“The Rise and Fall of Credit Default Swaps: An empirical investigation of global banks and non-bank financial institutions”

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Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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2013
Abstract

“Capitalism earns its keep through Adam Smith’s famous paradox of the invisible hand: self-interest, operating through markets, leads to the common good. Yet the paradox of self-interest breaks down when stretched too far. This is our global predicament today. Self-interest promotes competition, the division of labor, and innovation, but fails to support the common good...”

Prof. Jeremy Sachs
Director of the Earth Institute at Columbia University
In “Self-interest, without morals, leads to capitalism’s self-destruction”
Financial Times, 18 January 2012

The phenomenal growth in the credit default swap (CDS) market in the lead-up to the global financial crisis (GFC) has received much attention from academics, analysts, policymakers and the public. Many researchers and practitioners believe that credit derivatives exacerbated, if not contributed to, the GFC. The CDS market that grew to US$62 trillion (ISDA 2010a) in terms of the notional value outstanding came to a near total collapse during and after the GFC. This thesis presents a contribution to knowledge by examining the possible reasons for this “rise and fall”. Its purpose is to identify the main factor(s) that contributed to the growth and the eventual collapse of the CDS market, within the frameworks of Positive Accounting Theory and Agency Theory that highlight the role of managerial self-interest and its contribution to the excessive risk taking in institutions.

Managerial risk taking is a well-researched area in the literature. However, the focus in the literature is on managerial compensation structures and related implications on risk taking. Studies related to the implications of managerial risk taking on the growth and the collapse of the CDS market are scarce. This study develops a conceptual model which proposes that managers are driven by self-interest and, as such, would have incentives to increase risk taking which in turn could have contributed to the rise and fall of the CDS market.

The theoretical framework presents several arguments that highlight the potential incentives for risk taking in financial institutions. Firstly, agency theory argues that in corporations, due to the separation of ownership and control, agents tend to pursue their own interests rather than those of shareholders. However, in highly levered financial institutions, agents have higher incentives to take on more risk as the penalties of holding
large amounts of debt will be accrued to debtholders in the event of failure, while at the same time capturing profits by shareholders when the projects succeed. Secondly, financial institutions such as banks are perceived as being “too big to fail” (i.e. central banks would rescue them, due to fear of possible contagion effects on financial markets), and regulatory policies such as deposit insurance schemes and “lender of last resort” policies which will eventually ‘bail out’ banks irrespective of the level of risk taking. This study posits that such policies and perceptions encourage risk taking by managers in financial institutions. This is further exacerbated by “moral hazards” and the lack of monitoring on the part of depositors. Thirdly, the use of credit risk transfer products such as credit derivatives further increase risk taking in financial institutions, irrespective of whether they are used for hedging or speculative purposes. When managers are purely driven by self-interest and are not concerned with what is considered to be morally acceptable behaviour in businesses, the use of such products can increase risk. The risk transfer characteristics these instruments mean that lenders need not be concerned with the riskiness of the borrowers as the risk can be transferred to a third party. Additionally, the high fee income and trading income provided through the speculative activities of credit default swaps, although risky, can encourage managers to use these instruments to further their own interests rather than those of other stakeholders.

This explanatory, quantitative study explores whether variables such as a financial institution’s credit rating, returns volatility, size and profitability measures have an impact on managerial risk taking in 319 global financial institutions (bank and non-bank financial institutions). For the purposes of analysing the data, an advanced econometric model is used, a one-step system Generalised Methods of Moments (GMM). With CDS spreads being used as a proxy for managerial risk taking (i.e. a CDS spread is the premium/price of a CDS contract), the results indicate that credit ratings and returns volatility have a positive relationship with managerial risk taking, while profitability measures appeared to have a negative influence. This suggests that a financial institution’s exposure to an overall higher level of credit risk and higher volatility in equity would indicate higher level of risk taking by managers.

The findings of this study could potentially have many policy implications. The results indicate that managerial risk taking is one plausible reason for the CDS market’s rise and fall. As CDS spreads were used as a proxy for managerial risk taking, there is considerable
potential to use CDS spreads as a tool in exploring managerial risk taking. As such, financial regulators can monitor risk taking activity through the CDS spreads of a bank. This can help prudential regulators to monitor risk taking without unduly constraining it. Further, by analysing the incentives for risk taking in financial institutions, capital allocation in financial institutions can be addressed efficiently.
Dedication

This thesis is dedicated to my parents Ganjali and Edgar Dias with much appreciation for their love, kindness, unconditional support and the sacrifices they have made to support my education. Their encouragement in everything I do has been a constant source of inspiration to me.
Acknowledgements

The pages of this thesis hold far more than the conclusion of years of study. These pages also reflect the relationships with many generous and inspiring people I have met since the beginning my PhD study.

The list is long, but I cherish each contribution to my development as a scholar. Firstly, I would like to thank my supervisor, Dr. Nicholas Mroczkowski for his support throughout the journey of my PhD. I am very grateful for his feedback and critical comments. I am also grateful to Professor Brendan O'Connell from RMIT University for his guidance and direction in choosing this topic for my PhD.

It’s my fortune to gratefully acknowledge the support of my colleague and friend Julie Gerstman. Words fail to express my appreciation for her invaluable support, kindness, encouragement and advice which has given me a lot of strength in particular, during difficult times and I am extremely grateful for her support and generosity. I also wish to extend my gratitude to Carol Barry for her support and encouragement in many occasions.

I would like to acknowledge the financial support provided by Associate Professor Irene Tempone and the Faculty of Business and Enterprise to purchase CDS spreads database that was used in this study. Thanks to Dr. Mary Dunkley for reviewing my PhD despite her busy schedule. I also wish to express my sincere thanks to Mr. David Hudson for proofreading my thesis.

I take this opportunity to sincerely acknowledge the School of Actuarial studies and Applied Statistics, Australian National University for the accounting and market data provided, without which this thesis could not have been completed. I am extremely grateful for their support.

I would also like to acknowledge the financial support of the Faculty of Business and Enterprise, particularly the award of the PhD scholarship (Chancellors Postgraduate Research Award) that provided the necessary financial support to conduct this PhD.

I am most grateful to my friend Letchumy for assisting me in obtaining relevant technical support in working with specialist software and econometric modelling. My utmost gratitude to Mr. John Stapleton and Dr. Gary Deng from the Econometrics and Business Statistics Department of the Faculty of Business and Economics of Monash University, for
their support and guidance provided in the advanced econometric modelling techniques used in this thesis. I am also thankful to Dr. Jahar Bhowmik for his comments on my statistical analysis.

In particular, my heartfelt thanks to my Aunt in Melbourne who has been extremely supportive to me in every way, throughout the journey of my PhD.

I would like to extend a profound thank you to Faraz Bidar, for his support and motivation during this time.

Last, but by no means least, my utmost gratitude to my parents and my sister for their unconditional love, support and encouragement throughout this journey and my entire stay in Melbourne, Australia.
Declaration

I, Roshanthi Dias declare that the thesis:

• Contains no material which has been accepted for the award to the candidate of any other degree or diploma, except where due reference is made in the text of the examinable outcome;

• To the best of my knowledge contains no material previously published or written by another person except where due reference is made in the text of the examinable outcome; and

• Where the work is based on joint research or publications, discloses the relative contributions of the respective workers or authors.

Signature: Date:
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<td>Australian Prudential Regulation Authority</td>
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<td>CDO</td>
<td>Collateralised Debt Obligation</td>
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<td>CDS</td>
<td>Credit Default Swap</td>
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<td>CLO</td>
<td>Collateralised Loan Obligation</td>
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<td>CRT</td>
<td>Credit Risk Transfer</td>
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<td>FE</td>
<td>Fixed Effects</td>
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<td>GFC</td>
<td>Global Financial Crisis</td>
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<td>GMM</td>
<td>Generalised Methods of Moments</td>
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<td>ISDA</td>
<td>International Swaps and Derivatives</td>
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<td>OLS</td>
<td>Ordinary Least Squares</td>
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<td>OTC</td>
<td>Over the counter</td>
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<td>RE</td>
<td>Random Effects</td>
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<td>Return on Assets</td>
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CHAPTER 1
INTRODUCTION

1.1 Introduction

“We conclude that over-the-counter derivatives (credit default swaps) contributed significantly to this crisis”


The growth in the credit default swap (CDS) market has drawn much attention to the riskiness of these instruments and managerial risk taking by financial institutions since the global financial crisis (GFC). This growth is a prominent feature in recent CDS literature as well as in the literature that discusses the potential causes of the GFC. Yet, the empirical literature that discusses the motivations behind the massive growth in the CDS market and the market’s eventual collapse, is limited. This thesis adds to the existing body of literature and provides a particular perspective on the relationship that exists between managerial risk taking and managerial self-interest. It is posited that this relationship could provide a plausible explanation for the rise and fall of the CDS market. This research also provides evidence suggesting that certain factors (for example, firm credit rating, returns volatility, and profitability) are known to influence managerial risk taking in financial institutions, which in turn could help determine the growth and the eventual collapse of the CDS markets.

The purpose of this research is to investigate the possible motivations for the use of CDS by financial institutions, and given this context, the following major issues are examined in this study: the rationale for the exponential growth of CDS’s up until the GFC, and the causes for their eventual collapse of the CDS market during this crisis. The investigation is primarily undertaken within a global context. What follows in this Chapter, is firstly a brief explanation of CDS instruments, followed by a discussion on the motivation and background of this study, and its significance, the objectives of the study the design and outcomes of the study and finally the structure and organisation of the entire thesis.
1.2. Credit derivatives

Credit derivatives are credit risk transfer (CRT) instruments which are designed to hedge credit risk, that is, risk of a counterparty to a transaction defaulting on their obligation (Viney 2009). The value of these financial instruments is derived from the value of the underlying asset, and therefore is dependent on the credit quality of the underlying asset (Duffee and Zhou 2001). The most common form of credit derivatives is a credit default swap (hereafter, CDS). The use of CDS to hedge credit risk is similar to the concept of insurance, specifically related to hedging, where there is a protection buyer (the insured) and a protection seller (the insurer). The protection buyer (a bank that extends a loan) seeks to insure an asset against a possible default by the borrower. The protection seller agrees to provide insurance for a fee (Lancaster et al. 2008). A more detailed explanation of the workings and the related more complex CDS products are explained in the following chapter.

1.3 Motivation and background

The issue of risk within the banking industry world-wide, principally credit risk, has become significant in recent times, particularly since mid-2007; (Brunnermeier 2008; Petrova 2009; Van Duyn et al. 2008). Given the extensive coverage in the press regarding the use CDS during the GFC, arguably, many analysts were becoming sceptical of the advantages of credit risk transfer (CRT) mechanisms used by both bank and non-bank financial institutions. The past two decades have seen a dramatic increase in the use of CRT instruments, particularly CDS, as part of credit risk management of financial institutions (ISDA 2008). These new instruments of risk dispersion have enabled the largest and most sophisticated banks in their primary role of lending to divest themselves from this credit risk, deflecting it to institutions that are far less leveraged (Greenspan 2004).

The riskiness of banks and non-bank financial institutions, particularly arising from CDS, has become an important issue given the recent rise in the bank failures due to the GFC. Much attention has been focused on the so-called “weapons of mass destruction” (CDS) and their contribution to one of history’s worst financial/economic crises. Many academics, policy makers and analysts (see for eg: Dickinson 2008; Heyde and Neyer 2010; Jorion and
Zhang 2007) claim that these instruments certainly exacerbated the GFC as these derivatives contracts created the potential for relatively few market participants to destabilise the entire economic system. Nevertheless, the growth in the CDS market was phenomenal in both size and diversity since its inception in the early 2000s until the GFC. According to a survey by International Swaps and Derivatives Association (2010a), the total gross notional amount outstanding of CDS contracts reached a peak of $62 trillion by the end of 2007. However, the market for CDS collapsed with the onset of the GFC. Against this background, this thesis examines the potential causes for the dramatic increase in the CDS market and its eventual decline. The focus of the thesis is the global finance industry (particularly the global banking and shadow banking industries) and the factors attributable to the dramatic rise and fall in the use of CDS during the period surrounding the GFC.

The Financial Crisis Inquiry Commission concluded in their report (FCIC 2011) that over-the-counter (OTC) derivatives contributed significantly to the GFC. Like all derivatives, credit derivatives are used to hedge against, or speculate on, changes in prices, rates, indices or events such as the potential defaults of debt. However, due to lack of regulatory oversight, OTC derivatives and particularly credit derivatives spiralled out of control (FCIC 2011). The FCIC (2011) identified the reasons behind this growth as uncontrolled leverage; lack of transparency, insufficient capital and collateral requirements; speculation; contagion due to interconnections among institutions; and an imbalance in the concentrations of risk in the market. Moreover, the link between the CDS market and the securitisation market (i.e. synthetic securitisation)1 exacerbated the effects on losses. Given these specific circumstances, the creation of synthetic CDOs (collateralised debt obligations2) was critical in the growth of CDS that fuelled the mortgage securitisation pipeline. Although CDOs were designed to hedge against the decline in value of mortgage-related securities that are backed by risky loans, they were merely used as bets on the performance of real mortgage related securities. This amplified the losses from the collapse of the housing bubble in the US by allowing multiple bets on the same securities, which in turn spread to the entire global financial system. With the collapse of Lehman Brothers, trading of OTC markets for

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1 Synthetic securitisation is a form of securitisation where short positions of CDSs that have an exposure to the credit risk of the underlying asset are used as the underlying portfolio instead of the actual asset (see chapter 2 for a detailed explanation).
2 CDO is a product of securitisation.
derivatives came to a near total collapse; in certain cases there was no market at all (Markose et al. 2009). Therefore, with the absence of a derivatives market, risk management strategies of financial institutions also became difficult.

The soundness and the strength of financial systems are essential to a well-functioning economy, providing the backbone to the functions of the economy. Thus the sustained well-being of the financial system largely depends on the stability of financial institutions. To this end, accountability and ethics is important to a great extent in ensuring prudent risk taking that leads to the solvency of the institutions and therefore protects the interests of all stakeholders. One of the most important reasons behind excessive risk taking by financial institutions can be attributed to managers engaged in the trading of instruments such as CDS, mortgage backed securities, collateralised debt obligations (CDOs), CDO squared and synthetic CDOs, their involvement in the processes that created these securities was quite low. In other words, managers of financial institutions had lower stakes, thus less to lose (FCIC 2011). With CRT instruments of this nature, managers could always transfer credit risk to third parties with less difficulty. As such managers were not concerned about the riskiness of the underlying assets that formed the very foundation that these instruments, and thus derived its value. On the contrary, the heavy profits and fee income generated by trading these instruments (Yu 2006) and the smaller commitment required by managers provided a further incentive to increase exposure to these products.

The phenomenal growth of the CDS market raises the question of what motivates firms to engage in the trading of credit derivatives. The massive growth was unprecedented and in 2007 the CDS market grew far higher than the global GDP (World Bank 2010). In order for the CDS market to be higher than the global GDP there would have to be significant motivations for firms to participate in the CDS market. Such growth certainly deserves regulatory attention with the purpose of identifying the risks that financial firms are exposed to with the use of credit derivatives. Although single name CDS have been proved to be quite popular instruments among credit derivatives, index CDS have been a major source of growth since 2004. Index CDS are CDS instruments where the underlying reference entity is an index with many entities. Prior to the GFC, CDS markets had grown in size but also in diversity, i.e. the availability of the number of different CDS products. Their largest sector by product type in the credit derivatives market is CDS (ISDA 2010a;
An important development of the market was that although initially banks were the main participants, primarily for the purpose of hedging credit risks, there was an increase in hedge funds and insurance companies that participated in the CDS market (Mengle 2007). In particular, the CDS market has expanded into securitisation (as discussed previously) such as CDOs mostly referenced to mortgage-based underlying assets. This also meant that the secondary market for CDS based products grew rapidly where speculative investors, hedge funds and insurance companies would buy and sell credit protection (CDS) with no direct relationship to the underlying reference entity (Morrissey 2008). As such, trading of CDS was more of a gambling strategy that bets on a bankruptcy or failure of an underlying reference entity that investors had no ownership.

Due to the importance of the CDS market in the GFC, there have been an increasing number of recent studies, (for e.g. Beyhaghi and Massoud 2011; Heyde and Neyer 2010; Tang and Yan 2010a), that adds to earlier studies by Longstaff et al. (2005), Instefjord (2005), Minton et al. (2005) and Blanco et al. (2005). However, due to the limited data availability there has not been much early empirical literature. Such literature has mainly focused on the determinants of CDS spreads and their role in forecasting rating events (for eg: Cossin and Hricko 2001; Hull et al. 2004). However, this is less understood as there is a paucity of systematic analysis of the reasons behind the phenomenal growth in the CDS market.

