It may accordingly be argued that not enough attention was given to credit risk in the first place, and that markets were perhaps too busy analysing market risk while unwisely ignoring the significant threat posed by credit risk.

6.7. Double penalties

A final conclusion to this study relates back to the financial regulatory sphere where there is a clear danger that certain countries are not only being disadvantaged by capital requirements because they will have to pay more for the capital they are required to hold because of their higher costs of capital, but also that some countries will be doubly penalised. Countries with higher costs of capital will pay more for the capital that they hold as a result of their particular country-specific factors and the volatility of their equity markets in particular, as described above.

However, as regulatory capital requirements are increasingly being described as 'risk based' or 'risk sensitive' in the sense that the objective of the amount of capital a financial institution needs to hold should be reflective of the risks that it is exposed to, financial institutions operating in more volatile markets will have to hold more capital as a result. In other words, certain financial institutions that operate in countries with relatively volatile equity markets might find themselves paying for this risk twice: they will be required to *hold* more capital for these risks and they will have to *pay* more for this capital. This relates back to the previous conclusion discussed in section 6.6 which highlighted a possible over-emphasis on market risk factors. Regulators and policymakers should therefore be made aware of such possible nuances and anomalies that financial regulations might introduce.

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Chapter 5

A case for economic capital as a

Pillar 1 regulatory tool

A case for economic capital as a
Pillar 1 regulatory tool[i]

Johann Jacobs[ii] and Dr Gary van Vuuren[iii]

Abstract

Regulatory capital as a tool for financial regulation has come under scrutiny following the financial crisis of 2007 to 2010 in terms of its ability to achieve the three major objectives of financial regulations, namely: contributing to financial stability; providing equal competitive regulatory conditions for financial institutions; and ensuring that regulatory capital requirements are risk sensitive.

This article investigates and compares the risk sensitivity of economic capital and regulatory capital requirements empirically from a systemic and institution-specific perspective. The results are assessed to determine whether current regulatory capital requirements are representative of the relevant risks financial institutions face. Given these results, together with calls to strengthen the Basel Accords' Pillar 2 disciplines in the aftermath of the financial crisis, this study also presents a case for regulators to place a heavier reliance on *economic* – rather than *regulatory* – capital numbers.

Key words: *Capital requirements, regulatory capital, economic capital, risk sensitivity, banks, Basel, Solvency II.*

JEL: C61, G21, G22, G28, O16.

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1. Introduction and objective

Regulatory capital as a tool of financial regulations has come under scrutiny following the financial crisis of 2007 to 2010 (financial crisis) in terms of its ability to achieve the major objectives of financial regulations, i.e. contributing to financial stability and providing equally competitive regulatory conditions for financial institutions (Lall, 2009; Atik, 2011; Jacobs & van Vuuren, 2013a, 2013b).

A third objective of financial regulations is that of ensuring that regulatory capital requirements are risk sensitive, that is, they are reflective of the risks faced by financial institutions. This article highlights some of the weaknesses of current regulatory capital in terms of achieving this third objective and proposes economic capital as an alternative – and more appropriate – measure for regulators to consider as primary regulatory tool. Financial regulations in general including banking, i.e. the Basel Accords (Basel), and insurance regulations, i.e. Solvency II, are used as basis for the investigation.

Although several factors contributed to the financial crisis, one identified by the Financial Crisis Inquiry Commission (FCIC) was the failure of the current supplementary Pillar 2 disciplines of financial regulations. Under these disciplines, financial institutions are required to calculate, *inter alia*, their own internal economic capital requirements, and report their results to regulators. Economic capital is often considered a more accurate reflection of financial institutions' risk profiles because of the crude nature of regulatory capital requirements (Holton, 2004:2; Duesterberg, 2006:5; Ho, 2012:3). Financial institutions primarily use economic capital for their internal capital adequacy assessments, strategic decisions, capital allocations, and risk-adjusted performance measures (Burns, 2012).

This third objective of financial regulations, i.e. to be based on risk-sensitive measures and tools, coupled with the urgency following the financial crisis to strengthen the supervision of Pillar 2 disciplines (the Supervisory Review Process), establishes the objectives of this article:

- to investigate the risk sensitivity of economic capital and regulatory capital requirements for credit risk[iv] empirically, on a comparative basis from a systemic and institution-specific perspective, and to assess whether current regulatory capital requirements are truly representative of the risks financial institutions face; and
- to investigate the possible merits of the application of economic capital (as opposed to regulatory capital) as the primary Pillar 1 tool for financial regulation.

The remainder of this article is structured as follows:

Section 2 provides a comprehensive literature review covering the objectives of financial regulations, Pillar 2 regulatory requirements, a brief discussion of the financial crisis, and the sensitivity of capital.

[iv] Although only capital for credit risk is used in this study, it is noteworthy to point out that credit risk, as a proportional percentage, typically makes up more than 85% of total risk-weighted assets. This is illustrated by data obtained from the Banker Database (2013).

Section 3 describes the mathematics underlying the model employed for the economic capital calculations in this article, while section 4 provides details on the calculation methods and data employed in this article. The results and findings are discussed in section 5 before the article is concluded in section 6.

2. Literature review

This section provides a discussion of relevant literature.

2.1. Principles and objectives of financial regulations

Financial regulations, specifically Basel for the banking industry and Solvency II for the insurance industry, are based on similar principles in that both are based on a three-pillar approach and both set out to achieve the same broad objectives as mentioned above. More specifically, the principles on which both sets of regulations are based are that (i) both use regulatory capital as its primary regulatory tool (Pillar 1 requirements) with other supplementary measures under their Pillar 2 requirements, including so-called internal capital adequacy assessment processes (ICAAPs) for banks and own risk and solvency assessments (ORSAs) for insurers, and (ii) both use Pillar 3 requirements that focus on disclosure and reporting (Bank for International Settlements (BIS), 2006:158; European Union (EU), 2009:4; Lloyd's, 2010:5).

As mentioned earlier, the three major objectives that both sets of regulations set out to achieve are to contribute to financial stability; to level playing fields among financial institutions in terms of regulatory costs; and to be based on measures and tools that are risk sensitive, i.e. ones that are reflective of the risks faced by financial institutions (BIS, 1999:9; Gordy & Howells, 2004; Horcher, 2005:257; Lind, 2005:28; Tiesset & Troussard, 2005:65; van Roy, 2005:7; BIS, 2006:6; European Insurance and Re-insurance Federation (CEA), 2006:5; Sandström, 2007:12; van Duffel, 2008:9; EU, 2009:3; Lloyd's, 2010:4-8; Ho, 2012:2; Jacobs & van Vuuren, 2013a, 2013b; van Laere & Baesens, 2012).

A brief discussion of economic capital in the context of its current Pillar 2 requirements follows hereunder.

2.2. Pillar 2 capital adequacy assessments and the financial crisis of 2007 to 2010

The three pillar-principle followed by both Basel and Solvency II is meant to be mutually reinforcing by providing a solid base for supervision while providing a foundation for improved risk management.

Under Pillar 2 requirements, regulators conduct supervisory reviews whereby they assess and evaluate financial institutions' risk management capabilities and capital adequacy based on financial institutions' economic capital requirement calculations. These economic capital requirement calculations

form part of the ICAAP in Basel and the ORSA process in Solvency II, both of which processes refer to financial institutions employing their own risk management processes to determine their internal capital adequacy requirements (BIS, 2006:204-223, 2009; Committee of European Banking Supervisors (CEBS), 2006:2; EU, 2009:4, 34-35; European Insurance and Occupational Pensions Authority, 2011; van Laere & Baesens, 2012:8-9).

Basel and Solvency II's Pillar 2 requirements are principally the same and intend to ensure that financial institutions have adequate capital to support all the risks in their respective businesses. These Pillar 2 requirements also encourage financial institutions to develop improved risk management techniques and systems and to adopt a more active approach to capital planning and management (van Roy, 2005:7; CEBS, 2006:2; Hong Kong Monetary Authority (HKMA), 2010:6). Pillar 2 requirements were designed to bridge gaps in Pillar 1 requirements to ensure that financial regulations fully provide for the calculation of institutions' economic capital requirements designed to cover all the risks faced by an institution.

Pillar 2 requirements can be highly valuable to regulators and financial institutions alike from the information they provide, including economic capital calculations, risk management practices and processes, and financial institutions' overall risk profiles, to name but a few. Although Pillar 2 requirements in their current state are potentially powerful regulatory tools, the failure of Pillar 2 supervisory reviews and capital adequacy assessments were highlighted as a factor that contributed to the financial crisis because some risks that could have been, and indeed should have been, detected under Pillar 2 disciplines were not (Lall, 2009:21; Al-Darwish, Hafeman, Impavido, Kemp & O'Malley, 2011:41; FCIC, 2011:*xviii*). As a result of this failure, there have been calls for the strengthening of these disciplines.

A brief discussion on the major characteristics, purposes and applications of economic and regulatory capital follows hereunder.

2.3. Characteristics of regulatory and economic capital and their implications

So-called 'book capital' is the total amount of actual physical capital held by a bank, i.e. a financial institution's actual available capital (Ho, 2012:4). Regulatory capital and economic capital can then be thought of as the amount of capital that a financial institution *needs* either through its own assessment or by regulatory requirements (Liljeström, 2008:2).

Economic capital is the amount of capital that a financial institution requires to cover unexpected losses over a certain time period given a certain confidence interval which is often related to a desired credit rating (Duesterberg, 2006:3; Reif, 2006:11; Elizalde & Repullo, 2007:2; Ho, 2012:3). Therefore, economic capital is based on financial institutions' own risk measurement techniques which may

not be in line with prescribed by regulatory techniques. Economic capital is therefore often seen as an actual and true measure of an institution's risk and not just an indicator of a certain level of capital that is held (Tiesset & Troussard, 2005:62; BIS, 2009:14; Agiwal, 2011:4; Burns, 2012; van Laere & Baesens, 2012:8). Economic capital is also considered, in contrast to regulatory capital, as a good performance measure (Holton, 2004:2; Duesterberg, 2006:4; Zhang, 2011:22; Ho, 2012:3).

Regulatory capital requirements, on the other hand, are prescribed by regulators and are not customisable on a case-by-case basis, meaning that a prescribed measurement approach may not necessarily be reflective of the risks that a financial institution faces (Richardson & Stephenson, 2000:43; Holton, 2004:2; Agiwal, 2011:4).

By virtue of their different characteristics, economic capital and regulatory capital serve two different purposes: the former is the level of capital that financial institutions require to make sensible business decisions which would generate returns to shareholders, and the latter is the level of capital that financial institutions are required to hold by law to be able to be in business. Regulatory capital is intended to protect depositors and policyholders from losses while contributing to financial stability (Chorafas, 2004:107; KPMG, 2004:2; BIS, 2009:18; van Laere & Baesens, 2012:2-3).

As a result, many financial institutions have moved away from regulatory capital and therefore use economic capital as a basis for decision-making. This is not only because it is considered to be a measure of risk and performance, but also because it is viewed as a determinant of their overall capital adequacy levels, capital budgeting, capital allocation, risk-based pricing and strategic decisions (Holton, 2004:2; Society of Actuaries, 2004; Dvorak, 2005:2; Liljeström, 2008:2; BIS, 2009:1-3; Agiwal, 2011:4,17; Levy, 2011:4; Burns, 2012).

Although efforts have been made to make regulatory capital requirements more risk sensitive, they remain too crude a risk measure in many instances. This is because they also set out to achieve simplicity, transparency and the ability for regulators to conduct benchmarking and comparative analyses between institutions. In contrast to this, economic capital is considered as an institution-specific risk measure first and foremost (Holton, 2004:2; Society of Actuaries, 2004:5-6; Duesterberg, 2006:5, 19, 25; Ho, 2012:3;).

As economic capital is often considered by financial institutions as a true reflection of their own risk profiles, the following section will highlight previous research that has been undertaken on the topic of capital sensitivity before reinforcing the objective of this article.

2.4. Capital sensitivity

Because of the crude and prescriptive nature of regulatory capital requirements and the more dynamic risk-based nature of economic capital, the expectation would be that economic capital required would provide a more accurate reflection of a financial institution's riskiness than regulatory capital. Research on capital risk sensitivity remains relatively scarce (Elizalde & Repullo, 2007:3; van Laere & Baesens, 2012:3-4). Stolz (2002) provides an overview of available literature on a variety of topics relating to bank capital and the relationship between capital and banking failures was considered by Nowak (2011:40) and Zhang (2011).

Shrieves & Dahl (1992), Jacques & Nigro (1997) and Aggarwal & Jacques (1998) explored the relationship between banks' capital levels and risks using simultaneous equations models. Similar models have also been used to analyse these relationships in country-specific studies, including those by Rime (2000) for Switzerland; Nachane, Narian, Ghosh, & Sahoo (2000) for India; Heid, Porath & Stolz (2003) for Germany; and Abreu & Gulamhussen (2010) for the United States (US).

Van Roy (2008) used a similar model to analyse how banks adjusted their capital and risk under the 1988 Basel Accord, while Zhu (2008) expanded the body of literature by developing a stochastic model that can be used to analyse banks' decisions in response to capital regulation.

Further research based on the relationship between capital and risk, as well as banks' efficiency levels, to add a competitiveness perspective to the research, include research by Kwan & Eisenbeis (1995), Das & Ghosh (2004), Altunbas, Carbo, Gardener & Molyneux, (2007), Deelchand & Padget (2009), and Monghid, Tahir & Haron (2012).

Further significant research includes that of Suarez (1994), Calem & Rob (1999), Gambacorta & Mistrulli (2003), Repullo (2004), Estrella (2004) and Elizalde & Repullo (2004; 2007).

It is important to point out that all of the above research considers capital that banks *hold*, or book capital as it was referred to in section 2.3, and therefore does not refer to regulatory capital *per se,* nor does it distinguish between regulatory capital and economic capital.

A study including an analysis of the optimal level of banks' capital is that conducted by Miles, Yang & Marcheggiano (2011).

More recent research on the topics of economic capital and regulatory capital includes that of Hagendorff & Vallascas (2012), and van Laere & Baesens (2012). However, despite their research, an empirical analysis of the relationship between regulatory capital and economic capital remains elusive in academic literature because of data constraints mainly on the part of economic capital (Jacobson, Lindé & Roszbach, 2006:3-4; van Laere & Baesens, 2012:1).

This article aims to investigate levels of capital held, regulatory capital required, economic capital preferred and required, and the interrelationship between these given certain inputs. In addition, such

an investigation would provide the basis for possible future expansions in comparative empirical analyses between regulatory capital and economic capital.

3.   The model

The models employed by Elizalde & Repullo (2004; 2007) were used to analyse the determinants of regulatory, economic and actual capital. For the purposes of this article, the models were used to conduct a comparative analysis in order to ascertain relevant capital levels, whereas Elizalde & Repullo (2004; 2007) used them to analyse the determinants of regulatory and economic capital.

The basis for the dynamic optimisation model used to calculate economic capital is the calculation of capital at the end of a period t = 0, 1, 2 … The bank is funded with capital (K_t), which requires a return δ, and by deposits $(1 - K_t)$ which pay depositors a rate c (c is assumed to be $< \delta$). The bank is owned by risk-neutral shareholders who choose a level of capital in the interval $[0, 1]$ in the absence of minimum capital regulations. If $K_t = 1$, the bank is fully funded by equity capital, and if $K_t = 0$ it is fully funded by deposits.

For each period, the bank invests its funds in a portfolio of loans that pays a fixed exogenously determined interest rate (r). The return on this portfolio is determined stochastically and a random fraction of these loans (or the probability of default (PD), $P_t \epsilon [0,1]$) will default, in which case the bank loses the interest as well as a fraction of the principle, or the loss given default (LGD); $\lambda \epsilon [0,1]$.

Given these variables, the capital at the end of the period, K'_t can be calculated using:

$$K'_t = K_t + r - (1 - K_t)c - (\lambda + r)P_t \tag{1}$$

The distribution of the default rate (P_t) is assumed to be derived from the single risk factor model of Vasicek (2002), which is also used for the calculations of the internal ratings-based (IRB) capital charges of Basel. The cumulative distribution function of P_t is given by:

$$F(P_t) = N \left(\frac{\sqrt{1-\rho}\ N^{-1}(P_t) - N^{-1}(\bar{P})}{\sqrt{\rho}} \right) \tag{2}$$

Where $N(\cdot)$ denotes the distribution function of a standard normal random variable, the loans' unconditional PD is given by $\bar{P} \epsilon [0,1]$, while $\rho \epsilon [0,1]$ is the loans' exposure to the systematic factor. When $\rho = 0$, defaults are statistically independent, so $P_t = \bar{P}$ with a probability of 1. When $\rho = 1$ defaults are perfectly correlated, so that $P_t = 0$ with a probability of $1 - \bar{P}$ and so that $P_t = 1$ with a probability of $\bar{P}$. The default rate P_t is assumed to be independent over time.

The Elizalde & Repullo (2007) model employs the single risk factor model of Pykhtin & Dev (2002) to model the default rate probability distribution (p_t). This is the same model used to determine capi-

tal charges under the IRB approach of the Basel II framework. Vasicek's single-factor model assumes that a loan defaults if the value of the borrower's assets at the loan maturity T falls below the contractual value B of its payable obligations. The value of the ith borrower's assets (A_i), may be modelled using:

$$dA_i = \mu_i A_i dt + \sigma_i A_i dx_i \tag{3}$$

Where μ_i and σ_i represent the mean and the volatility of the asset values respectively.

The assumption is made that the PD on any one loan in a portfolio comprising n number of loans (of equal currency amounts) is p, and it is also assumed that the asset values of the borrowing companies are correlated with a coefficient ρ for any two companies. In addition, all loans have the same term (T).

The percentage gross loss from this portfolio (*L*) is given by:

$$L = \frac{1}{n}\sum_{i=1}^{n} L_i \tag{4}$$

Where L_i is the gross loss (i.e. before recoveries are factored in) on the ith loan such that $L_i = 1$ if the ith borrower defaults and $L_i = 0$ otherwise.

If the loan default events were independent of each other, the portfolio loss distribution would converge (using the central limit theorem) to a normal distribution as the portfolio size increases. However, defaults are not independent and therefore, the conditions of the central limit theorem are not satisfied and L is not asymptotically normal. The distribution of the portfolio loss subsequently converges to a limiting form, as derived by Vasicek (1991), given by:

$$P[L \leq x] = N\left(\frac{\sqrt{1-\rho}\cdot N^{-1}(x) - N^{-1}(p)}{\sqrt{\rho}}\right) \tag{5}$$

Where $N(\cdot)$ denotes the distribution function of a standard normal random variable, $\overline{p} \in [0,1]$ is the loans' (unconditional) probability of default, and $\rho \in [0,1]$ is their exposure to the systematic risk factor ρ. When $\rho = 0$, defaults are statistically independent and when $\rho = 1$, defaults are perfectly correlated. It is from this distribution that PDs (p_t) are sampled.

3.1. Economic capital

Elizalde & Repullo (2007) constructed closure rules as described by Suarez (1994) whereby banks may be closed by regulators if their capital falls below zero. With the first closure rule they assume that shareholders can recapitalise banks freely if capital falls below zero at the end of the period and that the bank will only be closed if shareholders do not exercise this recapitalisation option. For this closure rule, Elizalde & Repullo (2007) find that shareholders prefer to hold zero economic capital

because it will not be needed, since capital can be raised when needed. The second closure rule states that a bank is closed immediately if capital falls below zero. For this article, only the second closure rule is considered, so banks' economic capital can be calculated using the Bellman equation, which characterises banks' maximisation problem given this second closure rule:

$$V = max_{K_t \, \epsilon \, [0,1]} \left\{ -K_t + \frac{1}{1+\delta} \left[E(max \; \{K'_t, 0\}) + Pr(K'_t \geq 0) \, V \right] \right\} \qquad (6)$$

Briefly, the three terms of the equation represent (i) the amount of capital that is contributed by shareholders at the beginning of the period; (ii) the discounted expected payoff at the end of period t; and (iii) the discounted expected value of the bank remaining open at time $t + 1$.

The solution to the equation represents the amount of capital that shareholders would want to hold in the absence of minimum regulatory capital requirements given the bank's franchise value, V.

3.2. Regulatory capital

The IRB approach to calculate credit risk under Basel was used, in accordance with Elizalde & Repullo (2007:10) for the purposes of this article. According to this approach, regulatory capital must cover losses due to loan defaults given a certain confidence interval or probability (α), usually 99.9%.

Equation 7 describes the regulatory capital requirement (BIS, 2006:63-64):

$$\widehat{K} = \lambda \widehat{P} = \lambda N \left(\frac{N^{-1}(\bar{P}) + \sqrt{\rho} N^{-1}(\alpha)}{\sqrt{1-\rho}} \right) \qquad (7)$$

$\widehat{P}$ denotes the α-quantile of the distribution of the default rate P_t. The major difference between Equation 7 (used by Basel) and the one used in this article is that a one-year maturity is assumed, thus implying a maturity adjustment factor of 1. The correlation parameter (ρ) in Equation 7 is a decreasing function of the probability of default $\bar{P}$. Furthermore, in the IRB approach, expected losses $\lambda \bar{P}$ are covered by pricing and general loan loss provisions while the remaining losses (out to a given percentile), $\lambda(\widehat{P} - \bar{P})$ should be covered by capital. The distinction between expected and unexpected losses is considered immaterial and loan loss provisions are considered to be part of capital.

Elizalde & Repullo (2007) further differentiate Equation 7 so as to analyse changes in regulatory capital resulting from changes in its determinants.

3.3. Actual capital

When a regulatory minimum capital requirement is introduced, Equation 6 may be rewritten as:

$$V = max_{K_t \, \epsilon \, \left[\hat{K} \, ; 1 \right]} \left\{ -K_t + \frac{1}{1+\delta} \left[E(max \; \{K'_t, 0\}) + Pr\left(K'_t \geq \hat{K}_{min} \right) V \right], 0 \right\} \qquad (8)$$

The main difference between Equations 6 and 8 is that *minimum* capital values are introduced in the latter. If a bank's capital falls below a certain level, it is assumed to be closed by its regulator. This is the critical minimum value ($\widehat{K}_{min}$) instead of a bank closing when its capital level falls below zero (which represents a minimum regulatory capital requirement in terms of which a bank is closed if it falls below this level).

In addition to the critical minimum value, banks are required by regulators to hold a certain minimum amount of capital in order for them to operate. This is the normal regulatory capital requirement ($\hat{K}$). Equation 8 therefore calculates the level of economic capital that shareholders will hold given a certain minimum regulatory capital requirement and the relevant bank's franchise value.

Having explained the model which forms the basis for this research, the next section establishes the calculation methods, data used and any assumptions and approximations applied.

4. Calculation method and data

Actual or so-called 'real-world' data were used in the model as far as possible. This section describes the data that were used as inputs to the model along with any possible assumptions and approximations.

The data used for this article were for banks only, yet it is assumed that the results obtained by using these data can be applied across financial institutions, including insurance companies, because financial regulations are based on the same principles and they set out to achieve the same objectives.

Sample institutions

Data were gathered for banks in developed and developing countries, consisting of a set of 34 banks spread across 13 countries, comprising 6 developing countries and 7 developed countries. From each of these countries, the largest three banks were selected based on balance sheet size.[v] The composition of the sample institutions used per country (the number of banks for each country given in brackets) was Brazil (3), India (3), Mexico (2), Poland (3), South Africa (2), Turkey (3), Canada (3), France (3), Germany (2), Italy (3), Japan (2), United Kingdom (UK) (2), and the US (3).

Time series

In order to analyse and compare the sensitivity of economic capital to that of regulatory capital given certain macroeconomic or systemic conditions, it is necessary to ensure that both benign economic periods and more challenging economic conditions are included in the time series selected. In this article, the time period selected for the analyses was for the five years from 2007 to 2011. These years

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[v] In some cases banks not representing the three largest balance sheets in a specific country were selected based on data availability. In this regard, according to banks' size, for Mexico numbers 1, 3 and 4 were used; for Turkey 1, 2 and 4; and for Germany 1, 4 and 6 were used

are considered to include data pre- and up to the beginning of the financial crisis (2007), mid-financial crisis data (2008) (Miles, Yang & Marcheggiano, 2011), and data post- and up to the end of the financial crisis (2009 and 2010), while 2011 may be considered as another year during which challenging economic conditions were experienced.

Banks' actual capital

Since the assumption that $K_t \, \epsilon \, [0,1]$ and that a bank is fully funded by equity if $K_t = 1$, data were obtained from Bloomberg (2012) where the sample institutions' equity-to-total-capital ratios were used. Thus, if a bank's equity-to-total-capital ratio was, for example, 22%, this number was used as its *actual* capital number.

Banks' loan portfolios

To analyse and compare the sensitivity of economic capital to that of regulatory capital given banks' specific risk profiles, it is necessary to establish various risk scenarios each with its own associated input variables. In this article, three portfolio risk scenarios were applied to the economic capital model in terms of the loan portfolios banks are assumed to be invested in, namely low-, medium- and high-risk scenarios.

The three different portfolio risk scenarios are defined given the assumption of the model that the bank invests its funds in a portfolio of loans on which it receives a fixed interest rate return for the entire loan term. It is assumed that the bank invests its funds in a portfolio of loans consisting of equal exposures to retail mortgages, corporates, banks and sovereigns. These exposures are classified as low-, medium-, or high-risk loan portfolios and may be defined as follows:

- **Low-risk loan portfolio –** the bank invests its funds in a portfolio of loans with a weighted average credit rating equivalent to AAA to A- loans.
- **Medium-risk loan portfolio –** the bank's funds are invested in a portfolio of loans with a weighted average credit rating equivalent to BBB+ to BBB- loans.
- **High-risk loan portfolio –** the bank invests its funds in a loan portfolio with a weighted average credit rating equivalent to B and lower rated loans of emerging market countries' debt.

For each of these scenarios, the other variables are obtained, including the interest rate received on the loan portfolio (r), the PD (P_t), the LGD (λ), and the loans' systemic factor correlation (ρ). The deposit rate (c), the bank's franchise value (V), and its cost of capital (δ) are held constant across all three scenarios.

Interest rate received on loan portfolio (r)

It was assumed that the bank received a fixed interest rate on the loan portfolio in which its funds were invested over the period. Data on the returns on corporate bonds were obtained from the Federal Reserve Bank of St Louis Economic Data (FRED, 2012) and returns were categorised as per the portfolio risk scenario definitions above, i.e. low-risk (AAA to A-rated loans); medium-risk (BBB+ to BB- loans); and high-risk (B and lower-rated loans). First the daily average for each category was calculated[vi] after which the average daily return on each of these categories was used as a proxy for the return that the bank would receive in each of the equivalent portfolios. The average daily returns are shown in Table 1.

Table 1: Rates of return on loan portfolios

Category	Average annual return (%)				
	2007	2008	2009	2010	2011
Average AAA to A-rated	5.5%	6.2%	5.3%	3.5%	3.2%
BBB to BB-rated	6.7%	9.4%	9.5%	5.7%	5.6%%
B and lower-rated loans	9.0%	16.4%	22.4%	11.1%	11.0%

Source: FRED (2012).

After obtaining the average returns for each of these categories, the annual inflation rates for each of the countries used in the study were added to the average returns. The rates of inflation were obtained from the World Bank (2013) and are given in Table 2.

Table 2: Annual inflation rates

Country	Inflation (%)				
	2007	2008	2009	2010	2011
Brazil	3.6%	5.7%	4.9%	5.0%	6.6%
India	6.4%	8.4%	10.9%	12.0%	8.9%
Mexico	4.0%	5.1%	5.3%	4.2%	3.4%
Poland	2.4%	4.3%	3.8%	2.7%	4.2%
South Africa	7.1%	11.5%	7.1%	4.3%	5.0%
Turkey	8.8%	10.4%	6.3%	8.6%	6.5%
Canada	2.1%	2.4%	0.3%	1.8%	2.9%
France	1.5%	2.8%	0.1%	1.5%	2.1%
Germany	2.3%	2.6%	0.3%	1.1%	2.3%
Italy	1.8%	3.4%	0.8%	1.5%	2.7%
Japan	0.1%	1.4%	-1.3%	-0.7%	-0.3%
UK	2.3%	3.6%	2.2%	3.3%	4.5%
USA	2.9%	3.8%	-0.4%	1.6%	3.2%

Source: World Bank (2013).

[vi] The AAA to A category is the average of US AAA-rated, US AA-rated, US A-rated, and emerging markets AAA to A-rated counterparties; while the BBB+ to BBB- category is the average of US BBB-rated and emerging markets BBB+ to -BBB- rated loans, while the B and lower-rated category consists of emerging markets B and lower-rated loan returns.

Probabilities of default (PDs), losses given defaults (LGDs), and correlations (ρ)

PDs, LGDs and correlations used in this study were obtained from Fitch (2012). Actual PDs were used, which changed from year-to-year and were used for all countries in this study. LGDs and correlations were also varied on an annual basis, but were split according to developed markets and developing markets. The PDs, LGDs and correlations used in this paper are given in Table 3.

Table 3: PDs, LGDs and correlations

		Low-risk: AAA → A rated equivalent loan portfolio				
		2007	**2008**	**2009**	**2010**	**2011**
Developed	PD	0.2%	1.8%	0.6%	0.04%	0.1%
	LGD	48.5%	61.8%	58.2%	55.2%	57.4%
	ρ	19.9%	14.9%	15.0%	16.9%	21.9%
Developing	PD	0.2%	1.8%	0.6%	0.04%	0.1%
	LGD	40.7%	47.4%	51.3%	49.5%	52.9%
	ρ	17.0%	13.1%	13.4%	14.2%	14.7%
		Medium-risk: BBB → B-rated equivalent loan portfolio				
Developed	PD	4.5%	13.1%	8.8%	1.6%	3.0%
	LGD	48.5%	61.8%	58.2%	55.2%	57.4%
	ρ	19.9%	14.9%	15.0%	16.9%	21.9%
Developing	PD	4.5%	13.1%	8.8%	1.6%	3.0%
	LGD	40.7%	47.4%	51.3%	49.5%	52.9%
	ρ	17.0%	13.1%	13.4%	14.2%	14.7%
		High-risk: B and lower-rated equivalent loan portfolio				
Developed	PD	21.5%	25.3%	29.2%	16.7%	21.1%
	LGD	48.5%	61.8%	58.2%	55.2%	57.4%
	ρ	19.9%	14.9%	15.0%	16.9%	21.9%
Developing	PD	21.5%	25.3%	29.2%	16.7%	21.1%
	LGD	40.7%	47.4%	51.3%	49.5%	52.9%
	ρ	17.0%	13.1%	13.4%	14.2%	14.7%

Source: Fitch (2012).