The collapse of the CDS market with the onset of the GFC highlighted many problems as predicted within agency theory, for example, relationships between managers and other stakeholders of financial firms. Blundell-Wignall et al. (2009a) state that together, the agents failed the principals by creating incentives that led to excessive risk taking. The incentives for excessive risk taking that maximises private benefits while not bearing the consequences of such decisions may have been a contributing factor to the GFC. Agency problems arise due to the separation of ownership and management. Berle and Means (1932) originally discussed the separation of ownership and control in a modern firm. It is clear that this separation of ownership has implications for the risk taking behaviour of individuals in firms, thus leading to the development of modern risk taking research. As Jensen and Meckling (Jensen and Meckling 1976) note, this separation of ownership gives rise to conflicts of interest between different stakeholders of a firm, primarily assumed to
be due to managers wanting to pursue their own self-interest. By and large, all stakeholders are assumed to be self-interested and therefore likely to pursue their own interests in a way that is detrimental to others.

The banking literature has emphasised a number of agency problems and their relationship to risk taking (for eg: Blundell-Wignall et al. 2009a; Eisenbeis 2004; Nguyen et al. 2009; Pagano 2001). Jenson and Meckling (1976) described the agency relationship as a contract under which the principal engages another party (the agent) to perform activities/services on their principal. As the principal and agent are both utility maximisers, the agent will not necessarily act in the principal’s best interest. This agency problem arises due to the problem of inducing the agent to maximise the welfare of the principal.

Agency theory provides a theoretical base for explaining why companies engage in risk taking activities. In addition, when considering highly levered financial institutions, the theory argues that managers are more likely to take excessive risk due to risk transfer to debtholders (Jensen and Meckling 1976). Demsetz et al. (1997) identify that, as in non-financial corporations, a bank as a limited liability company gives its shareholders an incentive to extract wealth from bondholders by increasing risk. There is a problem of ‘moral hazard’ associated with banks due to deposit insurance and central banks acting as a lender of last resort. In this situation, as the principals (particularly depositors) are protected from the consequences of risk taking, their incentive to monitor and constrain the bank’s behaviour becomes less. In this case a second agency problem arises due to the limits on managerial wealth that force a separation between ownership and control. The moral hazard and owner/manager agency problems are by no means mutually exclusive in banking. This study has found that the relationship between ownership structure and risk of a bank is more significant in those that have a lower franchise value. In essence, the literature also identifies the use of CDS and the increased incentives for risk taking with the use of such instruments for hedging or trading purposes (Stulz 2010).

Positive accounting theory also supports the debate on managerial risk taking in that it explains the notion of managers furthering their own self-interest. Positive accounting theory as originally developed by Watts and Zimmerman (1978) is based on the assumption that agents or managers are rational individuals who are concerned with furthering their
own interest. Along these lines Holthausen (1990) identifies three overlapping perspectives in accounting choice, one of which is opportunistic behaviour by managers. In such a setting, managers are assumed to maximise their own wealth, which is related to performance related cash bonuses, the risk of employment (which arises from the possibility of bankruptcy or a takeover) and the value of the firm’s shares. Highly profitable CDS may motivate excessive risk taking by managers due to the opportunities to increase compensation for themselves.

This study particularly draws upon agency theory and positive accounting theory as the primary supporting theoretical frameworks, based on the fundamental assumption of managerial self-interest. While theories relating to risk and risk taking are not new themes in the literature, they have nonetheless attracted considerable interest in academic circles since the GFC (Chen et al. 2006; Demsetz et al. 1997). Despite the importance of CDS markets in the recent financial crisis and a number of studies on credit derivatives, there is little understanding of the possible motivations behind the phenomenal growth of the CDS market. This study endeavours to fill the gap in some way by ascertaining whether the motivations of risk taking have contributed to that market’s rise and fall.

1.4 Contribution of the thesis

1.4.1 Theoretical significance

The GFC highlighted the issue of risk management and risk taking in financial institution’s and many academics and practitioners have acknowledged the importance of the role which CRT instruments played in contributing to, if not exacerbating, the crisis (Stulz 2010). CDS markets have grown phenomenally (ISDA 2010a) since initial trading began in the early 2000s. However, these markets came to a near total collapse during the GFC. Despite the recognition in research of the risks in CDS (Instefjord 2005) and the risk taking incentives of managers or agents in financial institutions, especially in banks (Demsetz et al. 1997), there still remains the question of why CDS markets grew exponentially in less than a decade and what motivated individuals involved in this excessive trading.

Although the empirical literature on CDS was relatively sparse prior to 2000, the past decade has seen a significant increase in research in this area (Byström 2005; Instefjord
The literature appears to have accelerated as a consequence of the GFC, with most new studies tending to focus on the perils of credit derivatives and their effect on financial markets (for eg: Karras 2009; Neyer and Heyde 2008; Shadab 2009; Shiren et al. 2009; Stulz 2010; Weithers 2007).

CRT literature related to CDS concentrates on three broad areas. The first area concerns pricing considerations and as a result the determinants of CDS spreads (i.e. price of a CDS contract) employing reduced form and structural models, with particular emphasis on understanding what variables would determine the credit risk characteristics of a CDS (for eg: Batten and Hogan 2002; Bomfim 2005; Ericsson et al. 2009; JP Morgan 2006). Blanco et al. (2005) contend that CDS premia better reflect the credit quality of the underlying asset as compared to bond spreads. This could mean that understanding the theoretical determinants of CDS spreads would provide a better comprehension of pricing these instruments and the opportunity to take better advantage of trading opportunities.

Although research is limited mostly due to the CDS market only gaining in size since the early 2000s, determinants of CDS spreads and their use as a proxy for risk of a firm has been highlighted in recent literature (Chiaramonte and Casu 2010). Loosely following the strand of literature on structural models that investigate the determinants of CDS spreads, the literature on CDS spreads as a proxy for firm risk have used many different explanatory variables and types of samples. In particular, Bolton et al. (2010) find that they are a good proxy for managerial risk taking in financial firms. This is an important development and discussion that has motivated a link between managerial risk taking and CDS spreads in this thesis which also is an innovation available as a policy instrument.

This study also draws on the managerial risk taking literature, specifically bank risk taking, that focuses on the separation of ownership and control and its resultant implication of excessive risk taking, especially of highly levered financial firms (Boyd and De Nicolò 2005; Chen and Steiner 1999; Demsetz et al. 1997). Among several other papers, Jensen and Meckling (1976) have highlighted the risk shifting problem by managers in levered firms that are only compensated with equity. Bolton et al. (2010) also highlight how optimal risk taking will not be employed by shareholders, mainly due to them suffering from a commitment problem due to naïve debtholders, renegotiating of compensation contracts and deposit insurance schemes. One of the important contributions of this thesis to the
related literature is within an agency theoretic framework, the link between managerial risk taking and CDS spreads in highly leveraged global financial institutions using a particular set of explanatory variables.

The second category focuses on the risks in using credit derivatives, that is, in CDS per se and CDS markets in general, which lead to systemic effects (contagion) across economies. Special emphasis is placed on systemic, counterparty and liquidity risks in CDS markets, particularly witnessed in the GFC (for eg: Duffee and Zhou 2001; Morrison 2005; Neyer and Heyde 2008; Rule 2001; Stulz 2010; Stulz 2004; Weithers 2007). Systemic risk is one of the most important risks that need attention in relationship to CDS use. Both parties to a transaction are exposed to credit risk derived by the counterparty (i.e. counterparty risk) which reflects the potential for a counterparty to a transaction failing to meet its obligation. However, the structural features of the CDS market, such as majority of the CDS market being concentrated among a small group of dealers, the interconnectedness of the dealer market, increased sellers of protection and the lower levels of liquidity with the advent of the GFC, have led to a transformation of counterparty risk to systemic risk (ECB 2009). In essence, among other risks of CDS, systemic risks related to trading CDS provides an important argument for the regulation of the CDS market. This also provides an argument for the use of firm size as an indicator of the level of contribution to systemic risk.

The third category of literature discusses the regulatory implications of CDS, focusing on regulatory arbitrage and the regulatory treatment for capital adequacy, particularly in relationship to international banking regulations (Basel Committee 2005a; Buch and DeLong 2008; Cannata and Quagliariello 2009). However, it should be noted that CDS have been increasingly traded by non-bank financial institutions such as hedge funds and insurance companies which, as compared to regulated institutions, do not need to maintain regulatory capital. This also raises the question of the level of managerial risk taking in non-bank financial institutions.

Drawing from these three categories of literature, this thesis focuses on the issues of managerial risk taking in financial institutions as distinct from non-financial firms and the link between risk taking and CDS markets, thus identifying the potential reasons for the rise and fall of the CDS market. None of the categories above focused on the motivations
for the increased usage of CDSs by financial institutions and the reasons for the CDS markets eventual downturn during the GFC. In addition, there appears to be no evidence related to effects of managerial risk taking and its relevance the growth of the CDS market. Further, this area has not been examined through the theoretical frameworks of agency theory (Jensen and Meckling 1976) and positive accounting theory (Watts and Zimmerman 1978) that highlight the possibility of managerial risk taking due to the assumption of self-interested managers. At the time of writing this thesis, these issues also do not appear to have been examined empirically in a global context and hence this study aims to further develop an understanding of the way in which credit derivatives impact on the risk taking practices of financial institutions.

1.4.2 Practical Significance

This thesis potentially has many practical implications for financial institutions and in particular for regulators and policy makers. First, understanding the determinants of CDS spreads could provide a better understanding of some of the main constituents of managerial risk taking as this thesis provides a tool for the exploration of managerial risk taking (i.e. CDS spreads). The findings in the study confirms existing research that portrays CDS spreads as indicators of risk taking in firms (Bolton et al. 2010). Firms and regulators can use CDS spreads as an indicator of the level of risk and risk taking in highly levered financial institutions. If CDS spreads are indicative of managerial risk taking, then policy makers such as the Australian Prudential Regulation Authority (APRA) could monitor risk taking activities of financial institutions along with credit ratings, equity returns and equity volatility as indicated in this thesis. Second, this study demonstrates that highly levered financial firms are prone to excessive risk taking, due to depositor protection schemes, naïve debt holders and through aligning interests of managers and shareholders through incentive structures. This could mean that corporate governance and regulatory mechanisms need to be improved in order to link the manager’s interest with the interests of all stakeholders. Regulatory and structural distortions can create risk taking opportunities for banks. Due to their excessive public exposure, this alignment of interests between managers and all stakeholders should be more pronounced, as a failure of a bank can have substantial repercussions for the real economy.
Third, this study also highlights the importance of non-bank financial institutions in their role in CDS markets. Due to the lack of regulatory restrictions in the level of risk taking of institutions such as insurance companies and hedge funds, these had a crucial role in contributing to the GFC. In essence, this confirms the necessity of regulatory restrictions on such institutions in the extent of risk taking through the trading of CDS. It is important for regulators to demand more accountability from their managers, given that such firms are drivers of financial innovation and engaged in the trading of complex CDS products.

Fourth, the complexity of the CDS products used in this market and the counterparty risk that transforms into systemic risk have many implications for policy makers and thus confirm the necessity of standardisation of these products.

Finally and most importantly, this thesis pays significant attention to the size of the CDS market which grew from almost nothing in the early 2000s to as high as $62 trillion in 2007 (ISDA 2010a), being far higher than the global GDP at the time, and thus draws awareness of regulators and policy makers to the need for investigation into the causes behind such an exponential growth. An investigation of the inadequacies and malpractices of the participants in CDS markets could have greatly reduces the consequences of the GFC.

1.5 Research questions and objectives of the thesis

The primary objective of this thesis is to investigate the reasons behind the phenomenal growth of the CDS market and its eventual collapse within the context of the GFC. In essence we examine whether managerial risk taking has contributed to this rise and fall. Using panel data from global financial institutions, the link between indicators of CDS spreads (prices of CDS contracts) and its relationship to managerial risk taking is empirically examined. Using the theoretical framework of agency theory and positive accounting theory, this thesis investigates the link between the indicators of managerial risk taking proxied by CDS spreads and its relevance as a reason for the exponential growth and the eventual collapse of the CDS market.

In order to provide the theoretical underpinning for the issues discussed, a review of the literature on this debate is presented.
The following research questions and hypotheses ensue from this review:

I. Why did the CDS market increase in popularity up until the GFC?
II. Why did the CDS market almost completely collapse during and after the GFC?

In addressing these issues it is assumed that the finance industry constitutes the major player in CDS markets and thus has a critical role in their rise and fall. Another reason for the particular focus on the global finance industry is the extent of contagion and the resultant systemic risk which is far more pronounced in the finance industry due to the level of interconnectedness of the international financial markets.

Given these assumptions, the following hypotheses were developed in order to answer the research questions:

- $H_1$: There is a negative relationship between CDS spreads and the credit rating of an entity;
- $H_2$: There is a positive relationship between size of the entity and its CDS spread;
- $H_3$: There is a negative relationship between ROE and CDS spreads;
- $H_4$: There is a negative relationship between ROA and CDS spreads;
- $H_5$: There is a negative relationship between equity returns and CDS spreads;
- $H_6$: There is a positive relationship between CDS price and the underlying reference entity’s equity volatility.

The research questions are analysed using these hypotheses as follows.

First, a set of determinants of CDS spreads (i.e. price of a CDS contract) is introduced which are widely used as indicators CDS spreads, thus managerial risk taking. Three aspects of managerial risk taking in financial institutions are highlighted through the literature: profitability, firm risk and firm size, and are used to develop the hypotheses. Second, empirical investigation into the relationship between these variables and managerial risk taking, proxied by CDS spreads, is undertaken. The objective is to identify the potential factors that may contribute to managerial risk taking. More specifically this is modelled by panel data estimators such as fixed effects (FE), random effects (RE) and generalised methods of moments (GMM). Third, within the theoretical framework that was developed, the link between managerial risk taking and the growth and the collapse of the CDS market is discussed. It is argued that managerial self-interest that forms the foundation of agency theory and positive accounting theory has resulted in the excessive risk taking in financial
institutions that are highly leveraged as compared to non-financial firms, which is indicated through the variables indicated in the hypotheses and thus could have led to the rise and fall the CDS market.

1.6 Overview of the research design

This research uses a post-positivistic approach as a research paradigm due to the objective and subjective natures of risk (Ben-Ari and Or-Chen 2009). In this framework the meaning of risk is in technical and non-technical contexts, hence the definitions of such contexts can reflect an inherent distinction that the term probability could imply subjective possibilities. Within this framework a quantitative approach is used, with cross-sectional and time series data obtained from secondary sources. Data from several sources and databases are collected and panel data methodology (i.e. panel data regressions incorporate cross-section and time series data) is adopted, due to its important characteristics that can improve the estimations, for instance, controlling for individual heterogeneity, reducing problems of multicollinearity, reducing the estimation bias, and more importantly in this research capturing the dynamic relationships between independent and dependent variables (Baltagi 1995; Hsiao 2003).

In this research the quantitative panel data methodology was chosen in order to examine the relationships that exist between profitability, firm risk and firm size and credit CDS that is used as a proxy for managerial risk taking. A secondary database of CDS spreads were obtained from the Markit Group and other accounting and market variables were obtained from DataStream. The data were analysed using econometric methods, specifically using the statistical software STATA which is an integrated statistical package for data analysis, data management and graphics. This study uses an unbalanced panel mainly due to the data availability problems, however, the econometric analysis performed is not affected by the unbalanced panel as these methods can account for unbalanced panels with appropriate adjustments. Finally, the research hypotheses were tested using the above mentioned method and integrated with the theoretical framework in order to provide meaningful results.
1.7 Structure and organisation of the thesis

As discussed, the main objective of this thesis is to conduct an empirical examination into the rise and fall of the CDS market within the context of the GFC, examining global financial institutions across 33 countries. This thesis is structured as follow.

Chapter 2 provides the contextual background. Specifically, it introduces the reader to the necessary background and context within which this study is based. The first part of this chapter outlines the background and the rationale for this research. Then, the definition of risk and the concepts of risk management and risk taking are discussed. Risk management procedures are detailed while placing importance on controlling risk at the risk taking level. This chapter also discusses the CRT mechanisms that are available in general and with specific discussion on the benefits and drawbacks of their use. Emphasis is also placed on their contribution to the global GFC. Then credit derivatives in general and CDS, in particular are explained in detail. As it is important to understand the mechanism of these instruments, emphasis is placed on the workings and pricing and valuation considerations of CDS. Later, complex CDS products such as N-th to default CDS and synthetic CDOs are discussed as these are identified as a significant contributor to the growing CDS market. A detailed discussion of the perils and the benefits of synthetic securitisation is provided, due to the significant growth in this market and due to synthetic CDOs being a catalyst for predatory lending and excessive risk taking by financial institutions. Finally, regulatory concerns in relation to the banking industry and the implications of these regulations for the GFC are examined with a view to understanding the regulatory atmosphere within which major players of CDS markets, such as banks, operated.