Deposit rate (c)

As described in section 3, the dynamic optimisation model used to calculate economic capital assumes that the bank is partly funded by deposits, which promise to pay an interest rate to depositors. The calculation of c is based on the simple notion that based on banks' own credit ratings, they have to pay depositors a certain premium above a risk-free interest rate in order for the depositors to provide the bank with funding. For this, the sample institutions' historical credit ratings were obtained for the period from Fitch (2012) and historical interest rate data were obtained from FRED (2012). The risk-

free rate was assumed to be the annual average daily US 10-year Treasury bond rate over the period analysed.[vii]

To obtain the spreads above the risk-free rate, the sample institutions' own credit ratings were categorised into one of the following categories for each of the years in the sample period:

- US AAA-rated;
- US AA-rated;
- US A-rated;
- US BBB-rated;
- emerging markets rated AAA to A;
- emerging markets BBB1 to BBB3-rated;
- emerging markets BB-rated; and
- emerging markets B and lower-rated.

Based on the historical returns of each of the categories as per FRED (2012), the annual average daily spread of each of these categories above the assumed risk-free rate was calculated for the period analysed and is shown in Table 4:

Table 4: Risk-free rates and credit spreads above the risk-free rate

Category	2007	2008	2009	2010	2011
Risk-free rate	4.6%	3.7%	3.3%	3.2%	2.8%
Category	Average annual spread (bps)				
US AA-rated	68	153	124	-27	-20
US A-rated	86	230	160	7	31
US BBB-rated	111	322	268	85	097
Emerging markets AAA-A-rated	148	370	411	161	171
Emerging markets BBB-B-rated	88	293	263	63	86
Emerging markets BB-rated	150	451	527	209	227
Emerging markets B and lower-rated	313	910	936	365	445

Source: FRED (2012).

The US-rated categories were applied to all the developed countries in the sample set.

Cost of capital (δ)

The cost of capital numbers used in this article were obtained from calculations done by Jacobs & van Vuuren (2013a; 2013b) based on a model by Villarreal & Córdoba (2010), who calibrated the calculations to a one-year time horizon. Since the model employed in this study specifically deals with equity

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[vii] This assumption is considered as being rather conservative, considering that most countries that were used in this study will have a higher risk-free rate than the US.

capital, it is important to note that the weighted average cost of capital from these studies was not employed, but only the cost of equity.

Franchise value (V)

In determining the franchise value of banks, research by Demsetz, Saidenberg & Strahan (1996) and Pelizzon (2001) was considered. The definition used for the franchise value of banks is from Demsetz *et al.* (1996:13), who define it as the market-to-book equity ratio. It is calculated as:

$$V = \frac{Outstanding\ value\ of\ equity}{Book\ value\ of\ equity} \qquad (9)$$

The outstanding equity values for the sample institutions were obtained from Bloomberg (2012) and the book value of equity for the sample institutions from Fitch (2012).

Critical minimum capital value ($\widehat{K}_{min}$)

This value was set at 2% by Elizalde & Repullo (2007), the same value assumed for the purpose of this study.

Minimum regulatory capital requirements ($\widehat{K}$)

The minimum capital requirements assumed were calculated using the IRB approach for credit risk as prescribed by Basel (Equation 7). The same PDs, LGDs and correlations described above were used. The regulatory capital requirement figures for each of the scenarios are shown in Table 5:

Table 5: Minimum regulatory capital requirements

	Low-risk: AAA → A-rated equivalent loan portfolio				
	2007	**2008**	**2009**	**2010**	**2011**
Developed	2.4%	10.1%	4.3%	0.7%	1.9%
Developing	1.7%	7.0%	3.4%	0.5%	1.1%
	Medium-risk: BBB → B-rated equivalent loan portfolio				
Developed	17.6%	32.7%	25.2%	9.2%	17.9%
Developing	13.2%	23.7%	20.8%	7.1%	12.0%
	High-risk: B- and lower-rated equivalent loan portfolio				
Developed	36.1%	44.2%	44.2%	34.9%	44.0%
Developing	28.6%	32.6%	37.7%	29.0%	35.0%

Source: Fitch (2012).

Actual regulatory capital requirements

To approximate actual regulatory capital requirements for the sample set, risk-weighted assets data were obtained from Fitch (2012) for all the sample banks across the entire sample period. The risk-

weighted assets were multiplied by the relative factor that credit risk contributed to total risk-weighted assets to get to the credit risk-weighted assets. The contribution of credit risk to total risk-weighted assets was obtained from the Banker Database (2013) and the average of 85.0% was applied to the risk-weighted assets for all banks across the entire sample period. The relative contribution of credit risk as a percentage of total risk-weighted assets is given in Table 6:

Table 6: Risk-weighted assets composition

Region	Credit risk	Market risk	Operational risk
Asia	90.1%	3.3%	7.2%
Middle East	88.2%	2.5%	7.3%
Eastern Europe	87.3%	8.3%	9.7%
Western Europe	84.4%	4.0%	10.4%
Latin America	82.8%	9.3%	5.40%
Africa	77.4%	2.3%	10.9%
Average	**85.0%**	**5.0%**	**8.5%**

Source: The Banker Database (2013).

5. Results and findings

By running the above data through the model described in section 3, certain conclusions can be made regarding the sensitivity of economic capital relative to that of regulatory capital.

Although the model produced a plethora of data which can possibly be analysed in different contexts, this section focuses on the major findings within the context of what this article set out to achieve, i.e. to determine whether regulatory capital can achieve its third pertinent objective of being risk sensitive while exploring the possibility of economic capital's ability to be used a primary regulatory tool.

Figure 1 provides some examples of the graphs that were generated by the model. It also shows the results obtained for the Standard Bank Group from South Africa for the medium-risk portfolio scenario for 2008; BBVA Bancomer from Mexico for the high-risk portfolio scenario for 2010; and for the Bank of Tokyo-Mitsubishi for the high-risk portfolio scenario for 2011. The graphs show how the model simulated data points for all the inputs provided while searching to solve the optimisation problem of maximising a bank's franchise values and capital levels. The grey diamond in Figure 1 shows the bank's optimal franchise value as determined by the model while the black dot illustrates the corresponding maximum economic capital.

Figure 1: Example outputs generated from the model
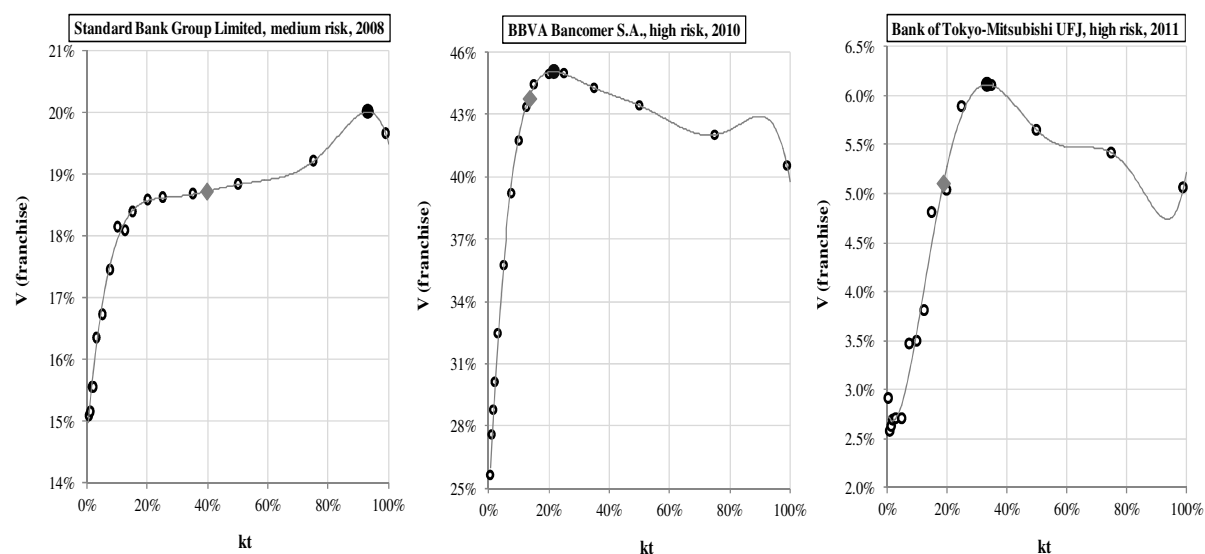
Source: Compiled by the author.

The capital numbers that are discussed and illustrated in this section are based on the weighted average based on the relative contributions of developed and developing countries to the sample set.

5.1. Economic capital is more risk sensitive than regulatory capital

This study considers the sensitivity of economic capital versus regulatory capital from two perspectives: a systemic one and a more hypothetical, bank-specific, risk perspective. As these are overlaid, they serve to provide evidence on the sensitivity of economic capital and regulatory capital from both of these perspectives.

It is important to highlight that the economic capital requirements calculated in this study are calculated using a dynamic optimisation model and reflect the amount of *equity capital* that shareholders would *prefer* to hold for them to maximise the franchise value of their institutions. This hypothetical capital requirement seems to exaggerate the magnitude of the preferred capital requirements at times, yet the directional movements and trends are clear.

5.1.1. Systemic risk perspective

Figure 2 illustrates that, from a systemic perspective, banks' shareholders would have preferred a much higher level of economic capital in 2008 during the financial crisis when the results show a dramatic increase in the economic capital numbers that were calculated.

In Figure 2 economic capital and regulatory capital calculated per the low-risk scenario inputs defined above are considered only. Economic capital increased significantly from 35.8% in 2007 to 92.9% in

2008. In contrast, the extent to which regulatory capital increased was not much compared with that of economic capital as it increased from an average of 2.1% in 2007 to 8.7% in 2008.

While it increased more dramatically than regulatory capital in response to the financial crisis, economic capital also decreased more dramatically when systemic risk conditions abated somewhat in 2009 and 2010 to 35.5% and 33.3% respectively before increasing again in 2011 to 43.0%. In turn, regulatory capital decreased to 3.9% and 0.6% in 2009 and 2010 respectively before increasing to 1.5% in 2011.

Figure 2: Systemic risk sensitivity of capital
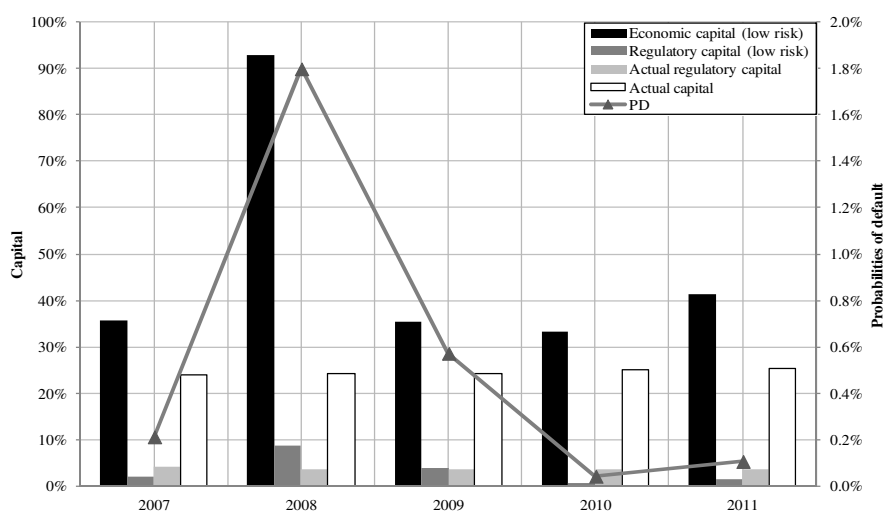
Source: PDs (Fitch 2012), actual regulatory capital (Fitch 2012), the Banker Database (2012).

Although it is acknowledged that financial markets and shareholders would prefer to have relatively stable capital requirements over time and not sporadic and unpredictable movements as illustrated by these results, it is important to keep in mind that these results show the levels of economic capital that shareholders would *prefer* to operate at and that it does not necessarily mean that it would be viable (or possible) to raise this much more capital in response to deteriorating systemic conditions. It does, however, highlight that given increased systemic risk, shareholders would prefer higher levels of equity capital to protect their institutions against such adverse conditions and that such increased economic capital requirements are much more sensitive to adverse or increased risk conditions than regulatory capital.

5.1.2. Bank-specific portfolio risk perspective

The previous section illustrated the results from a systemic perspective where only the low-risk portfolio scenarios were compared across the time series that includes benign and testing systemic financial conditions. In addition to these, this article analyses the sensitivity of economic and regulatory

capital from a bank-specific dimension where different portfolio risk scenarios were applied to the data. These bank-specific results are shown in Figure 3.

Figure 3: Bank-specific risk sensitivity of capital
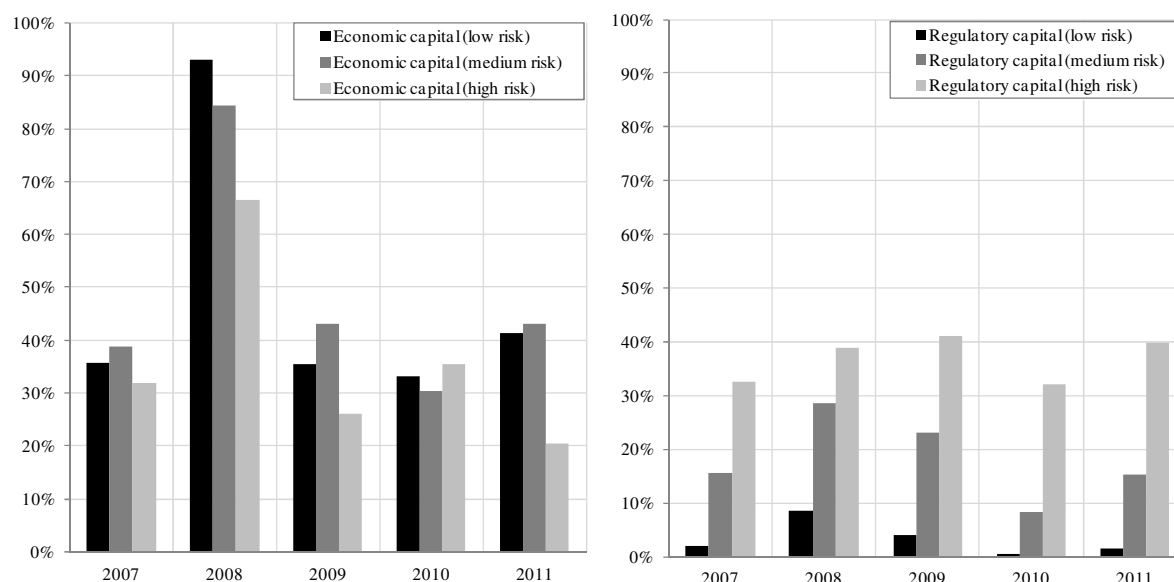
Source: Compiled by the author.

Regulatory capital was found to increase almost in parallel across the low-, medium- and high-risk scenarios, while economic capital behaved slightly more sporadically. As the low-risk scenarios were illustrated and discussed in the previous section, this section discusses the results of the medium- and high-risk scenarios only.