Chapter 3 provides the theoretical justification for the undertaking this study. A large body of literature in CDS relate to the debate on the determinants of CDS prices. Another strand of the literature discusses the tendencies of managerial risk taking in highly leveraged financial institutions. This managerial risk taking is further explored through the theoretical framework of agency theory and positive accounting theory which highlights that managerial self-interest can cause excessive risk taking in financial institutions for a number of reasons. These reasons being the naïve debtholders, regulatory policies such as “too-big-to-fail” and in particular the use of credit derivatives such as CDS. This chapter primarily considers the debate on the determinants of CDS spreads that relates to managerial risk
Chapter 4 provides a detailed discussion of the development of the hypotheses. Based on the theoretical underpinnings that were discussed in Chapter 3, six hypotheses are developed. The main determinants of CDS spreads related to this study are identified as profitability measure, firm risk indicators and firm size indicators. Using the theoretical framework mentioned previously, this section argues the appropriateness of these variables and their relation to CDS spreads and thus managerial risk taking. The particular accounting and market variables (independent variables) that are identified are ROA, ROE, equity returns, returns volatility, credit ratings and total assets. CDS spreads are used as the dependent variable and following Bolton et al. (2010), are assumed to be an indicator of managerial risk taking. This section also identifies the need for a lagged dependent variable in order to capture the dynamic nature of CDS spreads.

Chapter 5 outlines the research design and methodology. This study adopts a quantitative methodology based on cross-sectional and time series data. Quantitatively rigorous econometric analysis (a panel data methodology) is used to test the hypotheses that form the basis for answering the research questions. The chapter provides an explanation of the specific estimation models used, namely, pooled ordinary least squares (OLS), fixed effects model (FE), random effects mode (RE) and dynamic panel models such as generalised methods of moments (GMM): one step system GMM and two step system GMM models in order to obtain the model that best fits the data used. The importance of regression diagnostics in the choice of the appropriate model is also identified. Due to the presence of a lagged dependent variable, the need for a dynamic model is emphasised, hence the choice of a GMM technique is justified. This chapter also operationalises the variables and explains the software application STATA used in the econometric analysis.
Chapter 6 presents a preliminary analysis of the descriptive statistics of this study. The raw data is explained and a preliminary univariate analysis is undertaken. The statistics that are explained include the mean, median, standard deviation, skewness and kurtosis, for the dependent as well as independent variables. The minimum and maximums and the total number of observations are analysed in order to provide a feel for the description of the data. This chapter also includes a categorisation of the countries which forms the data as well as the classification of bank vs. non-bank financial institutions.

Chapter 7 analyses the relationship between the market and accounting variables and CDS spreads using an econometric analysis. It specifically discusses the econometric issues dealt with in the analysis such as non-stationarity and the dynamic panel bias, and addition tests for normality, linearity and heteroskedasticity are also conducted and results are discussed. The chapter includes a comprehensive analysis of all the models previously mentioned, and with results examined in detail.

Chapter 8 presents a discussion of the thesis’ findings and conclusion. It provides answers to the research questions and discusses the research hypotheses and associate findings that support the relationship between profitability, firm risk and firm size variables and CDS spreads. Finally, the theoretical and practical contributions, limitations of the study and recommendations for future research are provided.

Figure 1.1 presents an outline of this research.
Figure 1.1 Outline of the Study

Chapter 1: Introduction

Chapter 2: Contextual Background

Chapter 3: Credit Default Swaps and the Existing Views on Credit Risk Transfer: A Review of the Literature

Chapter 4: Development of Hypotheses

Chapter 5: Research Methodology

Chapter 6: Descriptive Statistics

Chapter 7: Data analysis and Results

Chapter 8: Findings and Conclusion
CHAPTER 2
THE CONTEXTUAL BACKGROUND

2.1 Introduction

“In our view, however, (credit) derivatives are financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal”

Warren E. Buffett
Chairman, Berkshire Hathaway Inc.
Annual Report 2002

The global financial crisis\(^3\) (GFC) has made us think harder about whether this statement by Warren Buffett is indeed true today. Credit risk transfer (CRT) grew rapidly over the years up until the GFC, with complex products bringing many benefits to financial institutions world-wide and the global financial system. However, many articles in the financial press and academia state that both banks and non-bank financial institutions should re-examine their risk management strategies, given the collapse and the near total collapse of prominent financial institutions around the world (e.g. Brown and Davis 2010; Davis 2010; The Economist 2009).

This study examines the market for a particular type of CRT instrument, namely, credit default swaps (CDS) and their related products on risk taking in financial institutions. The growth of the CDS market was phenomenal up until the GFC however, this market came to a near total collapse during the GFC (ISDA 2008). Thus emphasis is placed on its rise and fall and how CDSs have contributed to risk taking in the market. The use of CRT instruments by financial institutions has been growing rapidly, with benefits accruing to the global financial system. CRT has allowed credit risk to be transferred more easily and more widely dispersed across the financial market to those who are willing to bear the credit risk (Basel Committee 2008a). The market turmoil during the GFC can largely be attributed to insufficient understanding of CRT products such as CDSs.

The aim of this chapter is to provide the reader with the necessary background and context within which the study is based. It discusses the rationale of the study, the importance of

\(^3\) Explained in detail later in the chapter.
risk management and the comprehension of risk taking in light of the GFC, CDS and complex CDS products and their workings, and finally the discussion of the global regulatory framework and its relation to the GFC.

2.2 The rationale

Deregulation and globalisation of financial services and the growing sophistication of financial technology have made the activities of banks and their risk profiles more complex. This is largely attributed to commercial banks moving away from the main traditional forms of intermediary activities to off-balance sheet business which generates a fee income (Viney 2009). Viney (2009) further states that the notional value of off-balance sheet business in commercial banks at least in Australia is nearly six times more than the value of the accumulated assets of the banking sector.

The extent of deregulation and globalisation has created much progress in the finance industry, particularly in developed countries. At the same time, this has increased the risks in the system as well as risk taking. The GFC provides tangible evidence of the magnitude of destruction that can rapidly inflict on the international banking industry, through this increased risk and risk taking. CRT mechanisms such as securitisation and the use of credit derivatives which allows credit risk to be more easily transferred and potentially more widely dispersed across financial markets have recently gained immense popularity (Basel Committee 2008a). Some observers suggested that credit derivatives such as CDSs not only contributed to the GFC but to some extent also exacerbated it (Fukao 2008). Nevertheless, the Basel Committee (2008a) has identified deficiencies in these CRT instruments and related risk management practices, disclosure and supervisory approaches.

Although CRT instruments have been present in many financial institutions throughout their history, the attention devoted to managing CRT and its influence on bank risk taking has been heightened in recent years. This is due to several very costly and highly publicised credit events that occurred during the GFC, with Bear Sterns, Lehman Brothers and Merrill Lynch being some the most prominent US investment banks that were among the casualties of the GFC. The Lehman bankruptcy set in train a series of damaging events in the US money market industry worth $3,500 bn, used by financial institutions across the world for their short-term funding needs (Van Duyn et al. 2008). This is considered as one
of the biggest bankruptcy events in the entire history of Wall Street. The insurance giant, American International Group (AIG), was rescued by the US Treasury after they had issued $440 bn in CDSs to hedge defaults on debt (Helleiner and Pagliari 2008).

These events demonstrate the severe impact that credit risks and its related impact would have on a financial institution’s bottom line and ultimately on its solvency. Due to the above financial institutions being large and publicly held, the contagion effect⁴ is even more pronounced (Akhigbe and Madura 2001). The GFC commonly exposed deficiencies in risk management and prudential regulation approaches that rely heavily on mechanical risk management models (Buch and DeLong 2008). The use of CRT mechanisms has exposed financial institutions to many other risks. Therefore importance is placed in identifying where the risks were underestimated with the use of CDSs and how these instruments have created more incentive to increase risk taking by managers.

The GFC has highlighted the importance of proper risk management and the need for financial regulation. The Financial Crisis Inquiry Commission (2011) argue that one of the causes of this crisis was the failure of corporate governance and risk management of many systemically important financial institutions. As a result they have engaged in excessive risk taking with inadequate capital and excessive dependence on short-term funding.

The growth of the CDS market prior to the GFC has been phenomenal. Both the size and the diversity of CDS markets increased dramatically up until the onset of the GFC. The International Swaps and Derivatives Association, has recently stated that the notional amount outstanding of credit derivatives as at end of the crisis was a staggering $62 trillion which was significantly higher than the global GDP (ISDA 2010b; World Bank 2010). However, with the onset of the GFC, the CDS market collapsed. The heightened risk and risk aversion is depicted in Figure 2.1 with a sharp increase in the average CDS spread (price of a CDS contract) in 2007.

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⁴ Contagion effect refers to any transmission of information across banks due to the information being contagious to the other bank in a similar manner (Madura & Akhigbe 2000).
The global credit crunch affected most of the developed countries, but Australian financial institutions were not affected by the subprime crisis to the extent of their American and British counterparts. However, of the spillover effects from the subprime crisis, the run on Northern Rock\(^5\) was by far the most transparent and disturbing for the UK authorities. The prime source of contagion in the UK financial system has come through the international interbank market where banks have proved reluctant to lend to each other even at very low rates, thus highlighting the contagion of the finance industry. This arose due to banks piling up cash to meet their contingent claims of off-balance sheet vehicles as they have found it hard to fund themselves in traditional wholesale markets. This is primarily due to the uncertainty of their solvency, given the exposure to the subprime crisis (Hall 2008). In order to ease liquidity conditions, central banks around the world have injected liquidity

\(^5\) Northern Rock is a commercial bank in the UK.
into the financial system which would limit the potentially far reaching effects on the real economy. This would not only come through the exposure to the mortgage markets, but also threaten solvency for institutions that are over-exposed to wholesale markets as a source of funds.

The contagion risk in the banking/finance industry is much more pronounced than in any other industry. Therefore if one bank fails, others with a similar asset and liability structure may also face a run (Schoenmaker and Group 1996). Research shows that failures of large well-known banks can cause contagion effects, but “too big to fail” perceptions of regulators have limited the large bank failures (Akhigbe and Madura 2001). Nevertheless, in the GFC, this notion has been refuted by allowing Lehman Brothers, one of the world’s largest investment banks, to fail despite its possible contagion effects. This risk of contagion and its effects on the entire financial system and the broader economy has meant that bank and shadow bank regulation is vital for the smooth running of the economy.

Banks in particular have been aware for many years of risks and uncertainties arising from defective information technology and infrastructure, from fraud, from business disruption and legal liability. However, due to the recent credit risk debacles, the extent of integration in markets, and stability, the Bank for International Settlements has placed more emphasis on encouraging the management of risk in a global framework (Caruana 2010). Such a buffer, by acting to prevent banking failure at the individual firm level, simultaneously reduces systemic risk i.e. the risk that the failure of a single institution could create failures elsewhere in the system, due to the interconnectedness of transactions and institutions (Basel Committee 2003). The failure of large financial institutions can freeze certain financial markets, thereby drying up liquidity needed by other market participants. The interconnectedness of the financial system, through the use of CRT instruments, means the financial contagion could be much more pronounced. Hence, it is important to understand motivations for the use of credit derivatives such as CDSs that led to the phenomenal growth in this market and consequently leading to an amplification of risk in the global financial system.

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6 Contagion risk, also referred to as systemic risk, is defined as the risk that financial difficulties at one or more banks spill over to a large number of other banks or the financial system as a whole (Schoenmaker 1996).
2.3 What is risk?

Jorion (2007) defines risk as the “volatility of unexpected outcomes which represent the value of assets, equity or earnings”. While an exposure refers the value at risk, risk (as explained before) relates to an adverse outcome.

Risk is also argued to be relative to the observer and therefore subjective. This means that even in the event of referring to “absolute risk”, it may still end up being another individual’s perceived risk. However, there is also an “objectivist” school of thought which views risk as a probability of an occurrence (Kaplan 1997; Kaplan and Garrick 1981). Nevertheless, Apostolakis (2004) states that qualitative schools of thought disagree with the use of probabilities to measure risk as they cannot be realistically calculated. Kuritzkes and Schuermann (2008) define risk in banking as the earnings volatility, classified into five major categories: market, credit, asset/liability, operational and business risks. They propose that the knowledge of risk differs according to type, for example, more being known about market risk than credit risk, and less being known about non-financial risk than financial risks. They conclude that the bigger the source of risk, the more attention would it demand from the risk managers and the regulators. Therefore, the more known the risk is, the greater would be the ability to manage it. Figure 2.2 summarises the main risks banks are exposed to.

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7 i.e. there are no straightforward statistical methods to calculate “realistic” probabilities.
Figure 2.2 Classification of risk with risk contribution

Figure 2.2 indicates the relative contribution of the different sources of risks in banks. Credit risk is the largest source of risk; hence the greatest source of earnings volatility to a bank. Although this is primarily related to commercial banks that act as financial intermediaries, non-bank financial institutions are also exposed to a significant amount of credit risk due to the nature of their activities. This reflects the level of emphasis laid on credit risk measurement and capital requirement in Basel II regulations. Viney (2009) defines credit risk as the “risk of a counterparty to a transaction defaulting on their obligation”. It is inherent in financial intermediation due to its main activity of lending and is associated with a financial institution’s balance sheet and off-balance sheet businesses.

2.4 Risk management and risk taking

Risk management involves the design and implementation of procedures for identifying, measuring and managing risks (Jorion 2007).
In order to measure risk, it is important to identify the key risk factors that are likely to cause volatility in returns from the position concerned (see Figure 2.3). The risk manager should then identify the influence of the factors on each other, as measured by the covariance (Crouhy et al. 2006). Figure 2.3 highlights the steps involved in the process of risk management. Kuritzkes and Schuermann (2008) suggest that improvements should focus on the sources of risk of which financial institutions have limited knowledge and the greatest impact on the volatility of earnings.

Although risk management has received much attention from the media, academics and policy makers as a result of the GFC, the level of risk taking by financial institutions has received a secondary importance. Given the importance of the role that financial institutions play in the global economy, it is equally important to control imprudent risk taking. Especially due to the sheer size of financial institutions that operate in a global scale, excessive risk taking and thus failure of such companies can lead to a domino effect across the rest of the financial system. Financial firms that are considered to be “too big to fail” have a higher propensity to take on excessive risk in order to enhance short-term profits (Boyd and Gertler 1994). Given this context, it is important to focus more on risk taking behaviours of larger financial institutions that could threaten the global financial system.
2.5 Credit risk transfer (CRT)

Credit risk transfer (CRT) is a process by which financial institutions transfer or shed credit risk in a portfolio of assets. Banks and other financial institutions often transfer credit risk in order to release capital for providing further loans (Duffie 2008). There are many ways to transfer credit risk of which some of the most popular are collateralised debt obligations (CDOs), collateralised loan obligations (CLOs), CDSs, credit derivative product companies and speciality finance companies. Duffie (2008) argues that CRT could improve financial stability by dispersing risks among many investors. In this way it allows individual banks to hold less risk through the diversification of their existing portfolio. However, most of the total risk will still remain in the banking system, except a transfer to institutional investors, hedge funds or equity investors. Duffie (2008) also points out a weakness in CRT by banks,
particularly in the case of CDOs and CLOs as they would have a higher retention of toxic assets\(^8\) by banks. In addition, a bank that has transferred credit risk would have less incentive to monitor the borrower or control their risk-taking behaviour of the borrower. CRT could also increase the total amount of credit risk to inefficient levels. Acharya and Johnson (2007) argue that, due to the problem of asymmetric information, a lender would have private information about the likelihood of default of a particular borrower that in turn could be used to buy credit protection from a less informed counterparty. In addition, loan officers could pass on inside information to buyers of credit derivatives. When fears of such behaviour are extensive, liquidity of the credit derivatives market would be threatened.

Although banks benefit through the transfer of credit risk, they incur two major costs. The first is the lemons premium that investors charge; due to banks having inside information about the quality of the loan. This leads to a significant drop in the price of the borrower’s equity (Dahiya et al. 2003; Duffie 2008; Marsh 2006). The second cost is a result of moral hazard incurred by the lender due to inefficient control of the default risk of the borrower. However, the principle benefits of a CRT process are the diversification of risks and the reduction of costs of raising new capital for lending. Thus, a lender will transfer credit risk until the point where costs of doing so surpass benefits associated with lower capital requirements (Duffie 2008; Froot et al. 1993b; Froot and Stein 1998). However, if the cost transferring credit risk diverges across the pool of loans of a bank portfolio, it is expected that the bank will transfer only the credit risks of the loans that provide the greatest benefit with regard to lowering the capital requirement. Drucker and Puri (2009) also argue that banks that sell loans have lower monitoring costs\(^9\).

The benefits of CRT were well summarised by Alan Greenspan (2004): “The new instruments of risk dispersion have enabled the largest and most sophisticated banks in their credit-granting role to divest themselves of much credit risk by passing it to institutions with far less leverage”.

Numerous risks are inherent in credit risk management practices used by financial institutions. CRT mechanisms contributed to a large extent to the GFC which started in the subprime mortgage market in the US and then affected investors in North America,

\(^8\) Assets that are particularly illiquid and sensitive to economic changes.

\(^9\) Although CRT includes selling loans, such as in securitisation, with CDSs the loan remains on the balance sheet, while only the credit risk is transferred.
Europe, Australia and Asia. Banks suffered liquidity problems with losses topping US$300 billion as at June 2008 (Turnbull et al. 2008). Credit related problems have forced banks around the world to fail and in certain instances have resulted in nationalisation. This crisis has affected the general economy; credit conditions have tightened for all types of loans and have caused the risk premiums to increase eightfold (Turnbull et al. 2008).

Largely there are two sets of reasons for capital regulation for the broader financial institutions and banks in particular. The first is to protect the unsophisticated depositors and to protect consumers from obscure financial institutions. The second is to avoid systemic risks. Systemic risk arises from the central role of banks as payment systems and in the allocation of financial resources (Cannata and Quagliariello 2009).

2.6 The global financial crisis and CRT

In the year 2007, financial institutions around the world were hit by a series of catastrophic developments which originated in the subprime mortgages in the United States. The GFC resulted in losses of billions of dollars in financial institutions and markets. Liquidity was wiped out in money and capital markets, while central banks around the world provided support in order to prevent a collapse of individual institutions and thus a systemic risk in financial markets (Hellwig 2008).

Some of the reasons that could be attributed to this crisis are related to the credit risk management mechanisms that were used by banks and non-bank financial institutions. CRT mechanisms were gaining popularity since the early 1990s and usage of credit derivatives and structured credit products to manage credit risk has increased. Banks are inherently exposed to a maturity mismatch; as the risk is borne by the financial intermediary, the borrower would borrow for a longer time horizon whereas the lender (e.g. bank/financial intermediary) would finance through funds obtained by deposits. These are funds obtained by investors with short horizons. Banks use different arrangements in

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10 Risk premium is the excess return required by a particular asset that is over and above the risk free rate.
11 Systemic risk has less to do with intrinsic solvency of debtors and more to do with the malfunctioning of the financial system (Hellwig 2008).
12 Credit derivatives are instruments that derive their value from the underlying asset.
13 Financial instruments created through the process of securitisation.
14 Authorised deposit-taking institutions (APRA).
order to manage the risks that they are exposed to. The primary type of risk that banks are exposed to is credit risk, which is the risk of default by a counterparty to a transaction. Securitisation is one type of CRT mechanism that is used to hedge credit risk. In securitisation (also known as an originate-to-distribute model), the originating institution (e.g. a bank) would transfer the mortgage title to a special purpose vehicle, a specialised entity that packages and refines itself by issuing mortgage-backed securities.\footnote{Securities whose returns are contingent on the returns of the package of mortgages (Hellwig 2008).} According to Hellwig (2008) this helps the originating institution to divest itself of the credit risk that is associated with real estate finance. The credit risk of the borrower is merely transformed into counterparty credit risk. Securitisation transfers the risk to a third party. This essentially shifts risk to market participants who are in a better position to bear the risk.

However, what went wrong was that the moral hazard of origination was not eliminated, but enhanced by several developments. In addition, many mortgage-backed securities ended up in portfolios of highly leveraged institutions that engaged in substantial maturity transformation (Hellwig 2008). The process of transferring credit risk found its roots in the credit crisis. CRT mechanisms allow credit risk to be transferred more easily and more widely dispersed across the financial system (Basel Committee on Banking Supervision 2008a). However, the failure to understand and manage some of the risks has contributed to the market turmoil of the GFC. One of the benefits of the CRT mechanism is the ability to spread credit risk to a wider range of market participants that have the capacity and willingness to bear the risk. The Joint Forum’s report on CRT asserts that the market turmoil spread due to the failure in risk management at several banks and financial institutions. Supervisors still remain concerned about the complexity, valuation as well as risks such as liquidity, operational and reputation risks and the broader effects of the growth in the CRT markets (Basel Committee 2008a).

The key CRT instruments are CDSs on single corporate issuers (single name CDSs), CDOs\footnote{A collateralised debt obligation (CDO) is a structured credit product which synthetically transfers credit risk of a portfolio of bonds or loans.} and indices of corporate credit risk. A credit derivative is a financial instrument that offers a means of managing credit (default) risk. Its value is contingent on the credit quality of the underlying asset (Batten and Hogan 2002). The feature that distinguishes credit derivatives from other forms of derivatives is its dependence on a credit “event” to
activate the implementation of the default provisions. This is in contrast to other interest and currency instruments (forwards, futures, options or swaps) which are dependent on a price or rate change within a given maturity structure. Credit derivatives could include CDSs, credit linked notes, credit-spread instruments, total return swaps and other forms (Batten and Hogan 2002).

Credit derivatives have arisen as a demand by financial institutions for hedging credit risks, similar to interest rate and currency risks. It has been a low-cost means of taking on credit exposure. As a result, credit risk has been gradually changed from an illiquid risk to one that can be traded as others (Mengle 2007).

The weaknesses of the CRT markets that led to the current market turmoil are attributed to a number of reasons by the Joint Forum of the Basel Committee on Banking Supervision. The main issues behind the credit market turmoil were the weak subprime origination standards, the performance of synthetic CDOs, the role of credit rating agencies, the shift of the credit event to a liquidity event and the role of mono-line financial guarantors (Basel Committee on Banking Supervision 2008a). The underwriting standards of the subprime mortgages was very weak, due to the multiple layers of risk such as less creditworthy borrowers and limited or no verification of borrowers’ income.

Due to the progressive increase in the integration in financial markets, regulators are concerned about systemic risk.17 (Lehar 2005). Hoggarth et al. (2002) explain that output falls by an average of 15% to 20% of GDP during a period of crisis in the banking industry. The threat of banking crises is related to the correlation between asset portfolios. This is because when risk is assessed of a bank investment portfolio, in addition to identifying the individual exposures of risk, it is important to consider the correlation of the exposures. Nevertheless, Raunig and Scheicher (2008) further assert that trading a firm’s debt through CDSs is less risky than equity as debt is more senior than equity.

As the crisis unfolded, due to the contagion effect, write-offs in financial institutions increased. This was largely due to the dependence on market valuations of assets. The modern form of mark-to-market or fair value accounting has become a part of the risk

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17 Systemic risk is the risk that the failure of a single institution could create failures elsewhere in the system because of the interconnectedness of transactions and institutions (Basel Committee 2003).
management process and statutory regulation of banks, being used even when markets were almost non-existent. Fair value accounting, however, increases the scale of systemic risk as the value of the securities held by banks depend on the prices that prevail in the market. This adjustment would have immediate implications for the capital adequacy requirements of banks, thus they would need to either recapitalise or retrench on their overall operations (Hellwig 2008). The good functioning of the banking system depends largely on the performance of the asset markets.

According to Hellwig (2008), systemic interdependence has contributed to a large extent to this crisis. Therefore risk taking by banks cannot be purely attributed to recklessness, but also to inadequate understanding and insufficient information about systemic risk exposure. This would mean that regulatory reform should address risks generated by systemic interdependence. This would lead to the strengthening of risk management practices and risk control.

2.7 Credit derivatives explained

Credit derivatives are CRT instruments which are primarily used to manage credit risk by banks. Credit derivatives are over the counter (OTC) financial instruments/contracts that have payoffs contingent to the credit quality of the underlying asset (Duffee and Zhou 2001). This would mean that with the changes of the credit quality of the underlying asset (mortgage or bond), the value of the credit derivative would change. Credit derivatives are written on corporate bonds, leveraged bank loans, credit card receivables etc. Examples include single name CDSs, CDS indexes, CDS index tranches, synthetic CDOs and basket CDSs (Lancaster et al. 2008). Some of these instruments are explained in detail later in this chapter.

A single name CDS structure is at the heart of all synthetic CDS transactions, including synthetic CDOs. A CDS is similar to insurance where there is a protection buyer (the insured) and a protection seller (the insurer). The protection buyer (i.e. a bank that extends a loan) seeks to insure an asset against a default by the borrower. The protection seller on the other hand agrees to provide insurance for a fee (see Figure 2.4). In this case it is said that the protection seller is long on the underlying credit risk while the protection buyer is short on the underlying credit risk. The underlying asset is known as the reference
obligation; it could be bonds, leveraged loans of a corporate issuer, sovereign debt, a basket of bonds or loans, an asset-backed security\(^{18}\) or a tranche from a CDO (Lancaster et al. 2008). In a synthetic CDO, a commercial bank with a loan portfolio will shed the credit risk associated with the portfolio rather than selling the loans to a repackaging vehicle. Thus, the bank opts to keep the loans on its balance sheet and only discard the credit risk of the loan portfolio. The special purpose vehicle (SPV)/counterparty issues notes to various investor classes where the underlying asset would be the portfolio default swaps (Bomfim 2005)\(^{19}\).

The premium paid by the protection buyer to the seller is often called the “spread” and is quoted in basis points per annum of the contracts notional value and is generally paid quarterly. A CDS is similar to a put option\(^{20}\) written on a corporate bond. The protection buyer is protected from losses incurred by a decline in the value of the bond as a result of a credit event (Whetten et al. 2004).

**Figure 2.4 Structure of a CDS**

[Diagram showing the structure of a CDS]

*Source: Adapted from Banks et al. (2007)*

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\(^{18}\) An asset-backed security is a structured credit product such as a residential mortgage-backed security or a CDO.

\(^{19}\) Synthetic securitisation is explained in detail later in this chapter.

\(^{20}\) A put option gives the holder the right but not the obligation to sell the underlying asset at a specified price on a specified date.
If there is no default by the reference credit obligation, the protection seller makes no payment and the contract expires. A CDS could be settled in cash or physical terms. In cash settlement, the seller pays the buyer a sum equal to the difference between the par value of the underlying asset and its recovery value. However, with physical settlement the buyer delivers the reference obligation to the protection seller in exchange of the par value payment (Lancaster et al. 2008). In the case of credit derivatives, unlike securitisation, the loan is not shifted off the balance sheet. The bank only buys credit protection from a third party. Therefore, the credit exposure remains in the bank’s books; however, the credit risk is sold. One of the main points of differentiation between CDS markets and insurance contracts is that CDS contracts are tradable, which means credit protection can be bought even if the buyer does not have any exposure to the underlying asset (Marsh 2006).

CDSs are mainly traded “Over the Counter” (OTC), meaning the contracts are negotiated privately between the buyer and the seller. As a result of the transactions taking place without a formal clearing house or exchange that would minimise counterparty risk by
forcing margin requirements to all contracts, CDSs generally are exposed to high counterparty risk (Helleiner and Pagliari 2008).

CRT instruments such as credit derivatives have been growing in popularity as a means of managing credit risk exposure by financial institutions. According to the Bank for International Settlements (cited in Allen and Carletti 2006), the usage of credit derivatives increased from 1995 to 2002 by a great extent. The growth in particular in credit derivatives and CDOs has been rapid during this period. A study by the British Bankers Association in 2002 (cited in Allen and Carletti 2006) indicated that banks are major participants as both buyers and sellers in CRT, however overall, banks are net buyers while insurance companies are net sellers. CRT is beneficial as it allows risk to be diversified between parties that are willing to take the risk. Furthermore, it allows diversification between banking and insurance sectors. Although financial innovation in the form of new CRT instruments would lead to beneficial diversification, it could reduce the welfare to others through contagion effects.

One of the main advantages of the use of CRT instruments is the flexibility which helps manage informational problems. Banks design credit derivatives in order to reduce the problem of adverse selection created by asymmetry of information. As highlighted in the recent subprime crisis, the growth in their volume and diversity has not mitigated the lack of transparency in these markets. Credit derivatives have arisen as a means of hedging and diversifying credit risks, similar to those already used for interest rate and currency risks. They have also grown due to being a low-cost means of taking credit exposure.

Morrison (2005) argues that the existence of a credit derivatives market would cause companies to issue sub-investment grade bonds and to engage in less favourable behaviour. The introduction of the credit derivatives market eliminates the benefits of bank monitoring. In this case bond investors can anticipate this lack of monitoring leading bank debt to lose its certification value. As a consequence, institutions can substitute financing through low quality debt for mixed finance. Given this context, credit derivatives could cause disintermediation. However, with enhanced reporting requirements, the effects of such disintermediation could be minimised (Morrison 2005).
Credit risk in credit derivatives (CDSs) is present in two forms: counterparty default risk and the default of the CDS reference credit (Brigo and Chourdakis 2008). The protection buyer effectively sells credit risk of the reference entity, thereby relieving the buyer from exposure to default. In return, the buyer takes on counterparty default exposure to simultaneous default by the reference entity and the protection seller and counterparty replacement risk of default by only the protection seller (Mengle 2007). A CDS with two or more reference entities is known as a basket CDS.

There are also other risks present in credit derivatives, namely, operational and market risks. Operational risk in credit derivatives arises in three forms: settlement, confirmation and litigation risk (Henderson 2007). Market risk is present primarily through the exposure to the underlying assets interest rate movements (i.e. LIBOR\(^{21}\)) (Lancaster et al. 2008). It also includes basis risk which is created by unanticipated movements in relative prices of assets in a hedged position. Dealers also manage model risk which is associated with simplifying assumptions and unidentified errors in pricing models (Mengle 2007).

A standard credit derivatives contract specifies the obligations and the rights of the parties as well as key definitions such as what constitutes a “credit event”.\(^{22}\) A CDS allows only certain types of default events, such as bankruptcy, failure to pay, debt moratorium, debt repudiation, restructuring of debt and acceleration or default (Bomfim 2005).

According to the Bank for International Settlements (2007b), the notional amount outstanding in credit derivatives grew to almost $43 trillion as of June 2007. For credit derivatives, the risk management function is similar to other types of derivatives. When a dealer takes on risk from a client, they would hedge the risk, but might choose to leave some of it uncovered. By doing this, that is, by speculating, it adds liquidity to the market. Although this liquidity is important to the efficient functioning of the CDS market, it requires close management.

The entry of hedge funds and other institutional investors into credit derivatives is an important development in the liquidity and efficiency in the CDS market. Hedge funds

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\(^{21}\) The LIBOR (London Interbank Offered Rate) is a reference rate used to price variable rate fixed income assets.

\(^{22}\) A default from the reference entity.
primarily enter the market to take positions. That is, an investor (e.g. a hedge fund) that believes a reference entity is under-priced can buy protection in anticipation that the spreads will increase. If the expectation turns out to be correct, they could sell the CDS, thereby making a profit and vice versa (Mengle 2007). This caused increased volatility in the CDS market eventually contributing to the GFC.

Figure 2.5 shows the workings of a CDS and its relation to contagion.

**Figure 2.5 The workings of a CDS**

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Bond Premium Premium Premium
Reference entity Lender CDS Dealer Insurance Company Bank
A B C D E

Funds $10m Protection Protection Protection
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*Source: Adapted from Wallison (2008)*

Figure 2.5 shows a series of basic CDS transactions. The lender (B) has bought a $10m bond from a company which is known as the reference entity. The lender now is exposed to the credit risk of the reference entity. If the lender wants to diversify its assets or does not want to hold the credit risk it will have two options: to sell the bond or transfer the credit risk. If the lender does not want to sell the bond, the lender could enter into a CDS contract with a dealer. In this case the protection buyer is B and protection seller is C. Therefore, if the reference entity defaults, C would pay B. As a dealer, C generally aims to acquire an offsetting hedge for every risk it takes. Therefore C enters into a CDS contract with D (insurance company) and D would post collateral. D in turn would hedge their risk by entering into a CDS contract with E. They are separate transactions, so under no circumstance could B look to E if the reference entity (A) defaults. If the default risk of A has been increasing, the seller would post collateral, which means the buyer would be able to reimburse for an additional premium cost for a new CDS. Either a buyer or seller of a
CDS transaction could be “in-the-money”\(^{23}\) at any given point. For example, if the creditworthiness of the reference entity begins to decline, the CDS spread will rise. This would mean that the buyer is in-the-money as the buyer is paying a lower risk premium than its original credit risk. In this event, the seller would have to post collateral. However, if the reference entity’s creditworthiness improves, the CDS spread would decline, meaning the buyer would need to post collateral in order to ensure the continuity of premium payments. If A defaults in this chain of transactions, C would have a claim against B, D would pay C and E would pay D. However, in the event that either of the parties in the series of transactions become insolvent or default, the other parties may be affected negatively. This clearly shows the interconnections created by CDSs that could in turn result in a systemic risk (Wallison 2008). Wallison (2008) argues that irrespective of the use of CDSs, credit markets are interconnected in any case, as a default associated with one company would undoubtedly affect its ability of meeting obligations to others. Therefore, CDSs cannot be solely considered as the origination of this risk.