For the medium-risk scenario, regulatory capital increased from the low-risk scenario from 15.5% to 32.6% in 2007 while these increased to 28.5% and 38.8% for the respective scenarios in 2008. From there, capital requirements for the medium-risk scenario decreased to 23.1%, while it increased further for the high-risk scenario to 41.2% in 2009. Regulatory capital requirements for both medium- and high-risk scenarios decreased in 2010 before increasing again in 2011. The behaviour of regulatory capital across the three portfolio risk scenarios might have been expected, as it is determined solely by the three input variables, namely PDs, LGDs and correlations, illustrating the rigidity of current regulatory capital requirements. The relationship between PDs and regulatory capital requirements is illustrated in Figure 2, which clearly indicates that PDs contribute largely to the determination of regulatory capital. Moreover, as PDs (on the secondary axis) moved up and down, regulatory capital requirements followed suit.

Economic capital, on the other hand, was found *not* to increase in parallel in response to increased risk scenarios. Instead, it was found to be 38.9% for the medium-risk scenario and 32.0% for the high-risk scenario in 2007 – the high-risk portfolio scenario's being lower than that of the low-risk scenario.

From these levels both increased to 84.4% and 66.6% in 2008 for the medium- and high-risk scenarios respectively – an interesting finding given that at the height of the financial crisis the economic capital requirements for the high-risk portfolio scenario were less than for the medium-risk scenario. The economic capital requirements for the medium- and high-risk scenarios decreased consecutively in 2009 to 43.2% and 30.4% and to 26.0% and 35.5% in 2010 for the medium-risk and high-risk portfolio scenarios respectively. Economic capital increased to 43.0% in 2011 for the medium-risk scenario while it decreased for the high-risk scenario to 20.4% in the same year.

5.2. Capital stability

The levels of actual equity capital and regulatory capital requirements are illustrated in Figure 2. The calculations of these were discussed in section 4. It is clear that both actual equity capital held and actual regulatory capital numbers remained relatively constant across the time series.

Actual regulatory capital held was 4.1% in 2007, after which it remained in a narrow band between 3.6% and 3.7% for the period 2008 to 2011. Actual equity capital held also remained almost constant and trended upward slightly from 23.9% in 2007 to 25.4% in 2011. These actual levels of capital for the banks in the sample set show that they were not responsive to the systemic risk of the financial crisis and that banks held relatively large capital buffers above regulatory capital requirements. It might be expected that capital levels would not be subject to high levels of volatility of large sporadic movements because shareholders and financial markets would not respond favourably to such movements. However, it does show that current regulatory capital requirements will not be able to serve as an effective buffer against extreme adverse events such as the financial crisis because of this same rigidity and stability.

5.3. Shareholders prefer much higher levels of capital

In line with findings from Miles, Yang & Marcheggiano (2011), the results illustrate that when comparing the economic capital results with the actual levels of capital and actual levels of regulatory capital (Figure 2), shareholders would prefer to operate their banks at much higher levels of equity capital than what they are operating at currently. This is illustrated by considering economic capital requirements for the low-risk portfolio scenario in this study and comparing these with actual regulatory capital requirements and actual equity capital held. Actual regulatory capital held remained relatively constant across the time period 2007 to 2011, averaging at 3.7%. Actual equity capital held also remained almost constant over the period, averaging at 24.6%. Economic capital calculated for the low-risk portfolio scenario, although moving sporadically in response to systemic and portfolio-specific risks, averaged significantly higher at 47.8% across the time period.

In other words, given a choice, shareholders would prefer to operate their banks with much higher levels of equity capital in order for them to be able to maximise their banks' value. Obviously, there

are certain practical restrictions that would prevent banks from operating at such high levels of equity capital, but the model shows that shareholders would prefer higher levels of equity capital and lower levels of debt capital. It alludes to the fact that equity capital is perceived as having more risk-absorbing qualities and capacity than debt, indicating that economic capital might be a preferred buffer to protect banks against the risks they face.

5.4. Argument for economic capital as Pillar 1 regulatory tool

Based on the major findings from this article and the need that was highlighted following the financial crisis to strengthen Pillar2 disciplines, an argument can be made that economic capital may prove to be a superior regulatory tool to current regulatory capital requirements. Economic capital is more risk sensitive than current regulatory capital and considered as a true reflection of financial institutions' risks while financial institutions are managed accordingly. In addition, through the supervisory review processes, economic capital also guarantees supervisory understanding into financial institutions' respective businesses to help guarantee that their tools and actions are better tailored to the needs of different financial institutions. In addition to the obvious advantages of financial institutions' true risks being reflected and regulators gaining a better understanding into their business operations, governance structures and risk management capabilities, the following benefits could be derived by placing greater reliance on economic capital:

- Financial institutions would have fewer incentives to circumvent regulatory capital requirements and more incentives to improve their own risk management capabilities as their true capital requirements would be reflected.

- Financial stability would be promoted further as true risks would be reflected. Institutions would also continuously attempt to improve their risk management capabilities.

- There would be more of a shared responsibility between financial institutions and regulators in that regulators would have to understand financial institutions' businesses better while financial institutions would not be able to blame inadequate regulations for possible failures.

- Capital requirements would be tailored to fit each institution and therefore provide for more equal playing fields in that each institution would take into account its own institution-, industry-, or country-specific factors in determining its capital requirements instead of capital requirements and measurement techniques being imposed on it that may be irrelevant to or ignorant of certain of these nuances.

- Financial institutions might be faced with lower regulatory and compliance costs as regulatory requirements and measures upon which their businesses are managed would be aligned.

From the points made above, a compelling case can be made for using economic capital as a Pillar 1 capital requirement.

The following section provides a brief conclusion to this article.

6. Conclusion

The dynamic optimisation model described by Elizalde & Repullo (2007) was applied to bank data to determine whether economic capital can be considered as being more risk sensitive than regulatory capital and whether regulatory capital can achieve its objective of being a risk-sensitive measure. Although the original model was used to highlight drivers behind economic capital and regulatory capital respectively, it was applied using real-world data in this study to achieve its objectives.

The major finding of this article was that economic capital appears to be a more risk-sensitive measure than regulatory capital. As a result, regulatory capital cannot achieve its objective of being a truly risk-sensitive measure. Accordingly, particularly when also considering the need that was highlighted by the financial crisis to strengthen Pillar 2 disciplines, an argument for using economic capital as a primary regulatory tool for supervision instead of current regulatory capital requirements can be made.

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Chapter 6

Conclusions and recommendations

Conclusions and recommendations

6.1.   Summary and conclusions

The financial crisis of 2007 to 2010 (the financial crisis) highlighted some of the deficiencies that were present in the Basel Accords (Basel). Although several factors contributed to the financial crisis, the failure of financial supervision was highlighted as one. This study therefore critically assessed aspects of financial regulations in general, specifically banking (Basel) and insurance regulations (Solvency II), in order to determine not only which of the weaknesses that were present in Basel were carried over into Solvency II, but also to determine the extent to which both sets of financial regulations can achieve their primary objectives.

Although banks and insurers differ in many ways ranging from their economic functions, services offered, operating models, balance-sheet structures, and indeed their regulatory regimes, the fundamental principles and objectives of the financial regulations that govern them, specifically Basel and Solvency II, are the same and were discussed in various parts of this thesis. It was further highlighted that financial regulations set out to achieve three main objectives: contributing to financial stability; providing a level playing field for all financial institutions; and dispensing regulatory tools and measures that are risk sensitive, i.e. reflective of the nature and size of risks faced by financial institutions. These commonalities allow lessons learned in one milieu (i.e. Basel) to be adapted and applied to another (i.e. Solvency II).

In light of the objectives that financial regulations set out to achieve and the weaknesses that were brought to the fore by the financial crisis, the four studies which constitute this thesis explored four major problems facing financial regulations in general, namely:

i.   The weaknesses in the Basel Accords as they apply to Solvency II (Chapter 2).

ii.   Global regulatory standards and the levelling of playing fields (Chapters 3 and 4).

iii.   The drivers behind the cost of capital in developing countries (Chapter 4).

iv.   The risk sensitivity of regulatory capital and exploring a case for economic capital to be used as a Pillar 1 regulatory tool (Chapter 5).

A brief discussion of the findings of each chapter follows.

6.2.   Weaknesses in the Basel Accords as they apply to Solvency II

Chapter 2 investigated which of the weaknesses that were identified in Basel as a result of the financial crisis have inherently been carried over into Solvency II. With Solvency II yet to be implemented, it provides regulators with an opportunity to learn lessons from the banking sector's experience with

Basel and to be both aware of and address those weaknesses *before* the implementation of Solvency II.

A literature study was undertaken whereby the weaknesses of Basel that were highlighted by the financial crisis were identified and discussed before each of these were related back to Solvency II. The seven major weaknesses that were found to have been included to a greater or lesser degree in Solvency II include:

- generic international regulatory standards do not necessarily work;
- the procyclicality of capital and capital requirements;
- the assumption that micro-prudential regulation will achieve macro-prudential objectives;
- the potential to place overreliance on financial models;
- potential incentives to 'cheat';
- failures in Pillar II disciplines; and
- an overreliance that was placed on credit ratings agencies (CRAs).

Many of the weaknesses highlighted by the financial crisis underlined the *seeming inability of financial regulations in their current forms to achieve its first self-imposed objective, i.e. contributing to financial stability.* Given this finding, this study further assesses whether global regulatory standards based on capital can achieve its second major objective, namely that of providing financial institutions with level playing fields.

6.3. Global regulatory standards and the levelling of playing fields

The second major objective of financial regulations, and specifically Basel and Solvency II, is the levelling of playing fields between financial institutions by providing equal regulatory costs and requirements for all institutions. Since current (2013) financial regulations are based on capital requirements, the achievement of this objective is based on the implicit assumption that the cost of capital between institutions and countries is the same.

Chapter 3 and Chapter 4 investigated whether financial regulations based on capital requirements could provide equal competitive conditions between countries. Both chapters employed a weighted average cost of capital (WACC) model and capital asset pricing model (CAPM) designed to reflect more country-specific factors. The major findings in this regard were six-fold:

- the cost of capital between countries is not the same;
- the cost of capital increases incrementally when moving from developed countries to developing countries as more country-specific factors are considered;
- although less pronounced than the difference between the cost of capital between developed and developing markets, similar discrepancies were found among developing countries;
- country-specific factors are the major determinants of countries' cost of capital;

- unequal costs of capital contribute to unequal benefits, meaning that current financial regulations cannot achieve the objective of providing equal competitive conditions among financial institutions; and

- there is a need for more representation of the developing world in the formulation of financial regulations as they currently seem biased toward the developed world.

The fact that the cost of capital between countries is determined by country-specific factors, which are ignored in financial regulations, means that *financial regulations cannot truly level playing fields between financial institutions.* Further to the findings that the cost of capital not only differs between groups of developed and developing countries, but also between developing countries, the country-specific factors that determine the cost of capital in developing countries were investigated through regression analyses. Some interesting findings were forthcoming in this regard and are reflected below.

6.4. The drivers behind the cost of capital in developing countries

In addition to investigating whether the same competitive distortions existed between developing countries as found between developed and developing countries in Chapter 3, Chapter 4 also investigated the main drivers behind the cost of capital in developing countries through conducting various linear regression analyses. The major findings and conclusions were, once again, six-fold:

- although a strong relationship exists between credit ratings and the extent to which the cost of capital differed between such ratings, it was found that sovereign credit ratings hardly contribute to country risk premia and that the cost of capital do not depend on sovereign credit ratings;

- similar to the results found with sovereign credit ratings, banks' support ratings were found not to contribute significantly to the cost of capital in developing countries;

- the major driver behind the cost of capital in developing countries was found to be equity market volatility and not credit ratings or country risk premia as might have been expected;

- market risk premia used in practice do not seem to be reflective of the true country risks;

- a possible overreliance on market risk factors, and not on credit risk factors in determining country risk premia, was identified since equity market volatility was found to be the main driver behind the cost of capital in developing countries; and

- developing countries run the risk of being doubly penalised in the sense that their costs of capital are higher because of more volatile equity markets, and that they are penalised again for volatile equity markets in their regulatory capital requirements.

In determining the cost of capital among developing countries and analysing its drivers, the argument was made that current financial regulations based on regulatory capital requirements cannot achieve

their objective of providing financial institutions with equally competitive conditions. Chapter 4 also provided further conclusions regarding the drivers behind the cost of capital in developing countries.

Following the findings of Chapters 2 to 4 that financial regulations in their current form cannot achieve the first two of their major objectives, namely contributing to financial stability and providing financial institutions with equal competitive conditions, this study assessed their ability to achieve their third major objective, i.e. to be based on measures that are reflective of the risks faced by financial institutions.

6.5. The risk sensitivity of regulatory capital and a case for economic capital as a Pillar 1 regulatory tool

A third objective of financial regulation is to ensure that regulatory capital requirements are risk sensitive, that is, that they are reflective of the risks faced by financial institutions.

Failures of the current supplementary Pillar 2 disciplines of financial regulations were identified as having played a major role in the financial crisis. Under these disciplines, financial institutions are required to calculate, *inter alia*, their own internal economic capital requirements, and report their results to regulators.

Therefore, with the third objective of financial regulation and the apparent failure of Pillar 2 disciplines in mind, Chapter 5 investigated:

- the risk sensitivity of economic capital and regulatory capital requirements for credit risk on a comparative basis from a systemic and institution-specific perspective and, based on these results, assessed whether current regulatory capital requirements are truly representative of the risks financial institutions face; and
- the plausibility of regulators placing a heavier reliance on economic capital numbers given these results and calls to strengthen Pillar 2 disciplines in the aftermath of the financial crisis.

Chapter 5 provided a comprehensive literature study that included the objectives of financial regulations; Pillar 2 regulatory requirements; Pillar 2 requirements and the financial crisis; characteristics and purposes of economic and regulatory capital and implications thereof; and the sensitivity of capital. In view of the fact that an empirical analysis of the relationship between regulatory capital and economic capital remains largely unaddressed in academic literature (Jacobson *et al.*, 2006), Chapter 5 applied a theoretical dynamic optimisation model to compare empirically the risk sensitivities of economic capital and regulatory capital in one of the first studies of its kind.

The major findings and conclusion from Chapter 5 were that:

- based on the empirical results obtained from the dynamic optimisation model, economic capital is more risk sensitive than current regulatory capital requirements from a systemic risk perspective and from bank-specific perspectives;

- actual capital and actual regulatory capital held remained relatively constant across the period analysed (2007 to 2011), meaning that these were not found to be responsive to the increased systemic risk conditions that prevailed during the financial crisis; and

- given a choice, shareholders would prefer to operate their banks with much higher levels of equity capital than current in order for them to be able to maximise their banks' values. Obviously, there are certain practical restrictions that would prevent banks from operating at such high levels of equity capital, but the dynamic optimisation model shows that shareholders would prefer higher levels of equity capital and lower levels of debt capital. It alludes to the fact that equity capital has more risk-absorbing qualities and capacity than debt, indicating that economic capital might be the preferred buffer to protect banks against the risks that they face.

The resulting conclusions from the dynamic optimisation model indicated that current regulatory capital can also not achieve its third objective of being based on risk-sensitive measures. With this in mind, Chapter 5 proposed that both banking and insurance supervisors place more reliance on Pillar 2 disciplines, and that an argument can be made for economic capital to be used as a primary regulatory tool or, in other words, as a Pillar 1 capital requirement.