Credit derivatives could take one of three forms: CDS, credit options and total return swaps. CDSs primarily can take two forms: single name and multi name. A single name CDS is a credit derivative where the reference entity is a single name, while in a multi name CDS the reference entity has more than one name (i.e. portfolio or basket of CDSs or CDS indices) (Bank for International Settlements 2009b). A default of a multi name CDS would mean a default of a combination of credits in the basket of credits. Single name CDSs are the most liquid of the credit derivatives currently traded and form the base for the more complex structured credit products (Ashcraft and Santos 2009). In a CDS the protection buyer (counterparty) makes periodic payments to the protection seller expressed in basis points paid on the notional amount. In the event the borrower (underlying reference entity) defaults, the protection seller would pay the protection buyer. Credit options are put or call options on floating rate notes,\(^{24}\) bonds or loans. In the case of a credit put option, the option buyer has the right but not the obligation to sell the floating rate reference asset to the option seller at a pre-specified price. In contrast, a total return swap is rather similar to a CDS; its main point of differentiation is the payments that are exchanged between parties, which are based upon the changes in market valuation of the specified underlying

\(^{23}\) “In the money” is when the CDS spread moves favourably to either the buyer or the seller.

\(^{24}\) Medium term debt instruments with flexible interest rates.
asset, whether the credit event occurs or not (JP Morgan 2006). Credit indices and credit index tranches are other forms of credit derivative contracts. A credit index contract has a basket of reference entities for which an investor could either buy or sell protection and therefore represent a portfolio of CDS contracts. Credit tranches are instruments where investors get specific exposures to credit risk of an underlying portfolio (Eckner 2007).

2.8 Pricing considerations

JP Morgan (2006) argues that the common question when using credit derivatives as an investment or a risk management tool is how correctly they should be priced. For many years, credit risk has been thought of as a deep out-of-the-money put option on the asset of the company. To this extent, the methodology to pricing options could also be used to price credit derivatives. Theoretically, a combined position of a CDS and a coupon bearing bond of the same reference entity should trade close to the price of a risk-free coupon bond. Therefore, a CDS spread should be theoretically equal to the credit spread of a risk free rate (Daniels and Jensen 2005). The payment made by the buyer of the CDS per year is known as the CDS spread.

Skinner and Townend (2002) argue that CDSs are in fact put options. By taking this view they have determined the main factors that should be considered in valuing these financial instruments. The four main factors that they identify as statistically significant for pricing CDSs are risk-free rate, volatility, underlying asset and the time to maturity. They further highlight that users of these CDSs could manipulate the variables under their control in order to control the amount of credit risk that is traded.

Fabozzi et al. (2007) also identify the influence of various fundamental variables on CDS spreads. In addition to credit rating and risk-free rate, they also identify the industry sector and liquidity factors as determinants of the swap spread. However, unlike bond spreads which are shown to be inversely linked to liquidity (i.e. the greater the liquidity, the lower the bond spread), CDS spreads do not exhibit the same relationship. Empirical findings from this study show that CDSs that trade with greater liquidity would have a wider spread. This is mainly attributed to the difference in economic characteristics of a bond versus a CDS contract: The difference in economic characteristics of a CDS contract from a bond is that in a swap, the value of the protection is paid in instalments; while for a bond, the
credit risk has to be paid in advance. Due to this contractual difference, the liquidity premium or discount is reflected differently in the prices of these instruments. Tang and Yan (2010b) examine in an empirical study the interaction between market and credit risk in corporate credit spreads using CDSs. They argue that CDS spreads increase with cash flow volatility and beta at a firm level, while at the market level the most important determinant is investor sentiment. However, the market risk determinants change CDS spreads to a lesser proportion.

Hitchins et al. (2002) look at a deeper level of how the credit premium paid by the protection buyer is determined at the outset. Apart from credit quality, which is the most obvious determinant, the maturity of the credit derivative, the credit status of the protection seller, the number and type of credit events included in the contract, the combined probability of the default of the protection seller and the reference entity, the nature of the payout (cash, physical, etc.) and other risks such as the foreign exchange and interest rate risks will be determinant factors of the CDS premium.

CDS markets react faster and more significantly to changes in credit ratings than bond markets. At the origination, a CDS contract does not involve exchange of cash flows. Therefore, a CDS has a market value of zero at origination. Considering a corporate bond, which represents a bundle of risks including market risks such as duration, convexity and callability and credit risk, it is clearly inefficient if the only way to adjust credit risk is to buy or sell a bond. Fixed income derivatives allow firms to manage market risks of the bonds, however, credit derivatives allow independent management of default or credit spread risk (JP Morgan 2006; Reilly and Brown 2006). After origination however, the value of the CDS could change based on the market’s expectation of the credit risk of the underlying asset. The study conducted by the European Central Bank (2009) further suggests that, as the probability of a firm’s default over a short-time horizon is usually low and as debt is more senior to equity, the risk of a firm’s CDS is lower than the risk of holding the same firm’s stock in shorter time periods (ECB 2009).

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25 Duration is a measure of the interest rate sensitivity of a bond’s market price taking into consideration its coupon and term to maturity (Reilly & Brown 2006).
26 Convexity is a measure of the degree to which a bond’s price-yield curve departs from a straight line (Reilly & Brown 2006).
27 Callability is a feature of callable bonds which are bonds that could be redeemed before maturity.
In the use of credit derivative markets, a study by the European Central Bank (2004) identifies that for protection sellers the most important risks in engaging in CRT transactions are credit risk and model risks. However, protection buyers are more concerned about counterparty risk and to a lesser extent correlation risk. (ECB 2004).

As displayed in the Figure 2.6 CDS spreads, which are the annual premia paid in a CDS contract against a default of the notional amount, the most striking is the Lehman Brothers failure in September 2008 (demonstrating very high CDS spreads). Other Investment banks and AIG were particularly hit by this collapse (Brunnermeier 2008).

Figure 2.6: CDS spreads (Jan. – Dec. 2008)

Source: Deciphering the liquidity and credit crunch 2007-08 (Brunnermeier 2008)

2.8.1 Valuation of CDSs

CDSs allow credit risks to be traded the same way as market risks. When the company, which is known as the reference entity, defaults, the buyer of the insurance obtains the right to sell the particular bond at par value. The bond is known as the reference obligation and its total par value is called the swap’s notional principal. Hull and White (2001) provide a

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28 The notional amount is the value of the underlying asset, e.g. the bond or loan.
methodology for valuing CDSs when the payoff is related to a single reference entity assuming no counterparty default risk. The payoff of a CDS in the event of default at time $t$ is estimated as the difference between the face value of the reference obligation and the market value of the CDS after time $t$. The market value of the reference entity is estimated as the sum of the face value of the CDS and accrued interest. Therefore the payoff of a CDS is given as follows:

$$L - RL [1 + A(t)] = L [1 - R - A(t)]$$

Where $L$ is the notional principal, $R$ is the recovery rate, $A(t)$ is the accrued interest on the reference obligation at time $t$ given as a percent of its face value. In the valuation of a CDS the amount claimed by bondholders in the case of a default is estimated, as well as the expected recovery rate. In a plain vanilla swap rate, the expected recovery rate is considered to be relatively insensitive to the valuation (Hull and White 2001).

At origination, the premium is set such that the value of the CDS is set to zero. After origination, its value would change based on the changes in the market’s assessment of credit risk of the reference entity (Raunig and Scheicher 2008).

2.9 Complex CDS products

2.9.1 $N$-th to default CDSs

$N$-th to default CDSs are where the buyer of credit protection pay a premium, known as the CDS spread, on a specified notional principal, until the $N$-th to default occurs across a specified set of reference entities (Hull and White 2004). $N$-th to default CDSs are basket CDSs which are based on multi name CDSs. The CDS could be triggered based on the credit event or a default of one or several of the underlying assets. In these securities, the seller will only pay the buyer after the $N$-th to default occurs. In this case, the seller would pay the face value of the asset less its recovery rate. Although this is the most basic form of an $N$-th to default CDS, variations exist. The value of such instruments strongly depends on the default correlation structure of the underlying asset basket. For example, if the default correlation of the basket increases, the value of a first-to-default CDS will decline as all assets would default in the same way. On the other hand, higher default correlation
would increase the value of a higher order CDS, as with higher correlation, the probability of multiple defaults increases, thus the value of a higher order swap (e.g. n =100) would increase (Hull 2011; Jabbour et al. 2009).

Single name CDSs are the basic building block of the CDS index market. Ramadurai et al. (2009) identify that in some respects this market was at the heart of the credit crisis. This has been further highlighted by the reduction of the notional amount outstanding of CDS contracts by 27% to US$41.9trillion in 2008 from US$57.9tn from the year before (BIS 2009c). The decline in the notional amount outstanding of CDS contracts is mainly a reflection of the compression of the CDS agreements through the “netting” of outstanding multilateral contracts (ISDA 2009b). Portfolio compression is a technique that reduces the overall size of the notional amount of transactions outstanding in a portfolio of CDS contracts without changing the risk profile of the underlying portfolio. In addition to the process of compression, the outstanding amount of CDS contracts is also affected by the severe dislocation of credit markets. Although notional amounts are used as a proxy to gauge the extent of the exposure to credit risk, they are not a true measure of the risk. For this reason it is important to consider the marked-to-market positions of CDS contracts to ascertain the risk that banks are exposed to. However, notional values are considered to be a simple and consistent measure of the size of the market and the level of activity.

2.9.2 Synthetic securitisation

2.9.2.1 The workings of synthetic securitisation

Synthetic securitisation transactions combine the advantages of credit derivatives and conventional asset securitisations in order to circumvent the disadvantages of conventional securitisations. For example, a synthetic collateralised debt obligation (synthetic CDO) is a transaction that transfers the credit risk of the underlying asset. As such, they are referred to as credit derivatives, and a large portion of the risk transfer that occurs in credit derivative markets is due to synthetic CDOs (Gibson 2004). Hence, this section is devoted to the discussions of these instruments and the risk involved.

A collateralised debt obligation (CDO) is created with a portfolio of debt instruments that have widely different risk characteristics. It therefore can include four different tranches
based on their loss absorption (see Figure 2.7). The first tranche, known as the equity tranche, absorbs the first losses of up to 5% of the total bond principal, while the second tranche has 10% of the bond principal, hence will absorb losses in excess of 5% of the bond principal. Therefore, the second tranche will absorb until 15% of the principal. The third tranche has 10% of the bond principal and will absorb losses in excess of 15% with a maximum absorption of 25% on the bond principal. The fourth tranche has 75% of the principal and absorbs all losses in excess of 25% of the principal. Therefore, the fourth tranche (known as the senior tranche) would absorb the remainder or the final residual loss. Hence the fourth tranche usually receives a AAA rating as defaults on the bond portfolio needs to exceed 25% in order to trigger it (Hull and White 2004). The second and third tranches are known as mezzanine tranches.

This structure is known as a cash-CDO; however, an alternative structure would be a synthetic CDO where the creator sells a portfolio of CDSs and then passes default risk to the tranche holders of the synthetic CDO. Analogous to the previous example, the first tranche will be responsible for the payoffs of the CDSs until 5% of the notional principal and so on. This income from the CDSs will be distributed to the tranches based on the risk borne by each tranche holder which is similar to the cash CDO (Hull and White 2004). Thus in synthetic securitisation, the CDO investors take on exposure to a particular tranche by selling credit protection on the reference portfolio. The parties on the other side of the hedging transaction are ultimate sellers of credit risk to the CDO investor, and the CDO issuer acts as an intermediary.

Synthetic CDO tranches could be either “funded” or “unfunded” (see Figure 2.8 panels A and B). If tranche is funded, this means that the originating bank enters into a CDS with a third party, where the originator buys protection in return for a premium. The premium received is then added onto the interest received by the investors of the synthetic CDO tranche. Thus any defaults will be written down from the principal received by the investors. In this case the notional principal is exchanged at the beginning of the transaction. However, in the case of an “unfunded” synthetic CDO tranche there is no exchange of funds at the beginning of the transaction. In this case, the investor enters into a CDS where he/she receives premiums and pays when there is a default on the underlying reference entity. As unfunded tranches depend on the future ability and willingness to pay
of the investor of an unfunded synthetic transaction, it creates counterparty credit risk (Gibson 2004; Picone 2002).

In effect, FCIC (2011) argues that synthetic CDO structures do not contain actual tranches of CDOs or tranches of mortgage backed securities. Instead, they simply reference these mortgage securities. Hence, these synthetic structures are in effect bets of the probability of the borrower meeting payment requirements. As such, Goldman Sachs and other financial institutions found it cheaper and convenient to transact in synthetic CDOs rather than traditional CDOs as the supply of mortgages were beginning to dry up. The FCIC (2011) highlights that Goldman Sachs alone packaged and sold $73 billion worth of synthetic CDOs from 1 July 2004 to 31 May 2007 where they have referenced more than 3,400 mortgage securities, and with 610 of these referenced as twice. Therefore, synthetic securitisation amplifies losses from a default by allowing multiple bets on the same securities, thus assisting this loss to spread among the entire financial system.

Figure 2.7: Structure of a CDO

Source: Hull and White (2004)
Figure 2.8: Structure of a synthetic CDO

Panel A: Typical unfunded synthetic CDO

Panel B: Typical funded synthetic CDO

Source: Moody’s approach to rating synthetic CDOs (Yoshizawa and Witt 2003)
2.9.2.2 The development of the synthetic CDO market

Figure 2.9 provides a graph on CDO issuance from 2004 to 2007. The graph in the middle represents the growth in the synthetic CDO market. In 2006, the total issuance of synthetic CDOs was at $524 billion compared to $470 billion of cash CDOs during this period. The graph also depicts that the trading of CDS index tranches was also at record levels of $1,736 billion (BIS 2007a). The issuers of synthetic CDOs generate returns by selling credit protection which in turn improves liquidity in the derivatives market as well as the cash market. Therefore, the credit protection generated by the issuance of synthetic CDOs could be far higher than their notional values. It should be noted that investment grade corporate debt is the most common collateral, while the relatively small amount of high yield synthetic CDOs reflects the lack of liquidity in the high yield segment of the CDS market. In recent times the range of collateral used in synthetic CDO transactions have expanded to residential mortgage backed securities, commercial mortgage backed securities, CDO tranches and other structured finance securities which are represented in the category of “other”. Gibson (2004) suggests that originally synthetic CDO deals were motivated either through a desire to hedge credit risk or to reduce regulatory capital or both. However, in recent times the motivation is also a result of the growing arbitrage deals that account for a majority of market activity.
There are many advantages in the synthetic form of securitisation, and therefore the growth of the synthetic CDO market can be explained to a large extent by the benefits received in using these instruments.

In its most basic form, fewer risks occur in a synthetic transaction in comparison to a conventional one as only credit and currency/exchange rate risks apply in a synthetic transaction. Liquidty, prepayment and reinvestment risks do not have to be taken into consideration as most synthetic structures have replenishment and no SPV (Böhringer et al. 2001).
Regulatory capital relief is one of the common advantages to conventional securitisation as well as synthetic securitisation. However, Böhringer et al. (2001) identify several advantages that are specific to synthetic securitisation as listed below.

*Avoidance of true sale treatments*

As the corporate loans stay on the balance sheet, synthetic securitisation avoids all likely problems arising through the transfer of the assets. As a result there are fewer difficulties in having a reference pool containing assets from various jurisdictions. Therefore it is easier to set up and is less costly.

*Cheap transfer of credit risk exposure*

Cheap transfer of credit risk exposure occurs especially for the underlying portfolios, which are mostly securitised by a high portion of super senior CDSs.\(^2^9\) In order to securitise these assets without CDSs would require the issuance of notes. However, by engaging in a synthetic structure it is only required to pay the premium on the CDS contract to the counterparty, thus it is a cheaper process of transferring credit risk.

*Capital market*

In the case of “unfunded” synthetic structures, by using synthetic securitisation to securitise corporate loans/bonds the amount that can be issued exceeds conventional securitisation as it is only partly funded. By using a CDS, the protection buyer can use the capital market and private investors for the combined protection of an asset portfolio.

*Securitisation of a ‘heterogeneous’ asset pool*

In contrast to conventional securitisation, it is possible to securitise assets from jurisdictions with obstacles related to transferability. As a result, various synthetic transactions are linked to a portfolio of multi-jurisdictional reference entities.

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\(^{29}\) A super senior tranche is defined as one that is senior to a AAA rated tranche (Gibson 2004).
2.9.2.3 Risks involved in synthetic securitisation

As explained above, an important risk identified by the FCIC (2011) is the possibility of creating multiple synthetic CDOs on the same reference entity. In this case when a default occurs such as through the collapse of the subprime bubble, it could create a series of defaults across the financial system. This creates a high systemic risk. Gibson (2004) argues that as CDO tranches are sensitive to correlation of defaults of the underlying reference entities, they are typically driven by the business cycle. This means that the correlation structure of the CDOs would change based on the changes in the business cycle. This is referred to as correlation risk, and the business cycle risk characterises this correlation risk. Default correlation refers to the tendency of two companies defaulting at the same time (Hull and White 2004). Higher default correlation would mean a greater probability that losses could wipe out the equity and mezzanine tranches of a CDO and reduce the value of the senior tranche. However, this could also mean that the extreme case of the likelihood of fewer defaults occurring is more probable. Hence the value of the equity tranche may increase with high default correlation. This dynamic default correlation, if not correctly estimated, can lead to an underestimation of risk and thus an overvaluation of the securities. Therefore, in the event of large defaults as with the subprime crisis, there could be a significant loss of value in these CDOs and hence the synthetic CDOs thus leading to heavy losses to investors in these securities.

Synthetic securitisation was possible due to the existence of CDS, as CDSs were sold in order to investors to protect against a possible default of the mortgage related securities that are backed by risky loans/bonds. Companies that sold protection such as AIG (American Insurance Group) helped launch and expand the CDS market. As companies such as AIG were not required to maintain capital according to the riskiness of their assets, unlike for banks, as a cushion against losses generated through protection selling,\(^\text{30}\) in the case of multiple defaults such protection sellers can suffer substantial losses (FCIC 2011). In addition, if such companies are systemically important entities such as AIG, then the ripple effects across the rest of the financial sector both locally and internationally could be quite significant.

\(^\text{30}\) The risk of protection selling relates to the protection seller being exposed 100% to the default of the underlying reference entity.
In addition, as synthetic securitisation meant that there was no necessity to possess real mortgage backed securities, when there was a lack of mortgage backed securities, firms generated them synthetically, through the synthetic securitisation process, that were merely bets on the actual underlying security. Thus the creation of each synthetic product, which was far easier to produce as compared to the creation of CDOs, provided an opportunity for firms to increase profitability and generate more fee income. Therefore, it amplified the risk and increased the risk taking by managers.

2.10 The regulatory framework of the banking industry

2.10.1 The Basel Accord and capital adequacy

This section specifically relates to the banking industry. Although this study considers the entire finance industry, attention has been devoted to bank capital regulation due to the major role banks have played in CRT markets.

Capital provides a buffer to strengthen the safety and soundness of authorised deposit taking institutions (ADIs). The Basel Committee requires them to maintain capital according to the level of credit, market and operational risks they are exposed to. The 1998 Basel Accord developed by this committee had the objective of strengthening the soundness and stability of international banking and to achieve consistency in applying capital requirements across different countries around the world (APRA 2007a).

The Basel II capital adequacy system, known as the Basel II Accord, has introduced a more risk-sensitive approach to maintaining required capital levels. The main focus of Basel II is to improve the methodologies for assessing risk faced by banks and other ADIs; it also has introduced capital requirements for operational risk. These amendments were implemented in Australia from 1 January 2008 to coincide with the implementation of the Basel II prudential standards. The first pillar of the Basel II accord details the minimum capital requirement for the three primary risk types, namely credit, market and operational risk. The total minimum capital requirement for credit, market and operational risk should be no lower than 8%. The capital ratio is calculated using the definition of regulatory capital and risk weighted assets out of which 50% should be tier I capital while the other 50% should be tier II capital (Basel Committee 2005b). Tier I capital is defined as the core
capital which is freely available to absorb losses and has permanent and unrestricted commitment to funds. Examples include paid-up ordinary shares, general reserves and retained earnings. Tier II capital includes term subordinated debt, general provision for doubtful debt and cumulative irredeemable preference shares. (Viney 2009). If banks are unable to adjust their capital level directly, they may reduce their lending to a lower level. This could potentially lower the availability of new bank lending and could exacerbate a downturn.

For capital adequacy purposes, the Basel Committee (2003) defines credit risk as the risk of loss due to a default of a counterparty obligation. In calculating capital requirements for credit risks, Basel II recommends a choice between two broad methodologies: the standardised approach which is supported by external credit assessments (i.e. credit rating agencies), and the use of internal rating systems by banks with explicit approval by the domestic regulator. Under the most advanced approaches, banks are allowed to use their own risk parameters. The prudential standards for the standardised method and the internal ratings based approach in Australia are explained in detail by APRA in APS 112 & 113 (APRA 2007c, d).

Market risk is defined as the risk of loss in on and off-balance sheet positions due to changes in market rates such as interest rates, exchange rates, equity prices and commodity prices. (Basel Committee 2008b). Capital treatment for market risk is determined by two methods: the standardised approach and the internal model approach which in turn is subject to the explicit approval of the bank’s supervisor. The internal model approach is based on the Value-at-Risk (VaR) techniques. All positions that are held in the trading book with a trading intent or to hedge activities on the trading book should be marked-to-market. Where marking to market is not possible additional requirements are made to ensure that mark-to-model valuations are prudent (APRA 2007b). Operational risk is defined by in the Basel II Accord\(^{31}\) as “the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events” (Basel Committee 2001, p. 2).

\(^{31}\) Basel II accord is the commonly used description for the document titled *International Convergence of Capital Measurement and Capital Standards, a revised framework*, developed by the Bank of International Settlements in the group of G-10 countries and Luxembourg (APRA, 2007).
Although this definition includes legal risk, it excludes strategic and reputational risks for the purpose of calculating the minimum regulatory capital charge for operational risk. Operational risk manifests in different forms in all the industries that supervisory authorities regulate.

Although Basel II regulations imposed capital requirements based on the riskiness of the activities that banks undertook, especially in the US with more than 30 years of deregulation and a heavy reliance of self-regulation by financial institutions meant that banks have pushed away the key safeguards that would have protected them during a catastrophe. The FCIC (2011) states that as US financial firms were allowed to pick their preferred regulator, many were inclined to pursue the weakest regulator. This meant that the financial institutions could easily avoid strict costly regulation and thus engage in imprudent risk taking. Hence, failure in financial regulation is identified as a contributing factor to the financial crisis that originated in the US.

2.10.2 Basel II and GFC

Cannata and Quagliariello (2009) identified accusations of Basel II playing a role in the GFC, some of the main claims being:

- The average level of capital required by the new discipline is considered to be inadequate.
- The new capital accord’s relation to fair value accounting has resulted in large losses in portfolios of banks.
- In Basel II the assessment of credit risk is delegated to non-bank institutions such as rating agencies, therefore it is potentially subject to conflicts of interest.
- The assumption that banks internal models of risk assessment are superior, which is encouraged by Basel II, has proved wrong.
- The new framework aims to deconsolidate some of the very risky exposures from its balance sheet.

32 Legal risk includes, but is not limited to, exposure to fines, penalties or punitive damages resulting from supervisory actions, as well as private settlements (Basel Committee, 2003).
Although these are identified as deficiencies in the Basel II accord, the authors argue that it is not appropriate to draw such a link, as some of the main drivers cannot be attributed to the new regulations as a whole.

Firstly, an important reason identified for the inadequate capital base fostered by Basel II is as a pragmatic way to promote a gradual transition from the old to the new framework, as extraordinary changes in capital requirements could lead to a lower credit supply. Secondly, the simultaneous implementation of Basel II and the fair value accounting system has made bank balance sheets more vulnerable to asset value fluctuations. However, Basel II has not played a specific role in the crisis as the effect of introducing minimum capital requirements has smoothed out the effects of changing asset values on balance sheets. Thirdly, the main concern in delegating credit risk assessment to non-bank institutions such as credit ratings is the risk of the degree of independence of the ratings’ agencies judgement, especially related to structured products. The other concern is about the rating methodologies. The statistical models used have limitations, given the complex nature of the instruments. The limitations of rating agencies’ methodologies are related to inadequate datasets and excessive dependence on mathematical models. Having said that, the standardised approach to credit risk measurement (which uses external credit ratings) is considered an interim solution and banks are encouraged to use internal assessments which would lower their total cost of regulatory capital requirement. Fourthly, during the GFC, the internal models have revealed shortcomings for measuring risk exposure. Although Basel II does not state supreme internal methodologies developed by supervisors, it considers sensible risk assessment measures that are also used for risk management purposes of the intermediary. Therefore it is important that sufficient emphasis is placed on supervisory action to validate banks’ internal models. Finally, Basel II is considered to provide incentives to intermediaries to deconsolidate some of their very risky exposures from the balance sheets. The financial stability forum (2008) cited in Cannata and Quagliariello (2009) explains that although the transition from Basel I to II does not completely eliminate any regulatory arbitrage, it requires financial intermediaries to set aside capital to meet liquidity commitments to off-balance sheet vehicles. However, such vehicles are treated as senior exposures, which meant that capital commitments were lower than otherwise. The Basel Committee therefore is working towards strengthening the
capital treatment for liquidity facilities for structured credit products in order to reduce the incentives for regulatory arbitrage (Cannata and Quagliariello 2009).

2.11 Conclusion

This chapter gave an overview of the contextual background within which this study is based. One of the primary functions through which financial institutions in general and banks in particular generate a competitive advantage is the management of risk. Following the GFC and the failure of some of the world’s largest financial institutions, the issue of risk taking has been highlighted time and time again.

In this chapter, the GFC, its meaning, significance and the relation between CRT markets and the GFC was evaluated. Furthermore, the meaning and workings of a CDS and related products such as synthetic CDOs were discussed in relation to CRT and contagion that contributed to the GFC.

Finally, the international banking regulations (Basel II accord, designed by the Bank for International Settlements) were reviewed with regards to the adherence by banks as part of their risk management practices and the flaws of the regulatory framework were highlighted.

In the following chapter, the literature related to the key issues in CDSs and the existing views of CRT are discussed.
CHAPTER 3
CREDIT DEFAULT SWAPS AND CREDIT RISK TRANSFER:
A REVIEW OF THE LITERATURE

3.1 Introduction

“The boom in subprime mortgage lending was only a part of a much broader boom characterised by an underpricing on risk, excessive leverage and the creation of complex and opaque financial instruments that proved fragile under stress”

– Remarks by Ben Benanke, Chairman, US Federal Reserve Board,
UC Berkeley/UCLA Symposium, Oct. 2008

The issue of risk in the banking/finance industry has become significant in recent times and indeed is receiving considerable press following the global financial crisis (GFC). The GFC led many analysts to be sceptical of the advantages of credit risk transfer (CRT) mechanisms, and in particular of CDSs. Notwithstanding the massive growth in the CDS market before the GFC of US$62 trillion (ISDA 2009a), little is known about the real effects of their use.

Trends in the banking and related ‘shadow’ banking industries have contributed to the growing concerns regarding riskiness of such firms, as well as the recent difficulties that have been faced by financial firms. To a large extent, CDSs have been blamed for contributing to failure in financial institutions, if not exacerbating the effects of financial difficulty. In order to better understand the risks involved in these instruments, this study examines their use within the global finance industry, particularly bank and non-bank financial institutions, and investigates the potential reasons for the growth of the CDS market and its eventual collapse during the GFC.

This study is primarily based on the theoretical framework of positive accounting theory (Watts and Zimmerman 1978) and agency theory (Jensen and Meckling 1976). Based on the fundamental human assumption of managerial self-interest, both theories argue that managers are driven by their own self-interest rather than by what is morally acceptable as business behaviour. In the attempt to further their self-interest, managers can increase risk taking, which can be used to explain the “rise and fall” of the CDS market. These theories are crucial in explaining managerial self-interest in financial institutions that may have led to the excessive risk taking with the use of credit derivatives; in turn this could explain how
managerial risk taking has contributed to the growth and the eventual collapse of the CDS market during the GFC.

The primary purpose of this chapter is to provide a synthesis of the literature relating to CDSs, i.e. these instruments are used as a part of the hedging and trading strategies of financial institutions. The key issues and concepts related to CRT through CDSs and the risks involved in trading are highlighted. In addition, how managerial risk taking has contributed to CDS trading and vice versa is examined through the concept of managerial self-interest drawing on positive accounting theory and agency theory. Following an extensive discussion of the relevant literature, its surprising paucity is acknowledged. Although many studies have focused on the determinants of CDS spreads and the factors that affect the risk as indicated in such spreads, there are only limited studies that explore the risk indicated in CDS spreads that highlight managerial risk taking. In addition, to the knowledge of the researcher, this study is the first to explore the link between managerial risk taking, as identified by CDS spreads, and the rise and fall of the CDS market. Finally, given that there is a lack of literature covering the possible reasons behind the growth and the collapse of CDS market, a conceptual model is developed from which the research questions are identified.

3.2 Background

The GFC exposed deficiencies in risk management and prudential regulation approaches, particularly those that rely heavily on ‘mechanical’ risk management models (Buch and DeLong 2008). A popular risk management mechanism, used by many financial institutions is the use of credit derivatives as a means of transferring risk. According to the British Bankers’ Association Credit Derivatives Report (Barrett and Ewan 2006), these were one of the most significant markets prior to the GFC. Figure 3.1 shows the extent of their growth.
CRT instruments continued to enjoy significant growth in financial markets due to the sophisticated product development and product applications beyond the conventional management of portfolio risk. Credit derivatives provide opportunities to exploit and profit from errors in pricing credit risk, for example, through speculation (JP Morgan 2006). As a result of this speculative nature of CDSs it is important for financial firms to recognise the additional source of risk inherent in using credit derivatives. One criticism of CDSs is that these instruments provide more incentives for managerial risk taking even if they are used primarily for hedging purposes (FCIC 2011; Yu 2006).

One of the root causes of the GFC was arguably the poor risk management policies adopted by both bank and non-bank financial institutions and in particular credit risk management (Felsted 2008). In response to the GFC, most banks have upgraded their risk management systems and risk management is now at the forefront of their decision making processes. Figure 3.2 clearly shows that although CDSs were one of the most popular and successful instruments used by institutions as a CRT mechanism markets prior to the GFC, its onset resulted in a near total collapse of the market for CDSs.

As explained in Chapter 2, credit derivatives are CRT instruments designed to hedge credit risk. In the early to mid-2000s the market for CDSs grew exponentially, and in 2005 was one of the fastest growing markets for credit derivatives (Daniels and Jensen 2005). Their increased profoundly transformed the market for defaultable debt as these instruments significantly simplify trading of credit risk. Unlike typical interest rate derivatives, credit derivatives allow isolation of firm-specific credit risk from the overall market risk. The most common form is a CDS. The main participants in credit derivative markets are banks, hedge funds and insurance companies. Minton et al. (2005) find that 5% of their total sample of 314 large banks use credit derivatives. The usage of CDSs by banks is limited, due to the problems of moral hazard and adverse selection, which makes the market for credit derivatives illiquid for typical credit exposures of banks.

The GFC\textsuperscript{33} is a prime example of the inefficient function of the credit derivatives market and its contribution to the crisis and was largely a result of the CRT mechanisms used by banks and their flaws. According to the International Swaps and Derivatives Association (ISDA 2008) the CDS market exploded over the decade to mid-2007 by more than $45

\textsuperscript{33} Explained in detail in Chapter 2.
trillion, which was on average twice as high as the US stock market at the time. It then peaked at $62 trillion in the same year (ISDA 2010a). According to World Bank (2010) data this was far higher than the global GDP at the time. The subprime crisis in 2007 originated in the housing markets in the US with falling housing prices, but eventually materialised into a fully-fledged ‘credit crunch’ due to tightening of liquidity in financial markets. Diamond and Rajan (2009) have explored the causes and remedies of the credit crisis and state that as a result of the falling house prices, mortgage defaults started increasing and CRT instruments fell in value, while their prices were becoming more volatile. When banks tried to sell out their positions, prices declined, further making it harder for banks to borrow against these securities (CRT instruments). This resulted in bank runs, with the biggest trigger in worldwide financial markets being the collapse of Lehman Brothers. Credit markets ceased to exist not only as a result of liquidity and solvency concerns of banks but also due to the fear of having limited funds if investment opportunities improved in the future (Diamond and Rajan 2009).

The GFC has highlighted the importance of proper risk management and risk taking and the need for financial regulation. As a result, risk management is now at the forefront of issues under discussion in most financial institutions. A complete assessment of risk management in banks and other non-bank financial institutions is taking place around the world (Debelle 2010) and is changing the way risk management is organised to reflect the current deficiencies. Platt (2006) discusses the growth in the credit derivative markets and states that the rapid growth in global credit derivatives has put stress on settlement systems and operational controls. Banks are not merely using credit derivatives to hedge credit risk, i.e. they are not solely buyers of credit protection. Platt (2006) also states that banks have recently been involved in credit derivatives markets as sellers of protection, as they are using these instruments as trading vehicles and for taking on new credit risk when yields were low. Therefore banks have moved away from using CDSs for hedging purposes to trading purposes. This is confirmed by a survey by Fitch Ratings (2010) where 86% of participants highlighted that the use of credit derivatives by global banks is for trading purposes as compared to hedging purposes.