6.6. Contribution

This thesis uniquely contributed to the body of knowledge in five distinct ways:

- Firstly, it compared two unrelated regulatory frameworks for two completely different industries, work which has largely been absent from the literature until the present (2013). Although banks and insurers operate in completely separate worlds in terms of economic functions they fulfil, products and services provided, balance-sheet structures, and operating models, such a comparison is made possible by the fact that Basel and Solvency II set out to achieve the same objectives while being based on similar principles.

- Secondly, it investigated the cost of capital between developed and developing countries to determine whether financial regulations can provide financial institutions with equal competitive conditions, as this objective is based on the assumption that the cost of capital is equal between countries.

- Thirdly, it conducted a similar analysis into the cost of capital for developing countries only in an attempt to determine whether possible competitive distortions exist among developing countries based on their respective costs of capital.

- Fourthly, it investigated the drivers behind the cost of capital in developing countries, a study which has up to now been absent from academic literature.

- Finally, it employed a dynamic optimisation model to assess empirically the risk sensitivities of economic capital versus that of regulatory capital. This is one of the first studies to undertake empirical comparisons between economic capital and regulatory capital.

The results and contributions of the four studies comprising this thesis are summarised in Figure 6.1:

Table 6.1: Summary of the major contributions of this thesis

Attribute	Problem statement	Analysis	Results
Compose a comprehensive literature study on the weaknesses of Basel and how these relate to Solvency II.	To date (2013), no literature survey has been conducted to highlight the weaknesses of Basel that were exacerbated by the financial crisis and how they relate to and may be included in Solvency II.	Literature study. Accepted for publication in *The Journal of Economic and Financial Sciences* (JEF), Volume 6 Number 2 (July 2013). Accepted for presentation at the conference on *Financial Globalisation and Sustainable Finance: Implications for Policy and Practice,* Cape Town, 29 to 31 May 2013.	Many of the weaknesses of Basel are present in Solvency II.
Determine the cost of capital between countries using a modified WACC model.	In attempting to level playing fields between financial institutions, financial regulations are based on the assumption that the cost of capital between countries is the same. This study, which investigates possible competitive distortions between countries based on their costs of capital, is new.	Cost of capital analyses between developed and developing countries. Submitted for publication in *South African Journal of Economic and Management Sciences* (SAJEMS).	Cost of capital is not the same between countries. Financial regulations cannot level playing fields and therefore favour developed countries.
Analyse the drivers behind the cost of capital for developing countries.	An analysis of the drivers behind the cost of capital among developing countries is currently absent from the academic literature.	Cost of capital and drivers behind cost of capital in developing countries. Accepted for presentation at the *10th African Finance Journal Conference,* Durban, 15 to 16 May 2013. Accepted articles will be reviewed for publication in a special conference edition of the *African Finance Journal* (AFJ).	Similar competitive discrepancies exist between developing countries, and equity market volatility is the main driver behind the cost of capital in developing countries, not credit risk.
Empirically analyse the risk sensitivities of economic capital and regulatory capital using a dynamic optimisation model.	No empirical comparative studies on economic capital and regulatory capital are currently available in the academic literature.	Empirical analysis of the risk sensitivities of economic capital and regulatory capital. Submitted for publication in the *South African Journal of Economics* (SAJE).	Economic capital is more risk sensitive than regulatory capital and a better indicator of risk.

Source: Compiled by the author.

A comprehensive literature study was presented in Chapter 2 whereby the characteristics of Basel and Solvency II were compared. The financial crisis was also explained before the weaknesses in Basel and their potential prevalence in Solvency II were discussed. Although Solvency II has not been implemented or tested, the weaknesses identified serve as a warning taken from lessons learnt when Basel was severely tested during the financial crisis. From this, more questions arose that provided the basis for the remainder of this thesis.

A question that arose was whether financial regulations in general, Basel and Solvency II, in their current form can achieve the objective of levelling playing field between financial institutions. To be able to achieve this objective, financial regulations are based on the assumption that the cost of capital between countries is the same, which is not necessarily the case. Chapter 3 and Chapter 4 therefore employed a modified WACC to calculate the costs of capital for various developed and developing countries. The first major finding was that the cost of capital between countries is not the same, meaning that financial regulations cannot achieve the objective of providing equal competitive conditions to all financial institutions. Further to this, it was found that such competitive distortions favour developed countries over developing countries while similar competitive distortions also exist among developing countries.

Having done a comparative analysis on the cost of capital among developing countries, Chapter 4 also employed linear regression analyses to determine the major drivers behind the cost of capital in developing countries. It was found that equity market volatility, and not credit risk as might have been expected, is the largest driver behind the cost of capital in developing countries. This further implies that developing countries are at a disadvantage compared to developed countries in that they might be doubly penalised: their costs of capital are higher than developed countries, meaning that they pay more for regulatory capital requirements, and their equity market volatility might also lead to higher capital requirements.

The results and conclusions in Chapter 4 further strengthened the argument that current financial regulations cannot achieve the objective of providing level playing fields for financial institutions.

A further objective of financial regulations highlighted is that they aim to be based on measures and tools that are considered as being risk sensitive or, in other words, measures and tools that are reflective of the risks that financial institutions face. Chapter 5 investigated the ability of financial regulations to achieve this objective. Based on the results, it was proposed that not only Pillar 2 disciplines need strengthening, but that economic capital rather than regulatory capital should be used as a Pillar 1 regulatory requirement.

Chapter 5 provided a comprehensive literature study which included the objectives of financial regulations; Pillar 2 regulatory requirements; Pillar 2 requirements and the financial crisis; characteristics and purposes of economic and regulatory capital and implications thereof; and the sensitivity of capital. It was indicated that an empirical analysis of the relationship between regulatory capital and economic capital remains largely unaddressed in academic literature (Jacobson *et al.*, 2006), therefore the study presented in Chapter 5 can be considered as one of the first of its kind. Chapter 5 then applied a theoretical dynamic optimisation model to compare the risk sensitivities of economic capital and regulatory capital. The major conclusion from this chapter was that economic capital is a more risk-sensitive measure than regulatory capital. Based on this characteristic, arguments were presented for

regulators to use economic capital as the primary regulatory capital requirement or, in other words, as a Pillar 1 measure, instead of simply strengthening current Pillar 2 disciplines.

6.7. Possible future research

While contributing uniquely to the body of knowledge as indicted under section 6.6 above, this thesis also presents possibilities for six distinct future research opportunities:

- Regulatory frameworks not based on capital (section 6.7.1).
- Regulatory costs versus benefits analysis (section 6.7.2).
- Effective measures for macro-prudential financial regulation (section 6.7.3).
- Economic capital as regulatory tool (section 6.7.4).
- Approaches to credit rating calculations (section 6.7.5).
- Local market risk premia used globally (section 6.7.6).

Each of these is discussed briefly in the sections that follow:

6.7.1. Regulatory frameworks not based on capital

Financial regulation is typically seen as being inherently procyclical in nature and it was known that the use of capital as Basel's cornerstone could exacerbate this weakness (Daníelson, Embrechts, Goodhart, Keating, Muennich, Renault & Song-Shin, 2001:3).

Although the procyclical nature of capital requirements and its potential weakness were well known long before the implementation of the Basel II framework (Gordy & Howells (2004), the Basel Committee on Banking Supervision (BCBS) has, subsequent to the financial crisis, attempted to make its capital requirements more anti-cyclical. This attempt was made through the introduction of so-called 'forward-looking provisioning', capital conservation and liquidity ratio requirements as part of the Basel III framework. Only time will tell how effective these additional measures will be, but, from a high-level perspective, it seems counter-intuitive to supplement a countercyclical tool with more of the same, i.e. further capital requirements, much like reinforcing a straw house with more straw, to use an analogy. If anything, the financial crisis highlighted that although capital requirements are a useful tool at best as they do not fulfil the safeguarding role they have been assigned. Although the Basel III framework has introduced measures to supplement capital requirements in response to the financial crisis (van Vuuren, 2012), the fact is that the basis for regulation remains capital requirements that will remain procyclical along with any additional buffers required (Repullo & Saurina, 2011). Capital (as the cornerstone of financial regulations, and not necessarily its inherent procyclical nature), can even be considered as a *weakness* on which financial regulations are based.

Ideally, capital requirements should be anti-cyclical (Dowd, Hutchinson, Ashby & Hinchliffe, 2011:22). For now, however, it seems that the global standard of regulation relates to a 'capital stan-

dard' and that it will continue for the foreseeable future. Until such time that another standard is adopted, the procyclical nature inherent to capital will remain a major weakness of global regulatory regimes. The situation reminds of the 'gold standard' and the 'dollar standard' of currency exchange, both of which had to fail first for the world to change to free-floating exchanges rates despite the weaknesses having been apparent from the start.

This study critically assessed capital requirements as a regulatory tool from a slightly different perspective in that instead of considering capital from its procyclical nature, it followed an approach where the ability of capital requirements to fulfil the objectives of financial regulations were assessed. The inability of capital requirements to fulfil these objectives was highlighted in this study and, based on the conclusions that current financial regulations cannot achieve them; this study *potentially opens an argument against using capital requirements for financial regulation while the opportunity exists of exploring alternative measures that can be introduced as a more effective cornerstone of financial regulation.*

6.7.2. Regulatory costs versus benefits analysis

The introduction of Basel and Solvency II has had immense cost implications for banks and insurers alike. With the introduction of the latest Basel III measures; it seems that these costs will continue to rise in future. Although well-intended to attain objectives such as ensuring financial stability and protecting depositors and policyholders; providing equal competitive conditions for financial institutions; and being reflective of the risks that financial institutions face, these costs of financial regulations have been significant and with these increased costs come increased incentives for financial institutions to attempt to save on or circumvent these costs. This is especially true if certain countries are being disadvantaged through the implementation of regulatory requirements, as were highlighted in Chapters 3 and 4.

The world is largely capitalistic where profits, performance and incentives related to profits and performance determine corporate behaviour. Shareholders demand performance and financial institutions are under constant pressure to come up with new and innovative ways to stay ahead of competitors. Banks are also under pressure to save on capital that can, in turn, be used elsewhere in a business to generate higher shareholder returns through increasing the bank's asset base, financing new projects, or returning capital to shareholders in the form of dividends, thus allowing the bank to have a distinct competitive advantage over its peers (Lall, 2009:4). One of the major reasons for engaging in regulatory arbitrage is therefore to enhance shareholder value (Jones, 2000:37).

Arbitrage and capital aside, the cost burden that the implementation of regulatory requirements place on financial institutions is of such a nature that these institutions might start to question whether the costs truly reflect the intended benefits of regulation while they still remain under pressure from a business perspective to deliver value to shareholders, depositors, policyholders, and other stake-

holders. A further consideration on this point will be that if certain countries are being placed at a disadvantage by implementing regulatory requirements that do not necessarily reflect country-specific factors and nuances, or for which they might not enjoy any of the intended advantages, these countries would be reluctant to implement costly regulatory requirements.

Therefore, based on the argument that current financial regulations cannot achieve its objective of providing financial institutions with an equal competitive base, and in the absence of concrete cost/benefit analyses of financial regulations, a second future research opportunity could therefore be *to conduct a practical analysis of the costs that financial regulations impose on financial institutions versus tangible benefits that they receive in return as a result.*

The analysis of the costs of implementing new financial regulations should be relatively easy to estimate, while the quantification of the benefits will be more challenging and subjective. However, even broad estimates around potential operational and financial losses that were prevented by financial regulations might be first steps in truly identifying the benefits of financial regulations. Research along these lines is becoming an absolute necessity in a time where regulatory costs keep increasing while many financial institutions and markets participants are failing to see the tangible benefits associated with such costs.

In conducting such a cost-benefit analysis, and in considering the findings in Chapters 3 and 4 that current financial regulations seem to favour developed countries, *a cost-benefit analysis could be undertaken in which results between developed and developing countries are compared.*

6.7.3. Effective measures for macro-prudential financial regulation

In assessing the ability of current financial regulations to achieve their objectives, a further element that becomes clear is that current financial regulations are based on the assumption that the micro-prudential regulations and requirements they introduce will achieve macro-prudential goals and even systemic stability. However, the financial crisis partly emphasised the growing need to have macro-prudential regulatory measures in place along with the current micro-prudential measures (Davis & Karim, 2009:8).

Current financial regulations strive to be risk sensitive and to reflect closely the true risks that financial institutions are exposed to, yet Chapter 5 indicated that financial regulations cannot achieve this objective. From the analyses done on economic and regulatory capital and the lack of regulatory capital's risk sensitivity to systemic risks, the current micro-prudential regulatory frameworks potentially leave an alarmingly large risk unaddressed in the form of systemic risk. Current financial regulations therefore do not show potential risk build-ups across an industry, and even less so across national borders. This point is accentuated by the fact that prior to the financial crisis banks were well capitalised and stress tests showed that banks had sufficient capital to withstand large shocks (Mohan, 2009:10).

Regulators should therefore be mindful of other macro-financial and political indicators and variables for macro-prudential surveillance, such as international capital flows, exchange rate movements, lending policies and practices, distance to defaults, financial system value at risk (VaR), etc. Regulators need to find a means of monitoring systemic risks along with the micro- or institution-specific factors specified in Basel (Davis & Karim, 2009:6-8). The macro-financial and political indicators referred to do not imply simply using, for example, aggregated figures of non-additive measures such as capital requirements, leverage ratios, and capital buffers across the banking sector (Persaud, 2009).

In addition, the introduction of Solvency II will not simply fit into financial markets without causing some ripple effects, whether by way of regulatory arbitrage opportunities or increased mergers and acquisitions (ECB, 2007:2, 40). This indicates that the introduction of Solvency II may in itself introduce some new and unique systemic risks which need to be identified, monitored and managed on a holistic basis. Indeed, there are already concerns that banks and insurers might be more interconnected than before (Al-Darwish, Hafeman, Impavido, Kemp & O'Malley, 2011:48). The ECB (2007:2, 40) echoes this sentiment and states that there are growing interlinkages between banks and insurers through bancassurance which may pose a potential threat to the banking system. The expected longer-term financial stability such interlinkages will add might come at a cost of short-term financial stability risks.

Regulators should therefore become truly integrated in terms of information shared (across sectors and across borders), objectives, and activities in order for them to achieve a truly macro-prudential regulatory framework which would ensure real systemic stability (Persaud, 2009:7). In other words, in addition to monitoring banks and insurers on an individual basis and the obvious weakness that remains by doing so, regulators will have an arduous task to not only regulate either banks or insurance companies on a macro-prudential basis, but also banks and insurance companies.

The current micro-prudential regulatory frameworks potentially leave an alarmingly large risk unaddressed in the form of systemic risk. There is a clear need for regulators to at least start introducing measures and indicators into their regulatory regimes that will monitor financial risks from a macro-prudential perspective. Therefore, *possible ways of integrating complete macro-prudential supervision into current financial regulation may be explored, specifically around the measures and indicators that would prove most useful to serve this purpose.*

6.7.4. Economic capital as regulatory tool

Chapter 5 conducted an empirical analysis on the risk sensitivity of economic capital versus that of regulatory capital for credit risk in a study that can be considered as one of the first of its kind. Since empirical analysis of the relationship between regulatory capital and economic capital remains largely unaddressed in academic literature (Jacobson *et al.*, 2006), several research opportunities exist in the *empirical investigations into the relationship between economic capital and regulatory capital.* Such

studies may be considered as first attempts to analyse this relationship empirically. They may also present the opportunity to expand on the analysis carried out in this thesis. As this study focussed on credit risk economic capital requirements, future research could focus on market risk, operational risk and total economic and regulatory capital requirements on an empirically comparative basis.