Risk management has become more important in the global banking industry as deregulation of the US financial system has enabled more risk taking, and technical
advances are encouraging both risk taking and the estimation of forecasting risk. In particular, Crotty (2009), in his study identifying the structural causes of the GFC, criticises the deregulation in the US banking industry mainly in late 1990s, due to banks being allowed to hold risky securities off their balance sheets in \textit{structured investment vehicles} (SIVs) with no capital requirements as a cushion against losses. These SIVs invested heavily in CRT products such as CDSs, CDOs and other mortgage-backed securities. The US regulatory system induced banks to move many of their assets off-balance sheet, thus increase risk taking. Although CRT markets allow dilution of risk (i.e. spreading risk) which benefits the financial institutions, it creates externalities due to the problems of moral hazard and adverse selection as mentioned previously. The advent of buying and selling credit risk and transferring credit risk off-balance sheet, as with the use of CDSs, also poses challenges to financial institutions. This is because, although it is evident that risks would be removed to off-balance sheet when they are hedged, risks may not be entirely removed. Azarchs (2003) argues in a study by Standard and Poor’s that, with the use of credit derivatives, institutions that are exposed to credit risk improve their liquidity and convenience as well as their pricing of credit risk. The study further outlines that for net protection sellers, CDSs provide an attractive return for low-risk investments. Some players in CDS markets are both buyers and sellers of protection; i.e. by buying protection of their own loan portfolios and enhancing the diversification of these loan portfolios by selling protection on other reference entities that may not have access to in the loan markets. CDSs will alter the risk profiles of bank portfolios which in turn will affect the capital allocation of these portfolios (Azarchs 2003).

Shiller (2005), who identified the concept of “irrational exuberance” in markets that could lead markets to behave irrationally, argues that such over-optimism is encouraged by financial innovation and has proved to be a source of systemic risk. This irrational exuberance could have led to the rapid growth of credit which is identified as a signal of increasing problems of leverage and highlights danger in banks both at an individual level and in the system as a whole. As discussed in the theoretical framework developed later in this chapter, the principal-agent problems created due to the separation of ownership and control in financial institutions, as highlighted in agency theory (Jensen and Meckling...
Principal-agent problems have been highlighted time and time again in the different types of financial instruments used, as with innovation and the complexity of these instruments the asymmetry of information is more pronounced. Honohan (2008) investigates the deficiencies in risk management and prudential regulation approaches that led to the GFC and argues that the extent of the losses in the banking sector is a result of the failings within the banks and the banking system itself is due to the over-reliance on mechanical risk management models. This is because Basel II pillar 1 capital adequacy requirements place a heavy reliance on complex (see also Basel Committee on Banking Supervision 2005a) but mechanical statistical risk management models that are imperfect, thus the power and sophistication of the models should not be allowed to displace the discretion of risk managers. The risk taking culture of a bank therefore should highlight the dangers of misspecification or misapplication of these models.

Prior to embarking on a review of the literature related to the implications on the use of CDSs and related aspects, the following section explains characteristics of CRT, i.e. the CDS market, products (in particular, credit derivatives), and price determinants of CDSs.

### 3.3 Credit risk transfer

CRT instruments allow credit risk to be transferred more easily and potentially more widely dispersed across the financial markets. However, CRT also poses new risks, such as counterparty risk model risk that have contributed to the market turmoil in 2007 (Basel Committee 2008a). The Joint Forum of the Basel committee on Banking Supervision indicates that, the failure to understand and manage these new risks have contributed to the GFC in 2007. Major contributors are credit derivatives, of which CDSs are just one type.

#### 3.3.1 Credit Derivatives: Growth and Characteristics

As explained in Chapters 2 and 3, the credit derivatives market grew phenomenally since its origin in the late 1990s. Figure 3.3 demonstrates this growth over the period 2004-08 in Australia, which confirms an exponential growth compared to other OTC derivative products.

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34 This is discussed in detail in Section 3.9 of this chapter.
Traditionally, corporate credit risk has been essentially untradeable. However, CDSs give both banks and bondholders an opportunity to diversify their credit exposures. In the case of banks this would mean that capital held as a result of the riskiness of assets would be lower than otherwise. This saving that has arisen through diversification opportunities could lead to the efficient use of bank capital. This would mean that banks using CDSs to hedge credit risk could borrow funds and issue bonds at a lower interest cost. Ashcraft and Santos (2009) investigate whether the CDS market in fact has lowered the cost of corporate debt, as these instruments provide lenders with an opaque means to sever links to the borrower, thus lowering the incentives to screen and monitor. However, they have found no evidence that CDS trading has lowered the cost of debt for borrowers.

Credit derivatives are relatively new, in comparison to other CRT instruments, and were first publicly introduced by the International Swaps and Derivatives Association in 1992 (Weithers 2007). They are OTC financial instruments used to manage credit risk. They help
isolate credit risk from other types such as market and operational risk (Brandon and Fernandez 2005). Credit derivatives further reflect the likelihood of the reference asset (borrower) experiencing a credit event (default of payments due to bankruptcy) within a given timeframe. JP Morgan (2006) identifies several benefits of CDSs that led to their immense popularity. These include the liquidity provided to cash markets in times of market strain, offering a variety of off-balance sheet instruments that provide flexibility in terms of leverage, providing liquidity to individual credits under stress and as a channel for information across markets for distinct asset classes. (JP Morgan 2006)

As CDSs isolate specific aspects of credit risk of the underlying reference asset and transfers between two different parties, they differentiate ownership and management of credit risk from other qualitative and quantitative aspects of ownership of an asset. This allows entities to transfer even the most illiquid credit portfolios into liquid marketable securities and thus transfer the risk to those who are willing to take the risk (Batten and Hogan 2002; JP Morgan 2006; Mengle 2007; Rule 2001).

There are distinct arguments for the increasing use of credit derivatives by banks (Brandon and Fernandez 2005; JP Morgan 2006; Meng and Gwilym 2005; Vandervliet and Partida 2002). First, the reference entity (i.e. the underlying borrower whose credit risk is transferred) is neither a party nor aware of the underlying credit derivative transaction. This helps banks to manage credit risks discreetly without affecting the important customer relationships. This would mean that the terms of the credit derivative transaction would be tailored to suit the buyer and the seller of risk and not the underlying reference entity. Credit derivatives also introduce objective pricing as they are isolated from other aspects of ownership.

Second, credit derivatives are the first mechanism through which short sales of credit instruments are executed without the risk of a ‘short squeeze’. CDS trades could be settled physically or cash-settled. In physical settlement, the protection buyer transfers ownership of the actual debt obligation to the protection seller in exchange of the notional value of the contract. In the case of a ‘short squeeze’, this notional value is significantly larger than the market value of the entity’s actual debt obligation (Senior Supervisors Group 2009).

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35 Market risk is the risk of loss related to changes in market rates such as interest rates, exchange rates and equity prices (Basel Committee 2005).
36 Operational risk relates direct and indirect loss resulting from failed internal processes, systems, people or external events (Basel Committee 2005).
37 The amount of protection that a lender purchases is called the “notional amount” (Wallison 2008).
Although a bank loan cannot be short sold, a short position could be synthetically achieved through the purchase of a credit derivative. As the liquidity of credit derivatives improve, banks and other players in the market could exploit the arbitrage opportunities, which improves the credit pricing discrepancies and makes credit markets more efficient.

Third, as credit derivatives are ‘off-balance’ sheet instruments (except when embedded in structured notes such as in synthetic securitisation), they offer considerable flexibility in terms of leverage. That is, by taking exposure to bank loans through credit derivatives, a non-bank financial institution could both synthetically finance the position by receiving the net proceeds of the loan after financing in the case of a total return swap, and avoid the administrative costs of direct ownership of the asset. O’Kane et al. (2003) in their research explaining the credit derivative markets, products and regulatory aspects assert that in a CDS transaction there are three credit events that can trigger the payment of protection: bankruptcy, failure to pay and restructuring of the underlying reference entity.

Commercial banks are the most active participants of credit derivatives in the market, where they have acted as either protection buyers or sellers (OCC 2007). It is well known that banks use CDSs to hedge credit risk of loans and bonds and trade credit risk as well. They will be buyers of protection when they hedge credit risk and will be sellers of protection when they trade credit risk. For example, commercial banks may sell protection in the instances of information asymmetry where there are different expectations on the same credit risk. In such cases they would sell protection on the reference entities with which they are most familiar. In addition, as shown by Meng and Gwilyn (2005), commercial banks also play an important intermediary role between protection buyers and sellers.

As demonstrated by JP Morgan (2006), all credit derivatives are non-retail transactions which average $25 to $50 million per transaction. Maturities generally run from one to ten years and occasionally beyond that. For financial institutions’ credit risks, five years is the benchmark maturity where the greatest liquidity could be found. This suggests the market

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38 Selling an asset which is not owned by the investor in expectation of a price decrease and buying it back when the price falls.

39 See Chapter 2 for a detailed explanation of synthetic securitisation.

40 According to the Office of the Comptroller of the Currency (2007), a federal regulator in the US, commercial banks were the most active players in the CDS market with the top 25 banks holding more than $13 trillion of CDSs at the end of the third quarter of 2007.
is largest, hence most active, for CDSs with a five-year maturity resulting in greater liquidity in this market. Credit derivatives allow users to remove the credit risk inherent in an asset without physically removing it from the balance sheet. Furthermore, as shown by Gonenc et al. (2007), a CDS provides the ability to diversify portfolio risks without diversifying the portfolio itself. In comparison to hedging with less risky bonds, which requires a cash outlay upfront, CDSs do not subject the buyer to interest rate risk or funding risk, as CDSs separate the credit risk with other types of risk. Jakola (2006), in his study evaluating the viability of CDS index options in the CDS market, argues that it market was originally an inter-bank market to exchange credit risk without selling the underlying loans, but CDSs are now traded among non-bank financial institutions ranging from insurance companies to hedge funds.

A study carried out by Abid and Naifar (2006) examining the determinants of CDSs states that credit derivatives are considered to be an efficient mechanism of hedging credit risk even though they are more expensive and less liquid, given they are OTC instruments that are designed to meet specific user requirements. Credit derivatives increase the liquidity of a bond portfolio, enhance portfolio returns and reduce credit exposure to particular borrower groups. Therefore, they are more efficient instruments in hedging credit risk. Although there are many advantages, as mentioned above, in the use of credit derivatives as a CRT mechanism, Duffie (2008) argues that banks incur two major costs: the premium that the investor charges due to the inside information the bank has in relation to the credit risk of the borrower, and Moral Hazard, resulting in inefficient control of credit risk of the borrower. This is because a bank has less incentive to control the default risk of a loan that it sells compared to a loan that it retains. Duffee and Zhou (2001) also state that the introduction of the credit derivative market is not necessarily desirable as it can lead to other markets for loan-risk sharing to break down. In the event that banks have superior information about credit quality, the loan-sale market is affected by an asymmetric information problem. If the asymmetric information problem is not severe enough to limit the loan-sales market, the introduction of credit derivatives is not considered to benefit the bank. This is because the credit derivatives market may alter the investor expectations of the quality of the loans sold in the loan-sale market which would change the equilibrium in the market. (Duffee and Zhou 2001)
3.3.2 Price determinants of CDSs

Abid and Naifer (2006) state that there are several variables that are significant in determining the price of a CDS. For example, an entity’s credit rating is one of the most important factors that determine the credit risk of a CDS. In addition, macro-economic variables such as the risk free rate, the slope of the yield curve and liquidity in CDS markets are considered to affect the determinants of CDSs. Alexander and Kaeck (2008) in their study using five different iTraxx Europe CDS indices explore the determinants of CDS spreads and identify the risk-free rate as a determinant of a CDS spread. The higher the risk free rate, the higher would be the risk neutral drift, therefore the lower would be the probability of default.

In addition to the risk-free rate there are other influences of variables on CDSs, including credit ratings, interest rate data and stock market related information such as variance of returns and firm leverage (Cossin and Hricko 2001; Ericsson et al. 2005). Cossin and Hricko (2001) state that CDS rates could be seen as an alternative proxy to credit risk. Credit ratings are a widely observed measure of credit quality of a specific debt issue and play a significant part in explaining levels of CDS rates. Hull et al. (2004) identify that CDS spreads are closely linked to bond yield spreads, which are good indicators of credit risk. Their study shows a negative relation between the CDS spread of a company and its credit rating, i.e. the lower the credit rating, the higher would be the CDS spread. Due to many investors using CDSs as a speculative tool, the identification of the determinants of CDS spreads have become important in the literature.

Profitability measures such as Return on Assets (ROA), Return on Equity (ROE) and Equity returns also suggest that there is a relation between CDSs and profitability measures, and as such a determinant, which is reflected on the premium paid on a CDS contract known as the CDS spread. In particular Bartram et al. (2009) highlight that profitable firms have lower financial distress costs, hence would in turn have lower CDS spreads and also be less likely to use derivatives for hedging purposes. In addition, higher expected profitability also will lead to a lower probability of default, thus lower CDS spreads (Chiu and Wagner 2010). Therefore, profitability measures indicate a negative relationship to CDS spreads. Equity volatility, as measured by the standard deviation of
returns, is also identified in the literature as a determinant factor of CDS spreads. As volatility of the underlying asset indicates the uncertainty of the security’s value (value of its equity), higher equity volatility could translate into higher default risk (Hassan et al. 2011). In this sense, volatility has a positive relationship to CDS spreads. Credit ratings, profitability measures and equity volatility are highlighted in the literature as important determinants of CDS spreads.

3.4 Credit risk and its significance

The Bank for International Settlements in its Basel II accord defines credit risk as the ‘risk of a counterparty to a transaction defaulting on its obligation’ (Basel Committee 2005a). Credit risk is important to banks, bond issuers and bond investors because if a borrower defaults, neither banks nor investors would receive their funds. Although commercial banks have a greater exposure to credit risk due to their primary activity of intermediation, non-bank financial institutions are also exposed to a significant extent. While there are a variety of ways of managing credit risk, as posited by Neal (1996) they may not help entities to reduce risk to desired levels. Credit risk is affected by both business cycles and firm specific events. Typically it would be lower in periods of economic expansion due to stronger earnings by firms. Default rates would tend to increase during economic downturns as earnings deteriorate which makes it difficult to repay loans and bond payments. A broad measure of a firm’s credit risk is its credit rating (Norden and Weber 2004) as published by rating agencies such as Moody’s and Standard and Poor’s. These range from AAA (in Standard and Poor’s), the highest credit quality, to D where the debt is in default. A quantitative measure of credit risk is the credit risk premium. This is the difference between the interest rate a firm pays when it borrows and an interest rate of a risk-free security, such as a treasury security.

Non-bank financial institutions essentially focus on the business of managing risk, with banks placing more importance on risk management. Given their significance in the financial sector and public reliance on the banking system, one point of difference between banks and other businesses is the extent of public exposure. In this respect, the issue of managing risk is perhaps more critical than it might be for other businesses. Acharya (2009) investigates how systemic risk in the financial system is modelled that helps design prudential bank regulation. The author particularly argues that the limited liability of banks
and the presence of negative externalities, i.e. the effect of one bank’s failure on the health of the other banks, would result in systemic risk where all banks are affected in one way or the other. This increases the economy-wide aggregate risk. As a result of the health of one financial institution leading to systemic risk, prudential regulation is shown to operate at a collective level as well as an individual level. The findings of Acharya (2009) are relevant and important to this thesis as the largest participants in CDS markets are banks and as credit risk is one of the most important sources of risk that banks are exposed to. Due to the interconnectedness of banks, losses accumulated by an individual bank due to excessive exposure to the CDS market (as a result of a default on the underlying assets) could easily translate into significant losses for the entire banking industry. Credit risk that banks are exposed to can be transformed into systemic risk through the CDS market, hence systemic risk may have been a contributing factor to the eventual collapse of the CDS market.

As discussed above, credit risk has a significant influence on the overall risk profile of participants in the CDS market, in particular, banks. It is also important to understand the risk management and risk taking practices of banks that could highlight the extent of how risks are managed and deficiencies of risk management instruments such as CDSs. The following section presents a brief discussion of risk management and risk taking of banks.

### 3.5 Risk management and risk taking

A survey by KPMG (2009) states that risk culture is important in the overall management of risk, and 77% of those responsible for managing risk are dedicated to instilling a more robust risk culture in the organisation. Although most literature discusses the importance of risk management, it is also important to focus more on prudent risk taking. In certain cases, regulation is driving change in the risk culture of financial risk and thus risk taking, because in some institutions risk is still seen as a secondary compliance issue rather than an essential part of strategy. Financial institutions should set realistic limits on the risks they take that fit the culture and risk appetite of both the individual business units and the overall organisation. As a result there is a subtle balance in matching the level of risk exposure to the culture in which that risk is managed. KPMG (2009) further identifies risk governance, risk culture and reporting and measurement of risk as the key building blocks of a risk infrastructure and the main areas to be addressed in the context of risk management.
Stulz (2010) argues that CDSs in particular enabled an unsustainable credit boom as well as excessive risk taking by financial institutions that even led to market manipulation. This highlights that risk taking by financial institutions in the lead-up to the GFC can largely be explained by the use of CDSs. Stulz (2008) also highlights that not all significant losses are necessarily attributable to the failure of the risk management. Although this thesis focuses on the aspect of risk taking by firms and hence the need to concentrate more on risk management, it is important to understand that the extent of losses suffered by firms may not necessarily reflect poor risk management. For example, risk management strategies could fail by choosing the wrong risk metrics, failing to communicate risk assessments to top management and boards etc.; however, when the models reach their limits of usefulness, the losses would not necessarily be attributable to a flaw in the risk management system. In such cases Stulz (2008) recommends using ‘scenario planning’ that assesses the implications of crises thereby determining the financial health and survival. Scenario planning that uses economic analysis rather than past data could evaluate the sudden illiquidity and associated feedback effects that commonly occur in financial crises. Nonetheless, it is more important to make prudent judgements in risk taking rather than focusing all efforts on risk management.