Chapter 5 found economic capital to be more risk sensitive than regulatory capital and that, given a choice, shareholders would prefer to operate their banks at much higher levels of capital than currently being done. Therefore, given certain risks and based on these findings, it was proposed that economic capital could be used as the major instrument for regulators.

Some of the benefits of such an approach were highlighted and may include:

- economic capital is more risk sensitive and is more reflective of true risks faced by financial institutions;
- financial institutions would have less negative incentives to attempt to minimise and avoid capital requirements;
- there would be more of a shared responsibility between financial institutions and regulators in terms of protecting depositors and policyholders;
- capital requirements would be reflective of financial institutions' specific nuances and country-specific factors and would be less rigid than current capital requirements;
- regulators would gain a greater understanding of financial institutions' business operations, governance, risk management practices and strategic objectives; and
- financial institutions would potentially be faced with lower regulatory and compliance costs as the capital numbers produced for internal decision-making and strategic initiatives would be the same numbers that are sent to regulators, meaning that only one process would be used.

From the above advantages, economic capital appears to fulfil all three of the major objectives of financial regulations. However, despite the advantages of possibly using economic capital as a primary regulatory tool, some disadvantages to such an approach exist:

- along with a shared responsibility of contributing to all three major objectives of financial regulations, there will be a greater onus on the integrity of financial institutions in general, which may in certain instances be conflicting between achieving its profit objectives and helping to contribute to social objectives, for example;
- the responsibility of regulators to understand financial institutions in detail increases dramatically, which would have a large cost and resource implication for regulators; and
- this type of regulation may be considered as truly micro-prudential as each financial institution will have its own capital requirements and nuances, making peer analysis and comparisons between financial institutions practically impossible. This would therefore highlight a greater need for improved macro-prudential regulation and a shift in the way that current

macro-prudential regulation is done. This ties in with one of the opportunities for future research highlighted in Section 6.7.3 above.

By considering the above, the analysis in Chapter 5 and the advantages and disadvantages of such an approach are theoretical. Therefore, a possible research opportunity stemming from this study might be *an investigation into the practical merits and implications for both financial institutions and regulators of implementing such an approach.*

6.7.5. Approaches to credit rating calculations

A major finding of the causes to the crisis was that banks relied too heavily on CRAs to obtain ratings for complex products (FCIC, 2010:*xxv*). The possible overreliance on CRAs was highlighted when the Basel II framework was in its initial development phase, yet it was one of the reasons that contributed to the financial crisis (Daníelson, *et al.*, 2001:3).

CRAs were relied upon to produce ratings for highly structured and complex products while banks themselves could not price them. The reliance on these ratings by regulators and bank employees point to a failure of corporate governance and risk management principles. Arguments levelled at CRAs were that conflicts of interest had arisen through the fact that banks paid them to provide credit ratings. This meant that they had to produce some ratings although they could not have given assurance on their accuracy (Dowd, *et al.*, 2011:20). This, along with a lack of liability on the part of CRAs for providing inaccurate ratings, meant that banks conveniently relied on these inaccurate ratings because they could not rate these products themselves, essentially abdicating their responsibility to the CRAs (Levitin & Wachter, 2012:1234).

Recent years (specifically 2010 to 2013) have seen discussions on how CRAs can be made more impartial and the Basel III framework has introduced its own measures and incentives for banks to develop their own internal ratings capabilities, although these are attempts to treat symptoms only. Although CRAs found themselves in a precarious situation, the outcome would not have been any different had banks used their own internal calculations to obtain ratings for their products, simply because no one knew how to rate these 'packaged' loans (Cannata & Quagriariello, 2009:2-10).

In addition to possible overreliance issues, Chapter 4 of this thesis found that credit ratings do not contribute significantly to the cost of capital among developing countries as might have been expected. Instead, equity market volatility was found to be the major contributing factor. This finding allows for further questioning current sovereign credit rating calculation methodologies.

The fact that credit ratings do *not* appear to play a meaningful role in determining the riskiness of countries or in their cost of capital further adds impetus to the conclusion that credit ratings are perhaps not accurate measures of countries' risks, and that these alone should not be considered when analysing the riskiness of a country. Markets tend to rely heavily on credit ratings for various reasons

and objectives and credit quality movements, i.e. upgrades and downgrades, and they have major implications for financial markets and institutions across the globe. With the apparent weaknesses in the modelling methodologies of credit risk for complex products and for sovereign credit ratings, future research could *focus on the improvement of current, and the introduction of new, modelling methodologies in order for them to reflect more accurately the credit risk of complex products and countries.*

6.7.6.   Local market risk premia used globally

One of the conclusions from Chapter 4 was that local market risk premia do not provide an accurate reflection of inherent risks of countries. Local market risk premia that are used globally do not relate well to country risk premia, nor to the cost of capital in this study. This indicates that these local market risk premia are determined inconsistently and that they may be determined intuitively based on perceptions, rather than on a more analytical basis.

A possible future research opportunity could be an analysis of the measurement of local market risk premia used for different countries. Based on the results of such a study, *new approaches that would be more accurate reflections of countries' true market risks could be explored.*

6.8.   Final statement

The financial world is ever-changing and through the introduction of new products and services offered, it is constantly faced with new risks being introduced into the system. Financial regulations should therefore be dynamic and should constantly evolve to be reflective of these risks. Regulations should consider lessons that were learnt when regulations were tested to the extremes during the financial crisis. Solvency II is yet to be implemented for insurance firms, yet many of the weaknesses in Basel that were highlighted by the financial crisis seem to have been included in Solvency II.

Though financial regulations have noble intentions of contributing to financial stability, providing equal competitive footing for financial institutions, and striving to be based on risk-sensitive measures, current financial regulations are struggling to achieve these intentions, probably because of its rigidity and apparent failure to constantly evolve with financial market conditions and innovations.

The principles that financial regulations are based upon need to be reviewed to ensure that they can firstly achieve the objectives that they set out to do, and secondly ensure that adherence to financial regulations is not a simple compliance exercise for financial institutions. This is a real threat to financial regulations and they should therefore be more flexible in pursuing its objectives while also being more reflective of actual risks that financial institutions face.

In conclusion, the current principles and tools of financial regulatory regimes need to be reconsidered for them to remain relevant in future.

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CEA *see* COMITÉ EUROPÉEN DES ASSURANCES, European Insurance and Re-insurance Federation.

CEBS *see* COMMITTEE OF EUROPEAN BANKING SUPERVISORS.

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Appendix A   Cost of capital between developed and developing countries: calculations

Company	Ticker	t	1-t	R_F	Intermediation spread	K_D	CR	CR*	K'_D	D/E	D/(D+E)	E/(D+E)	R_M	R_E	R_P	b_U	b_E	b_L	K_E	K_E (Check)	WACC (V&C)	CAPM (V&C)	K'_DI (K'd=Rf+Rp)	K_E1 (Ke=Rf+bu(Rm-Rf))	K_E2 (Ke=Rf+bu(Rm-Rf)+Rp)	WACC_1	WACC_2
Emerging countries																											
Brazil		34.00%											0.03%														
Banco do Brasil S.A.	BBAS3:BZ	34.00%	66.00%	3.80%	2.57%	6.37%	8.84%	7.44%	15.21%	4.31	0.81	0.19	0.03%	1.01%	7.70%	0.70	0.18	0.03	10.961%	10.961%	10.211%	10.211%	6.37%	1.16%	8.86%	3.63%	5.08%
Itau Unibanco Holding S.A.	ITUB4:BS	34.00%	66.00%	3.80%	2.57%	6.37%	8.84%	7.47%	15.21%	2.98	0.75	0.25	0.03%	1.07%	7.70%	0.55	0.19	0.05	10.975%	10.975%	10.272%	10.272%	6.37%	1.73%	9.43%	3.58%	5.52%
Banco Bradesco S.A.	BBDC4:BS	34.00%	66.00%	3.80%	2.57%	6.37%	8.84%	7.87%	15.21%	2.54	0.72	0.28	0.03%	1.55%	7.70%	0.62	0.23	0.07	11.206%	11.206%	10.367%	10.367%	6.37%	1.48%	9.18%	3.43%	5.61%
China		25.00%											0.05%														
Industrial and Commercial Bank of China	1398:HK	25.00%	75.00%	3.80%	1.34%	5.13%	9.06%	11.06%	14.20%	1.54	0.61	0.39	0.05%	-0.91%	9.40%	1.01	0.47	0.19	13.145%	13.145%	11.631%	11.631%	5.13%	0.00%	9.40%	2.33%	6.03%
China Construction Bank Corporation	939:HK	25.00%	75.00%	3.80%	1.34%	5.13%	9.06%	11.41%	14.20%	1.22	0.55	0.45	0.05%	0.07%	9.40%	0.97	0.51	0.23	13.353%	13.353%	11.868%	11.868%	5.13%	0.14%	9.54%	2.18%	6.42%
Bank of China	3988:HK	25.00%	75.00%	3.80%	1.34%	5.13%	9.06%	10.42%	14.20%	1.61	0.62	0.38	0.05%	-1.18%	9.40%	0.88	0.40	0.15	12.773%	12.773%	11.462%	11.462%	5.13%	0.48%	9.88%	2.56%	6.16%
India		32.44%											0.21%														
State Bank of India	SBIN:IN	32.44%	67.56%	3.80%	2.57%	6.37%	9.88%	11.29%	16.24%	1.83	0.65	0.35	0.21%	-0.26%	8.50%	1.05	0.47	0.17	13.914%	13.914%	12.013%	12.013%	6.37%	0.05%	8.55%	2.80%	5.80%
ICICI Bank Ltd.	ICICIBC:IN	32.44%	67.56%	3.80%	2.57%	6.37%	9.88%	11.33%	16.24%	2.67	0.73	0.27	0.21%	-1.03%	8.50%	1.32	0.47	0.13	13.940%	13.940%	11.783%	11.783%	6.37%	-0.94%	7.56%	2.87%	5.19%
Punjab National Bank	PNB:IN	32.44%	67.56%	3.80%	2.57%	6.37%	9.88%	11.48%	16.24%	1.15	0.54	0.46	0.21%	-0.51%	8.50%	0.86	0.49	0.23	14.034%	14.034%	12.397%	12.397%	6.37%	0.70%	9.20%	2.63%	6.58%
Indonesia		25.00%											0.73%														
PT Bank Mandiri (Persero) Tbk	BMRI:IJ	25.00%	75.00%	3.80%	2.57%	6.37%	8.98%	14.11%	15.34%	0.74	0.43	0.57	0.73%	-0.27%	7.30%	1.28	0.82	0.47	16.369%	16.369%	14.297%	14.297%	6.37%	-0.13%	7.17%	1.96%	6.15%
PT Bank Rakyat Indonesia (Persero) Tbk	BBRI:IJ	25.00%	75.00%	3.80%	2.57%	6.37%	8.98%	14.63%	15.34%	0.43	0.30	0.70	0.73%	0.41%	7.30%	1.16	0.88	0.62	16.711%	16.711%	15.150%	15.150%	6.37%	0.23%	7.53%	1.60%	6.71%
PT Bank Central Asia Tbk	BBCA:IJ	25.00%	75.00%	3.80%	2.57%	6.37%	8.98%	11.97%	15.34%	0.13	0.12	0.88	0.73%	1.38%	7.30%	0.64	0.58	0.51	14.961%	14.961%	14.551%	14.551%	6.37%	1.83%	9.13%	2.18%	8.61%
Mexico		30.00%											0.15%														
BBVA Bancomer S.A.	BBVA:SM	30.00%	70.00%	3.80%	1.34%	5.13%	8.54%	6.98%	13.67%	7.30	0.88	0.12	0.15%	-1.65%	7.30%	0.72	0.12	0.01	10.143%	10.143%	9.640%	9.640%	5.13%	1.19%	8.49%	3.30%	4.18%
Banco Santander (Mexico),S.A.	SAN*:MM	30.00%	70.00%	3.80%	2.57%	6.37%	8.54%	6.97%	14.91%	6.13	0.86	0.14	0.15%	-1.21%	7.30%	0.97	0.17	0.03	10.515%	10.515%	10.155%	10.155%	6.37%	1.54%	8.84%	4.05%	5.07%
Grupo Financiero Banorte	GFNORTEO:MM	30.00%	70.00%	3.80%	2.57%	6.37%	8.54%	9.83%	14.91%	1.95	0.66	0.34	0.15%	-0.15%	7.30%	1.07	0.45	0.15	12.645%	12.645%	11.184%	11.184%	6.37%	-0.10%	7.20%	2.91%	5.39%
Philippines		30.00%											0.20%														
BDO Unibank, Inc.	BDO:PM	30.00%	70.00%	3.80%	2.57%	6.37%	9.89%	13.24%	16.26%	1.21	0.55	0.45	0.20%	-0.25%	5.60%	1.18	0.64	0.29	15.403%	15.403%	13.197%	13.197%	6.37%	-0.45%	5.15%	2.24%	4.77%
Bank of the Philippine Islands	BPI:PM	30.00%	70.00%	3.80%	2.57%	6.37%	9.89%	14.22%	16.26%	0.25	0.20	0.80	0.20%	-0.05%	5.60%	0.87	0.74	0.59	16.022%	16.022%	15.084%	15.084%	6.37%	0.68%	6.28%	1.44%	5.91%
Rizal Commercial Banking Corp.	RCB:PM	30.00%	70.00%	3.80%	2.57%	6.37%	9.89%	13.48%	16.26%	1.25	0.56	0.44	0.20%	-0.67%	5.60%	1.24	0.66	0.29	15.551%	15.551%	13.236%	13.236%	6.37%	-0.67%	4.93%	2.18%	4.67%
Poland		19.00%											-0.52%														
Bank Pekao SA	PEO:PW	19.00%	81.00%	3.80%	1.34%	5.13%	6.66%	10.61%	11.80%	0.69	0.41	0.59	-0.52%	-1.08%	6.20%	1.22	0.78	0.46	11.389%	11.389%	10.643%	10.643%	5.13%	-1.47%	4.73%	0.82%	4.50%
BRE Bank SA	BRE:PW	19.00%	81.00%	3.80%	1.34%	5.13%	6.66%	7.39%	11.80%	5.29	0.84	0.16	-0.52%	-1.32%	6.20%	1.58	0.30	0.05	10.256%	10.256%	9.667%	9.667%	5.13%	-3.03%	3.17%	3.02%	4.00%
ING Bank Slaski	BSK:PW	19.00%	81.00%	3.80%	1.34%	5.13%	6.66%	8.41%	11.80%	1.80	0.64	0.36	-0.52%	-0.70%	6.20%	1.11	0.45	0.16	10.613%	10.613%	9.934%	9.934%	5.13%	-1.00%	5.20%	2.32%	4.53%
Russia		20.00%											-1.02%														
Sberbank of Russia	SBER:RU	20.00%	80.00%	3.80%	2.57%	6.37%	7.64%	11.85%	14.01%	0.82	0.45	0.55	-1.02%	-1.53%	7.50%	1.25	0.75	0.41	13.319%	13.319%	12.365%	12.365%	6.37%	-2.21%	5.29%	1.09%	5.20%
Bank VTB (JSC)	VTBR:RU	20.00%	80.00%	3.80%	2.57%	6.37%	7.64%	8.06%	14.01%	2.64	0.73	0.27	-1.02%	-3.55%	7.50%	0.79	0.26	0.07	11.923%	11.923%	11.403%	11.403%	6.37%	-0.03%	7.47%	3.69%	5.75%
Bank of Moscow	MMBM:RM	20.00%	80.00%	3.80%	2.57%	6.37%	7.64%	6.66%	14.01%	3.47	0.78	0.22	-1.02%	-0.33%	7.50%	0.27	0.07	0.02	11.407%	11.407%	11.251%	11.251%	6.37%	2.49%	9.99%	4.51%	6.19%
South Africa		28.00%											0.81%														
Standard Bank Group Limited	SBK:SJ	28.00%	72.00%	3.80%	2.57%	6.37%	8.23%	10.35%	14.59%	1.02	0.51	0.49	0.81%	0.59%	6.30%	0.93	0.54	0.27	13.327%	13.327%	11.903%	11.903%	6.37%	1.00%	7.30%	2.81%	5.93%
Absa Group Limited	ASA:SJ	28.00%	72.00%	3.80%	1.34%	5.13%	8.23%	8.62%	13.36%	1.64	0.62	0.38	0.81%	0.74%	6.30%	0.72	0.33	0.12	11.338%	11.338%	10.270%	10.270%	5.13%	1.65%	7.95%	2.92%	5.31%
FirstRand Bank Limited	FSR:SJ	28.00%	72.00%	3.80%	2.57%	6.37%	8.23%	13.32%	14.59%	0.21	0.18	0.82	0.81%	0.81%	6.30%	1.04	0.90	0.74	15.214%	15.214%	14.383%	14.383%	6.37%	0.69%	6.99%	1.38%	6.56%
Turkey		20.00%											-0.30%														
Turkiye Is Bankasi A.S.	ISCTR:TI	20.00%	80.00%	3.80%	2.57%	6.37%	11.76%	14.59%	18.13%	1.86	0.65	0.35	-0.30%	0.18%	8.10%	1.10	0.44	0.15	17.879%	17.879%	15.683%	15.683%	6.37%	-0.69%	7.41%	3.08%	5.90%
Turkiye Garanti Bankasi A.S.	GARAN:TI	20.00%	80.00%	3.80%	2.57%	6.37%	11.76%	14.63%	18.13%	2.40	0.71	0.29	-0.30%	1.44%	8.10%	1.30	0.44	0.13	17.909%	17.909%	15.506%	15.506%	6.37%	-1.51%	6.59%	3.15%	5.53%
Akbank T.A.S.	AKBNK:TI	20.00%	80.00%	3.80%	2.57%	6.37%	11.76%	14.61%	18.13%	2.09	0.68	0.32	-0.30%	0.69%	8.10%	1.18	0.44	0.14	17.892%	17.892%	15.603%	15.603%	6.37%	-1.03%	7.07%	3.11%	5.74%
Developed countries																											
Canada		26.00%											0.11%														
Royal Bank of Canada	RY:CN	26.00%	74.00%	3.80%	0.89%	4.69%	2.95%	2.77%	7.64%	2.77	0.74	0.26	0.11%	0.60%	5.90%	0.60	0.20	0.05	5.504%	5.504%	5.612%	5.612%	4.69%	1.57%	7.47%	2.96%	4.53%
Toronto-Dominion Bank (The)	TD:CN	26.00%	74.00%	3.80%	0.89%	4.69%	2.95%	3.09%	7.64%	1.64	0.62	0.38	0.11%	0.56%	5.90%	0.68	0.31	0.12	5.421%	5.421%	5.564%	5.564%	4.69%	1.28%	7.18%	2.64%	4.87%
Bank of Nova Scotia	BNS:CN	26.00%	74.00%	3.80%	0.89%	4.69%	2.95%	2.92%	7.64%	2.42	0.71	0.29	0.11%	0.30%	5.90%	0.69	0.25	0.07	5.466%	5.466%	5.597%	5.597%	4.69%	1.24%	7.14%	2.82%	4.54%
France		33.33%											-0.49%														
BNP Paribas	BNP:FP	33.33%	66.67%	3.80%	1.48%	5.28%	3.00%	2.30%	8.28%	17.60	0.95	0.05	-0.49%	-0.68%	6.00%	1.27	0.10	0.01	5.392%	5.392%	5.514%	5.514%	5.28%	-1.66%	4.34%	3.24%	3.56%
Crédit Agricole	ACA:FP	33.33%	66.67%	3.80%	1.48%	5.28%	3.00%	2.51%	8.28%	11.95	0.92	0.08	-0.49%	-1.86%	6.00%	1.52	0.17	0.01	5.302%	5.302%	5.504%	5.504%	5.28%	-2.74%	3.26%	3.04%	3.50%
Societe Generale (SG)	GLE:FP	33.33%	66.67%	3.80%	1.48%	5.28%	3.00%	2.90%	8.28%	15.12	0.94	0.06	-0.49%	-1.63%	6.00%	1.86	0.17	0.01	5.305%	5.305%	5.507%	5.507%	5.28%	-4.16%	1.84%	3.04%	3.42%
Germany		29.48%											-0.29%														
Deutsche Bank AG	DBK:GR	29.48%	70.52%	3.80%	1.48%	5.28%	2.70%	2.53%	7.98%	8.21	0.89	0.11	-0.29%	-2.69%	5.40%	1.57	0.23	0.03	5.306%	5.306%	5.593%	5.593%	5.28%	-2.62%	2.78%	3.03%	3.62%
Commerzbank AG	CBK:GR	29.48%	70.52%	3.80%	1.48%	5.28%	2.70%	2.33%	7.98%	15.87	0.94	0.06	-0.29%	-7.38%	5.40%	1.91	0.16	0.01	5.409%	5.409%	5.615%	5.615%	5.28%	-4.04%	1.36%	3.26%	3.58%
Landesbank Baden-Wuerttemberg	IFUB:GR	29.48%	70.52%	3.80%	1.48%	5.28%	2.70%	2.09%	7.98%	5.25	0.84	0.16	-0.29%	-0.10%	5.40%	0.33	0.07	0.01	5.530%	5.530%	5.612%	5.612%	5.28%	2.45%	7.85%	3.52%	4.38%
Italy		31.40%											-1.27%														
UniCredit S.p.A.	UCG:IM	31.40%	68.60%	3.80%	1.48%	5.28%	6.14%	6.26%	11.42%	6.06	0.86	0.14	-1.27%	-1.99%	5.50%	1.72	0.33	0.05	8.189%	8.189%	7.883%	7.883%	5.28%	-4.91%	0.59%	2.41%	3.19%
Intesa Sanpaolo SpA	ISP:IM	31.40%	68.60%	3.80%	1.48%	5.28%	6.14%	5.90%	11.42%	5.37	0.84	0.16	-1.27%	-1.13%	5.50%	1.29	0.28	0.04	8.127%	8.127%	7.879%	7.879%	5.28%	-2.74%	2.76%	2.62%	3.49%
Banca Monte dei Paschi di Siena SpA	BMPS:IM	31.40%	68.60%	3.80%	2.16%	5.96%	6.14%	5.17%	12.09%	6.96	0.87	0.13	-1.27%	-2.27%	5.50%	0.90	0.16	0.02	8.464%	8.464%	8.307%	8.307%	5.96%	-0.77%	4.73%	3.48%	4.17%
Japan		38.01%											-0.88%														
Nomura Holdings, Inc.	8604:JP	38.01%	61.99%	3.80%	2.16%	5.96%	4.23%	3.28%	10.18%	14.22	0.93	0.07	-0.88%	-2.10%	5.00%	1.53	0.16	0.01	5.996%	6.241%	6.307%	6.307%	5.96%	-3.34%	1.66%	3.23%	3.56%
Mizuho Financial Group, Inc.	8411:JP	38.01%	61.99%	3.80%	1.48%	5.28%	4.23%	3.61%	9.51%	8.52	0.89	0.11	-0.88%	-1.87%	5.00%	1.47	0.23	0.02	5.786%	5.786%	5.881%	5.881%	5.28%	-3.09%	1.91%	2.60%	3.13%
Bank of Tokyo-Mitsubishi UFJ	8306:JP	38.01%	61.99%	3.80%	1.48%	5.28%	4.23%	4.01%	9.51%	4.07	0.80	0.20	-0.88%	-1.31%	5.00%	1.16	0.33	0.06	5.743%	5.743%	5.863%	5.863%	5.28%	-1.62%	3.38%	2.31%	3.29%
United Kingdom		26.00%											-0.06%														
HSBC Holdings plc	HSBA:LN	26.00%	74.00%	3.80%	0.89%	4.69%	2.65%	2.77%	7.34%	2.74	0.73	0.27	-0.06%	-0.53%	5.30%	0.92	0.31	0.08	5.060%	5.060%	5.330%	5.330%	4.69%	0.24%	5.54%	2.60%	4.02%
Barclays plc	BARC:LN	26.00%	74.00%	3.80%	1.48%	5.28%	2.65%	2.57%	7.93%	10.61	0.91	0.09	-0.06%	-1.40%	5.30%	2.02	0.23	0.02	5.593%	5.593%	5.845%	5.845%	5.28%	-4.00%	1.30%	3.23%	3.68%
The Royal Bank of Scotland Group plc	RBS:LN	26.00%	74.00%	3.80%	1.48%	5.28%	2.65%	2.89%	7.93%	6.68	0.87	0.13	-0.06%	-3.77%	5.30%	2.08	0.35	0.05	5.445%	5.445%	5.813%	5.813%	5.28%	-4.24%	1.06%	2.85%	3.54%
United States		40.00%											-0.15%														
JPMorgan Chase & Co.	JPM:US	40.00%	60.00%	3.80%	1.48%	5.28%	2.75%	2.49%	8.03%	4.30	0.81	0.19	-0.15%	-0.14%	5.50%	1.10	0.31	0.06	4.451%	4.451%	4.749%	4.749%	5.28%	-0.53%	4.97%	2.47%	3.51%
Bank of America Corporation	BAC:US	40.00%	60.00%	3.80%	1.48%	5.28%	2.75%	3.23%	8.03%	4.06	0.80	0.20	-0.15%	-2.52%	5.50%	1.98	0.58	0.11	4.129%	4.129%	4.682%	4.682%	5.28%	-4.00%	1.50%	1.75%	2.84%
Citigroup Inc.	C:US	40.00%	60.00%	3.80%	1.48%	5.28%	2.75%	3.04%	8.03%	5.84	0.85	0.15	-0.15%	-3.46%	5.50%	2.28	0.51	0.07	4.212%	4.212%	4.730%	4.730%	5.28%	-5.20%	0.30%	1.95%	2.75%

Calculated as average of all developed countries' ratios

Source: Compiled by the author.

Appendix B   Cost of capital between developing countries: calculations

		t	1-t	R_F	Intermediation spread	K_D	CR	CR*	K'_D	D/E	D/(D+E)	E/(D+E)	R_M	R_E	R_P	b_U	b_E	b_L	K_E	K_E (Check)	WACC	CAPM	K'_DI (K'd = Rf + Rp)	K_E1 (Ke = Rf + bu(Rm-Rf))	K_E2 (Ke = Rf + bu(Rm-Rf)+Rp)	WACC_1	WACC_2
Emerging markets Asia																											
China		25.00%												0.05%							0.13748							
Industrial and Commercial Bank of China	1398:HK	25.00%	75.00%	3.80%	2.28%	6.08%	9.02%	11.01%	15.10%	1.54	0.61	0.39	0.05%	-0.91%	9.40%	1.01	0.47	0.19	13.802%	13.802%	12.30%	12.30%	6.08%	0.00%	9.40%	2.76%	6.46%
China Construction Bank Corporation	939:HK	25.00%	75.00%	3.80%	2.28%	6.08%	9.02%	11.36%	15.10%	1.22	0.55	0.45	0.05%	0.07%	9.40%	0.97	0.51	0.23	14.009%	14.009%	12.54%	12.54%	6.08%	0.14%	9.54%	2.57%	6.81%
Bank of China	3988:HK	25.00%	75.00%	3.80%	2.28%	6.08%	9.02%	10.38%	15.10%	1.61	0.62	0.38	0.05%	-1.18%	9.40%	0.88	0.40	0.15	13.433%	13.433%	12.13%	12.13%	6.08%	0.48%	9.88%	3.00%	6.60%
India		32.44%												0.21%							0.15713							
State Bank of India	SBIN:IN	32.44%	67.56%	3.80%	2.28%	6.08%	11.57%	13.22%	17.65%	1.83	0.65	0.35	0.21%	-0.26%	8.50%	1.05	0.47	0.17	15.651%	15.651%	13.24%	13.24%	6.08%	0.05%	8.55%	2.67%	5.68%
ICICI Bank Ltd.	ICICIBC:IN	32.44%	67.56%	3.80%	2.28%	6.08%	11.57%	13.27%	17.65%	2.67	0.73	0.27	0.21%	-1.03%	8.50%	1.32	0.47	0.13	15.684%	15.684%	12.95%	12.95%	6.08%	-0.94%	7.56%	2.73%	5.05%
Punjab National Bank	PNB:IN	32.44%	67.56%	3.80%	2.28%	6.08%	11.57%	13.44%	17.65%	1.15	0.54	0.46	0.21%	-0.51%	8.50%	0.86	0.49	0.23	15.804%	15.804%	13.73%	13.73%	6.08%	0.70%	9.20%	2.52%	6.47%
Indonesia		25.00%												0.73%							0.085122							
PT Bank Mandiri (Persero) Tbk	BMRI:IJ	25.00%	75.00%	3.80%	2.28%	6.08%	4.16%	6.54%	10.24%	0.74	0.43	0.57	0.73%	-0.27%	7.30%	1.28	0.82	0.47	8.578%	8.578%	8.19%	8.19%	6.08%	-0.13%	7.17%	1.87%	6.06%
PT Bank Rakyat Indonesia (Persero) Tbk	BBRI:IJ	25.00%	75.00%	3.80%	2.28%	6.08%	4.16%	6.78%	10.24%	0.43	0.30	0.70	0.73%	0.41%	7.30%	1.16	0.88	0.62	8.641%	8.641%	8.35%	8.35%	6.08%	0.23%	7.53%	1.53%	6.64%
PT Bank Central Asia Tbk	BBCA:IJ	25.00%	75.00%	3.80%	2.28%	6.08%	4.16%	5.55%	10.24%	0.13	0.12	0.88	0.73%	-0.25%	7.30%	0.64	0.58	0.51	8.317%	8.317%	8.24%	8.24%	6.08%	1.83%	9.13%	2.15%	8.58%
Philippines		30.00%												0.20%							0.130848							
BDO Unibank, Inc.	BDO:PM	30.00%	70.00%	3.80%	2.28%	6.08%	8.65%	11.58%	14.72%	1.21	0.55	0.45	0.20%	-0.25%	5.60%	1.18	0.64	0.29	13.537%	13.537%	11.77%	11.77%	6.08%	-0.45%	5.15%	2.13%	4.66%
Bank of the Philippine Islands	BPI:PM	30.00%	70.00%	3.80%	2.28%	6.08%	8.65%	9.06%	14.72%	0.25	0.20	0.80	0.20%	-0.05%	5.60%	0.41	0.35	0.28	12.062%	12.062%	11.71%	11.71%	6.08%	2.33%	7.93%	2.72%	7.19%
Rizal Commercial Banking Corp.	RCB:PM	30.00%	70.00%	3.80%	2.28%	6.08%	8.65%	11.79%	14.72%	1.25	0.56	0.44	0.20%	-0.67%	5.60%	1.24	0.66	0.29	13.655%	13.655%	11.80%	11.80%	6.08%	-0.67%	4.93%	2.06%	4.56%
Emerging markets Europe																											
Kazakhstan		20.00%												-0.44%							0.102982							
Kazkommertsbank	KKGB:KZ	20.00%	80.00%	3.80%	2.80%	6.60%	2.83%	2.65%	9.43%	3.41	0.77	0.23	-0.44%	-0.07%	7.50%	0.51	0.14	0.03	7.347%	7.347%	7.50%	7.50%	6.60%	1.62%	9.12%	4.45%	6.15%
Poland		19.00%												-0.52%							0.141448							
Bank Pekao SA	PEO:PW	19.00%	81.00%	3.80%	2.80%	6.60%	8.56%	8.90%	15.15%	5.29	0.84	0.16	-0.52%	-1.08%	6.20%	1.22	0.23	0.04	13.250%	13.250%	12.43%	12.43%	6.60%	-1.47%	4.73%	4.26%	5.25%
BRE Bank SA	BRE:PW	19.00%	81.00%	3.80%	2.80%	6.60%	8.56%	12.44%	15.15%	1.80	0.64	0.36	-0.52%	-1.32%	6.20%	1.58	0.64	0.23	14.998%	14.998%	13.25%	13.25%	6.60%	-3.03%	3.17%	2.35%	4.57%
ING Bank Slaski	BSK:PW	19.00%	81.00%	3.80%	2.80%	6.60%	8.56%	10.79%	15.15%	1.80	0.64	0.36	-0.52%	-0.70%	6.20%	1.11	0.45	0.16	14.186%	14.186%	12.96%	12.96%	6.60%	-1.00%	5.20%	3.08%	5.29%
Russia		20.00%												-1.02%							0.135087							
Sberbank of Russia	SBER:RU	20.00%	80.00%	3.80%	2.80%	6.60%	8.60%	13.33%	15.19%	0.82	0.45	0.55	-1.02%	-1.53%	7.50%	1.25	0.75	0.41	14.987%	14.987%	13.71%	13.71%	6.60%	-2.21%	5.29%	1.17%	5.29%
Bank VTB (JSC)	VTBR:RU	20.00%	80.00%	3.80%	2.80%	6.60%	8.60%	9.07%	15.19%	2.64	0.73	0.27	-1.02%	-3.53%	7.50%	0.79	0.26	0.07	13.115%	13.115%	12.42%	12.42%	6.60%	-0.03%	7.47%	3.82%	5.88%
Bank of Moscow	MMBM:RM	20.00%	80.00%	3.80%	2.80%	6.60%	8.60%	7.49%	15.19%	3.47	0.78	0.22	-1.02%	-0.33%	7.50%	0.27	0.07	0.02	12.424%	12.424%	12.21%	12.21%	6.60%	2.49%	9.99%	4.65%	6.33%
Slovenia		20.00%												-0.64%							0.183788							
Nova Kreditna Banka Maribor	KBMR:SV	20.00%	80.00%	3.80%	2.80%	6.60%	14.33%	14.96%	20.93%	3.81	0.79	0.21	-0.64%	-5.25%	6.68%	0.99	0.24	0.05	19.157%	19.157%	17.24%	17.24%	6.60%	-0.59%	6.09%	4.06%	5.45%
Abanka Vipa d.d.	ABKN:SV	20.00%	80.00%	3.80%	2.80%	6.60%	14.33%	12.71%	20.93%	5.04	0.83	0.17	-0.64%	-3.24%	6.68%	0.44	0.09	0.01	17.601%	17.601%	16.88%	16.88%	6.60%	1.86%	8.54%	4.71%	5.82%
Turkey		20.00%												-0.30%							0.092361							
Turkiye Is Bankasi A.S.	ISCTR:TI	20.00%	80.00%	3.80%	2.80%	6.60%	4.64%	5.76%	11.24%	1.86	0.65	0.35	-0.30%	0.18%	8.10%	1.10	0.44	0.15	9.235%	9.235%	9.08%	9.08%	6.60%	-0.69%	7.41%	3.19%	6.02%
Turkiye Garanti Bankasi A.S.	GARAN:TI	20.00%	80.00%	3.80%	2.80%	6.60%	4.64%	5.78%	11.24%	2.40	0.71	0.29	-0.30%	1.44%	8.10%	1.30	0.44	0.13	9.237%	9.237%	9.06%	9.06%	6.60%	-1.51%	6.59%	3.28%	5.66%
Akbank T.A.S.	AKBNK:TI	20.00%	80.00%	3.80%	2.80%	6.60%	4.64%	5.77%	11.24%	2.09	0.68	0.32	-0.30%	0.69%	8.10%	1.18	0.44	0.14	9.236%	9.236%	9.07%	9.07%	6.60%	-1.03%	7.07%	3.23%	5.86%
Emerging markets Latin America																											
Argentina		35.00%												-1.20%							0.090801							
BBVA Banco Frances	FRAN:AR	35.00%	65.00%	3.80%	3.53%	7.33%	5.99%	6.91%	13.31%	0.25	0.20	0.80	-1.20%	0.34%	9.90%	0.59	0.50	0.40	9.150%	9.150%	9.05%	9.05%	7.33%	0.87%	10.77%	1.65%	9.56%
Banco Santander Rio S.A.	BRIO:AR	35.00%	65.00%	3.80%	3.53%	7.33%	5.99%	5.96%	13.31%	0.43	0.30	0.70	-1.20%	0.07%	9.90%	0.44	0.35	0.24	8.994%	8.994%	8.89%	8.89%	7.33%	1.59%	11.49%	2.54%	9.47%
Banco Macro S.A.	BMA:AR	35.00%	65.00%	3.80%	3.53%	7.33%	5.99%	6.58%	13.31%	0.55	0.35	0.65	-1.20%	1.09%	9.90%	0.61	0.45	0.29	9.096%	9.096%	8.94%	8.94%	7.33%	0.75%	10.65%	2.17%	8.57%
Brazil		34.00%												0.03%							0.082413							
Banco do Brasil S.A.	BBAS3:BZ	34.00%	66.00%	3.80%	3.53%	7.33%	4.83%	4.07%	12.16%	4.31	0.81	0.19	0.03%	1.01%	7.70%	0.70	0.18	0.03	8.223%	8.223%	8.06%	8.06%	7.33%	1.16%	8.86%	4.14%	5.60%
Itau Unibanco Holding S.A.	ITUB4:BS	34.00%	66.00%	3.80%	3.53%	7.33%	4.83%	4.09%	12.16%	2.98	0.75	0.25	0.03%	1.07%	7.70%	0.55	0.19	0.05	8.226%	8.226%	8.08%	8.08%	7.33%	1.73%	9.43%	4.06%	5.99%
Banco Bradesco S.A.	BBDC4:BS	34.00%	66.00%	3.80%	3.53%	7.33%	4.83%	4.31%	12.16%	2.54	0.72	0.28	0.03%	1.55%	7.70%	0.62	0.23	0.07	8.275%	8.275%	8.10%	8.10%	7.33%	1.48%	9.18%	3.89%	6.06%
Chile		20.00%												0.51%							0.14016							
Banco Santander Chile	BSAN:CC	20.00%	80.00%	3.80%	3.53%	7.33%	9.09%	8.42%	16.42%	2.94	0.75	0.25	0.51%	0.89%	5.70%	0.42	0.13	0.03	13.871%	13.871%	13.32%	13.32%	7.33%	2.41%	8.11%	4.99%	6.43%
Banco de Credito e Inversiones	BCI:CC	20.00%	80.00%	3.80%	3.53%	7.33%	9.09%	8.88%	16.42%	2.83	0.74	0.26	0.51%	1.06%	5.70%	0.58	0.18	0.05	14.161%	14.161%	13.41%	13.41%	7.33%	1.91%	7.61%	4.63%	6.32%
Mexico		30.00%												0.15%							0.103791							
BBVA Bancomer S.A.	BBVA:SM	30.00%	70.00%	3.80%	3.53%	7.33%	6.55%	5.35%	13.88%	7.30	0.88	0.12	0.15%	-1.65%	7.30%	0.72	0.12	0.01	10.055%	10.055%	9.76%	9.76%	7.33%	1.19%	8.49%	4.66%	5.54%
Banco Santander (Mexico),S.A.	SAN*:MM	30.00%	70.00%	3.80%	3.53%	7.33%	6.55%	5.35%	13.88%	6.13	0.86	0.14	0.15%	-1.21%	7.30%	0.62	0.12	0.02	10.055%	10.055%	9.76%	9.76%	7.33%	0.14%	8.84%	4.63%	5.65%
Grupo Financiero Banorte	GFNORTEO:MM	30.00%	70.00%	3.80%	3.53%	7.33%	6.55%	7.54%	13.88%	1.95	0.66	0.34	0.15%	-0.15%	7.30%	1.07	0.45	0.15	11.027%	11.027%	10.16%	10.16%	7.33%	-0.10%	7.20%	3.36%	5.83%
Peru		30.00%												0.33%							0.139478							
Banco de Credito del Peru	CREDITC1:PE	30.00%	70.00%	3.80%	3.53%	7.33%	10.84%	8.83%	18.17%	2.27	0.69	0.31	0.33%	1.60%	7.80%	0.30	0.11	0.04	13.564%	13.564%	12.98%	12.98%	7.33%	2.77%	10.57%	4.41%	6.80%
Banco Internacional del Peru - Interbank	INTERBC1:PE	30.00%	70.00%	3.80%	3.53%	7.33%	10.84%	9.96%	18.17%	1.78	0.64	0.36	0.33%	2.68%	7.80%	0.49	0.22	0.08	14.331%	14.331%	13.30%	13.30%	7.33%	2.09%	9.89%	4.04%	6.84%
Emerging markets CEMEA																											
Bahrain		0.00%												-3.17%							0.274164							
Ahli United Bank BSC	AUB:BI	0.00%	100.00%	3.80%	4.04%	7.84%	18.32%	21.40%	26.16%	2.88	0.74	0.26	-3.17%	0.02%	6.00%	0.65	0.17	0.04	28.066%	28.066%	26.65%	26.65%	7.84%	-0.75%	5.25%	5.63%	7.17%
National Bank of Bahrain	NBB:BI	0.00%	100.00%	3.80%	4.04%	7.84%	18.32%	19.63%	26.16%	1.09	0.52	0.48	-3.17%	-0.28%	6.00%	0.15	0.07	0.03	26.974%	26.974%	26.55%	26.55%	7.84%	2.75%	8.75%	5.41%	8.28%
BBK	BBK:BI	0.00%	100.00%	3.80%	4.04%	7.84%	18.32%	20.01%	26.16%	2.87	0.74	0.26	-3.17%	-0.38%	6.00%	0.36	0.09	0.02	27.209%	27.209%	26.43%	26.43%	7.84%	1.30%	7.30%	6.15%	7.70%
Kuwait		15.00%												-0.99%							0.071402							
National Bank of Kuwait	NBK:KK	15.00%	85.00%	3.80%	4.04%	7.84%	1.85%	2.06%	9.69%	2.30	0.70	0.30	-0.99%	0.76%	6.60%	0.78	0.26	0.08	7.468%	7.468%	8.01%	8.01%	7.84%	0.08%	6.68%	4.67%	6.67%
Gulf Bank	GBK:KK	15.00%	85.00%	3.80%	4.04%	7.84%	1.85%	2.00%	9.69%	1.52	0.60	0.40	-0.99%	-0.15%	6.60%	0.53	0.23	0.09	7.557%	7.557%	7.97%	7.97%	7.84%	1.24%	7.84%	4.52%	7.13%
Kuwait Finance House	KFIN:KK	15.00%	85.00%	3.80%	4.04%	7.84%	1.85%	2.74%	9.69%	0.66	0.40	0.60	-0.99%	0.24%	6.60%	0.98	0.63	0.38	6.395%	6.395%	7.13%	7.13%	7.84%	-0.89%	5.71%	2.11%	6.09%
Nigeria		30.00%												-1.14%							0.174926							
First Bank of Nigeria Plc	FIRSTBAN:NL	30.00%	70.00%	3.80%	4.04%	7.84%	10.95%	14.00%	18.80%	0.69	0.41	0.59	-1.14%	0.72%	6.90%	0.86	0.58	0.34	16.637%	16.637%	15.22%	15.22%	7.84%	-0.44%	6.46%	1.99%	6.07%
Guaranty Trust Bank PLC	GUARANTY:NL	30.00%	70.00%	3.80%	4.04%	7.84%	10.95%	15.00%	18.80%	0.25	0.20	0.80	-1.14%	1.75%	6.90%	0.86	0.73	0.59	17.573%	17.573%	16.68%	16.68%	7.84%	-0.47%	6.43%	0.74%	6.24%
Zenith Bank Plc	ZENITHBA:NL	30.00%	70.00%	3.80%	4.04%	7.84%	10.95%	16.97%	18.80%	0.39	0.28	0.72	-1.14%	0.72%	6.90%	1.08	0.85	0.61	18.268%	18.268%	16.84%	16.84%	7.84%	-1.53%	5.37%	0.43%	5.40%
Saudi Arabia		20.00%												-0.44%							0.06756							
Al Rajhi Bank	RJHI:AB	20.00%	80.00%	3.80%	4.04%	7.84%	1.52%	1.77%	9.36%	0.19	0.16	0.84	-0.44%	0.19%	6.30%	0.42	0.37	0.31	6.482%	6.482%	6.64%	6.64%	7.84%	2.00%	8.30%	2.67%	7.98%
Saudi Investment Bank, The	SIBC:AB	20.00%	80.00%	3.80%	4.04%	7.84%	1.52%	1.58%	9.36%	0.78	0.44	0.56	-0.44%	-0.62%	6.30%	0.40	0.24	0.14	6.825%	6.825%	7.12%	7.12%	7.84%	2.12%	8.42%	3.94%	7.48%
Riyad Bank	RIBL:AB	20.00%	80.00%	3.80%	4.04%	7.84%	1.52%	1.51%	9.36%	0.78	0.44	0.56	-0.44%	-0.67%	6.30%	0.31	0.19	0.11	6.961%	6.961%	7.19%	7.19%	7.84%	2.47%	8.77%	4.13%	7.68%
South Africa		28.00%												0.81%							0.16105							
Standard Bank Group Limited	SBK:SJ	28.00%	72.00%	3.80%	4.04%	7.84%	9.34%	11.75%	17.18%	1.02	0.51	0.49	0.81%	0.59%	6.30%	0.93	0.54	0.27	15.787%	15.787%	14.06%	14.06%	7.84%	1.00%	7.30%	3.35%	6.47%
Absa Group Limited	ASA:SJ	28.00%	72.00%	3.80%	4.04%	7.84%	9.34%	9.79%	17.18%	1.64	0.62	0.38	0.81%	0.74%	6.30%	0.72	0.33	0.12	14.453%	14.453%	13.16%	13.16%	7.84%	1.65%	7.95%	4.14%	6.52%
FirstRand Bank Limited	FSR:SJ	28.00%	72.00%	3.80%	4.04%	7.84%	9.34%	15.12%	17.18%	0.21	0.18	0.82	0.81%	0.81%	6.30%	1.04	0.90	0.74	18.075%	18.075%	17.07%	17.07%	7.84%	0.69%	6.99%	1.57%	6.75%

Source: Compiled by the author.