3.5.1 Research paradigms and concepts of risk

The dichotomy in the concept of risk was first proposed by Knight (1921): 'if you don’t know for sure what will happen, but you know the odds, that is risk' and 'if you even don’t know the odds, that is uncertainty'. This definition concentrates on the probabilistic component of risk. This makes an important distinction between predictable and unpredictable outcomes.

Many authors have proposed different conceptions of risk. The literature identifies three theoretical frameworks that present dichotomous perceptions of risk. The first framework relates to the positivist vs. the relativist (Shrader-Frechette 1991), the second relates to the positivist vs. the constructivist (Hornig 1993) and the third relates to the probabilistic vs. contextualist (Thompson and Dean 1996). In the first framework, Shrader-Frechette (1991) argues that positivists claim that risk is purely a scientific concept which requires scientific quantitative methods for its evaluation. However, relativists claim that risk is purely a subjective phenomenon that is encountered in personal experiences. Hornig (1993) following Shrader-Frechette (1991) presents a similar dichotomous view. The main
difference between the first and second frameworks is that Hornig (1993) defines the competing conception as contextualist/constructivist, meaning a subjective perspective. The author agrees that the need to measure the dimensions of risk is important, which is consistent with the perspective of positivists, but they may neglect the importance of other dimensions in a given context (i.e. non-experts understanding of risk). The third perspective contrasted the probabilistic and contextualist perspectives of risk, seeing both as important in understanding risk, as focusing on one extreme may distort the view of risk.

Following the above theoretical frameworks, Ben-Ari and Or-Chen (2009) identify a theoretical framework that integrates two perspectives of risk that have been traditionally presented: the positivist-probabilistic and the contextualist perspectives. By reconciliation of these approaches the authors attempt to present a deeper understanding of risk and increase the scope and utilisation of research methodologies in risk. The meaning of risk could be distinguished in technical and non-technical contexts. In a technical context it is defined as a situation or an event where something of human value is at stake and the outcome is uncertain (Rosa 2003). In non-technical terms it is defined as the possibility of an event occurring that will have an impact on the achievement of the objectives in future. Ben-Ari and Or-Chen (2009) argue that even if people act on determined probabilities it is difficult to ascertain that an estimate of a risk is exactly correct. These definitions reflect an inherent distinction that the term ‘probability’ could imply objective chances or subjective possibilities. The very concept of probability implies a certain degree of uncertainty.

The positivist-probabilistic perspective of risk is based on the assumption that there is an objective reality in risk that is independent of human perception and that can be known by employing systematic scientific methods of inquiry. This perspective is based on the quantification of probabilities that involves formulas, estimates, correlations and predictions that suggest a useful guiding tool for individuals involved in risky circumstances.

The contextualist perspective is based on the assumption that there is no objective reality independent of human consciousness (Ben-Ari and Or-Chen 2009; Tversky and Kahneman 1974), that is, there is no way of separating reality from a subjective perception that would be used to interpret it. This is because risk cannot be treated as a purely scientific fact that is independent of human experiences. Although risk is explained using probabilities, correlations, rational and irrational behaviour and certainty and uncertainty, it
cannot be completely understood by this objective perspective. According to the contextualist perspective, no single attribute such as probability is characteristic of risk, therefore it would be more realistic to use both positivist-probabilistic and contextualist perspectives to understand the different paradigms within which risk operates.

Douglas (1990) asserts that risk is not only the probability of an event occurring but also the magnitude of the possible outcome. The evaluation of the value that is set as an outcome will vary among different communities that might judge the seriousness of the risk depending on the extent to which they value the consequences. The knowledge of risk requires the firms to act according to principles, responsibilities and accountabilities, thus more importantly risk carries connotations of accountabilities. Conceptualisation of risk requires these two modes of thought which allow for application of a mixed method research design. Such a research design would have a post-positivistic paradigm that is mostly combined with a quantitative method and at the same time operating in a naturalistic paradigm that employs qualitative methods (Ben-Ari and Or-Chen 2009). Jackson et al. (2006) argue that, as individuals do not operate in a vacuum, the psychological analysis of the risk perception should be combined with the culturally embedded meaning of risk. This is because a pure psychological analysis would tend to ignore why individuals select one risk versus another. There is a benefit in integrating social and psychological analysis in understanding why the risk culture is so important in comprehending risk at a more realistic and practical level.

Sjoberg (2000) emphasises that risk mitigation should be directed towards the activity giving rise to unwanted events and to their causes. This is because risk mitigation is driven mostly by the severity of the consequences of unwanted events rather than the probability or the risk of the activity. Furthermore, as the concept of risk is closely related to the probability of the occurrence of an unwanted event, it has limited usefulness in understanding policy attitudes.

It is important to note that, in this thesis, risk is perceived from a contextualist perspective. This is mainly due to the decisions of using CDSs for trading and/or hedging purposes, and the level of risk involved is not expected to be purely judged by the objective technical meaning, but also by the subjective judgement of the managers of financial firms that helps
distinguish between a “good” risk and a “bad” risk. Weithers (2007) argues that there is a
difference between the trading of “real” credit and the market’s perception of credit. The
market’s perception is influenced by the probability of bankruptcy, default probabilities,
recovery rates, credit ratings and their changes or any other circumstance that would
influence the market price of credit risk. This is mostly reflected in credit derivatives
products such as CDSs. Moreover, as CDSs can be traded on their own without an
exposure to the underlying reference entity, the market’s perception of credit risk is to a
large extent relevant to the trading of CDSs. Hence, the contextualist perspective of credit
risk is adopted.

3.6 Regulatory treatment of credit derivatives

This section relates solely to regulatory treatment in credit derivatives for banks. While it is
appreciated that there are many non-bank financial institutions that trade in CDS markets
and thus are considered in this study, due to the larger number of participants in CDS
markets being banks, attention has been devoted to understanding the regulatory treatment
for credit derivatives.

The Basel Committee on Banking Supervision, under the Basel Accord, requires banks to
maintain adequate capital as a cushion against expected and unexpected losses related to
their operations (Basel Committee 2005a). As CRT markets allow credit risks to be traded,
it would blur the distinction between the banking book and the trading book (ECB 2004).

The primary concept behind risk-based capital requirement is to relate banks’ capital
requirements to the risk (i.e. credit, market and operational risks) associated with the assets
in financial institutions. If regulatory capital would reflect the financial risk of a bank, it
could reduce bank insolvency. Mei-Ying (2009) states that the incentive for a bank to
increase asset risk declines as the correlation between asset risks and risk weights declines.
Furthermore, only if the risk weights\(^{41}\) (Basel Committee 2005a) are proportional to
systemic risks (i.e if the risks are market-based), the risk based capital ratio would tend to

\(^{41}\) According to the Basel II capital adequacy regulations, commercial banks are required to maintain capital in
relation to the risk weighted assets. They are required to assign a risk weight to each balance sheet and off-
balance sheet item based on an external rating published by an approved credit rating agency (Basel
Committee 2005a).
be biased towards risky assets and effectively reduce the threat of insolvency. Maintaining capital according to the risk weights of assets is more meaningful in reducing the risk of insolvency of a bank. Empirical findings by Mei-Ying (2009) suggest that risk weights set by the Basel Accord do not properly reflect financial risk, rather they encourage risky behaviour as they are more favourable to risky assets than riskless assets. Such behaviour leads to the problem of moral hazard for supervisors in that they fail to reduce the incentives for risk taking behaviour.

Given that credit exposure of a protection seller to the underlying reference entity is identical to that of a lender to the same reference entity (APRA 2003), the protection seller is required to hold capital against this exposure, as long as the protection buyer can demonstrate that the credit risk of the underlying asset has been transferred to the protection seller. In the event the terms of the credit derivative do not adequately capture the risk parameters of the underlying asset for regulatory capital purposes, the risk weighting of the underlying asset should be replaced by the risk weighting of the protection seller (APRA 2003, 2006).

A principal benefit of CRT is the reduction in the costs of raising external capital for loan intermediation (Duffie 2008). The key consideration for banks is which credit risk to transfer and which to retain. This would depend on the cost of selling loans. If the cost diverges significantly across the pool of loans the bank would sell only those that provide the greatest benefit in terms of reducing the capital requirements. In adhering to Basel II bank capital regulations, banks need to maintain capital relative to the riskiness of their loan portfolio, therefore more capital will be required for banks that have higher risk loans. This would mean that it will be beneficial for banks to sell high risk loans and retain lower risk loans. Drucker and Puri (2009) argue that banks have relatively low monitoring costs for loans that are sold as there are restrictive covenants attached to loan packages. The implication for banks would be that they are more likely to transfer risk via products such as CDSs due to the need to maintain less capital which results in a lower cost. The existence of such CRT products would also mean that banks have a lesser incentive to accept loans of higher quality as the risk could be transferred to a third party.
Commercial banks, on a routine basis, employ credit risk management instruments such as CDSs to hedge credit risk from their loan portfolios as they share a substantial share of income as compensation for bearing credit risk. Although CDSs are not transferred off-balance sheet, due to the credit risk being transferred off-balance sheet, banks release the risk capital held with regard to the reference entities (Bomfim 2005).

Upon reviewing the regulatory treatment of credit derivatives, the next section briefly explains the regulatory environment within which risk is managed as this could have a significant impact on financial markets.

3.6.1 Regulatory environment in risk management

The 2007-08 credit crisis and its contribution to future risk management practices is an important area of debate among both academics and practitioners. Went (2009) argues that levelling the playing field of financing of different types of financial institutions such as commercial and investment banks could have a significant impact on financial markets and risk management of these institutions. The book leverage ratios of commercial banks are required by regulation to restrict their leverage in order to reflect the riskiness of the balance sheet assets and the off-balance sheet contingencies. This curtails their activities in comparison to investment banks.

Most risk disclosure requirements focus on the downside, i.e. what can go wrong, and the management’s attempt to prevent the downside from happening, mainly in US regulations such as the GAAP and SEC Risk Disclosure Requirements (Eccles et al. 2001). In risk reporting, managers are required to report the amount of risk in quantitative terms and the assumptions and methodologies used to arrive at the estimates. Also the management objectives and policies are required to be stated in order to indicate how they manage risk. In addition they need to disclose the fair value of all financial instruments when it is practical to do so and the methodologies and assumptions used to arrive at these values. It is also a concern that only some of these disclosures are audited but most are not.

Lending practices in credit risk management methodology have made progress in that credit risk is determined by the credit quality of the underlying company and the inherent riskiness of the product itself. However, Eccles et al. (2001) state that there is a large
information gap about the asset quality, in particular in the banking sector. This US based study further explains that both banks and insurance companies believe that they have good information systems for asset quality and do actively report them, although the market disagrees (i.e. the information not revealed in market prices), reflecting a large information gap. This dilemma is argued to be due to the difficulties in disclosing risk as it causes problems with competitors and investors alike. There is a lack of consensus in the market about a bank’s riskiness. Banks are particularly opaque as compared to non-bank financial institutions. This means that the risks taken in the process of intermediation are hard to observe from the perspective of an outsider. Banks are heavily regulated. This opacity of banks can be considered as a contributing factor to the collapse of the CDS market as banks have a better understanding of the risk characteristics of the borrower as compared to the market, leading to the problem of ‘adverse selection’ on the part of the investor.

Traditionally bank risk evaluation focuses on quantitative and qualitative aspects based on capital adequacy, asset quality, management, earnings and liquidity and funds management. Although through this approach a bank risk could be understood, a bank’s credit risk is mainly obtained by external credit ratings which are not able to provide direct information about a bank’s default probability and the loss in case of default. Structural credit models are considered to be a better proxy for credit risk (Liao et al. 2009).

3.6 Implications and issues with the use of credit derivatives

Commercial banks use credit derivatives to tailor their credit risk exposures. Junxun (2008) suggests that there are several reasons that explain why European commercial banks use credit derivatives to hedge more of their credit risk than previously. Firstly, before to the GFC, credit spreads were at low levels, with the effect of reducing the cost of hedging. Secondly, accounting changes in Europe meant that banks could carry loans at fair value, thereby reducing the conflict between the accounting treatment for credit derivatives and their use in risk management. Thirdly, the Basel II accord has aligned regulatory capital charges to actual credit risks and greater recognition of hedging. Junxun (2008) further identifies several challenges in risk management with the use of credit derivatives. The four

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42 They are able to endogenously generate default probabilities and, in certain instances, the loss given default.
challenges explored in this study are credit risk, counterparty risk, model risk and settlement risk. Credit derivatives do not eliminate credit risk, but they transfer it to other market participants. In certain cases this is done in ways that are not easy to understand, especially in the complex use of credit derivatives in CDO tranches. The fact that risk was not understood properly has been one of the reasons attributed to financial institutions incurring millions of dollars worth of losses. Counterparty risk, on the other hand, is the risk that the counterparty to a credit derivative contract will default (Junxun 2008). Although dealers post collateral and margin, (which reduces counterparty risk) due to the complexity of certain credit derivatives, the future potential exposures are not able to be identified accurately, therefore the management of counterparty risk in credit derivatives has become a challenge. Thirdly, model risk is another risk management challenge identified in the use of credit derivatives. Complex credit derivatives require complex valuation models. As most credit derivatives are not traded in liquid markets, the credit derivative products without a liquid market are referred to as marked-to-model. This risk of loss due to a flawed model is known as model risk. Finally, settlement risk is another challenge. Traditionally, settlement in CDS markets has taken the form of physical settlement. As the credit derivative markets have grown, the notional amount of CDS contracts outstanding referencing to a particular issuer is larger than the face value of the issuer’s bonds. This would increase the risk of the buyer not being able to be settled in due course. Credit derivatives pose another important challenge to risk management in banks due to synthetic CDOs.43 Gibson (2004) highlights that these are sensitive to the correlation of the defaults among the credits of the reference portfolio which are CDSs. Due to this correlation being unobservable, there would be differences of opinion among market participants with regard to the correct default correlation, which as a result creates trading opportunities and “correlation risk” which need to be managed in financial institutions.

Credit derivatives transfers credit risk to a third party while simultaneously retaining the legal title of the asset. Morrison (2005) suggests that there are two characteristics that differentiate CDS markets from other secondary loan markets. First, as credit derivatives could be traded easily in a secondary market they help banks manage concentration risk, as it improves portfolio diversification synthetically along with better management of credit

43 Synthetic CDOs gain credit exposure to a portfolio of fixed income assets without owning those assets through the use of CDSs.
portfolios. As a result, many bank originated loans are actively traded and held by non-banks. The second reason is that borrowers are not informed that their loan is the reference asset of a transaction. As the reference entity does not require knowing the existence of the trade, OTC contracts are called for keeping the transaction confidential.

Hirtle (2009) explores whether the use of credit derivatives is associated with an increase in bank credit supply, and evidence does support their greater use as being with greater supply of credit especially for large term loans. This evidence also suggests that benefits of the growth in credit derivatives are narrow, mainly accruing to large firms. Further, the findings have indicated that the use of credit derivatives appears to be complementary to the other forms of CRT mechanisms. Although there are many studies that highlight the cost advantage to a firm’s debt financing in using CDSs. Ashcraft and Santos (2009) investigate the effect of CDS spreads that underlying firms pay at issue when they seek funding in the corporate bond market. The study found no evidence that the onset of CDS trading affects the cost of borrowing for the average borrower, but it has a small positive effect on spreads on issue for transparent and safe firms. The study identifies problems such as when the CDS market would give an option to banks to hedge their corporate exposures, it reduces the effectiveness of the retained share of a lead bank with other participants of a loan syndicate. This could have an adverse impact on the CDS market on risky and opaque borrowers.

Geithner (2006) recognises that although credit derivatives are only 7% of the total notional OTC derivative contracts, it generates a significant fraction of the counterparty credit risk. This counterparty credit exposure is believed to be larger than the capital cushions of many bank and non-bank financial institutions. Greenspan (2005) states that risk transfer through derivatives is effective only if the parties whom the risk is transferred to can perform their contractual obligations. These counterparties include the derivative dealers that act as intermediaries and hedge funds and other non-bank financial institutions that bear the ultimate risk. The counterparty credit exposures are expected to be harder to measure due to the complexity of the instruments. Counterparty risk is also identified as the risk that the financial system becomes vulnerable to a crisis due to credit derivatives being dominated by too few banks, which means that if one of the banks fails to meet its obligations it will create a systemic effect across the financial system (Kraft and Steffensen
Geithner (2006) highlights that in the present financial system there is less risk-concentrated in banks due to the use of CRT instruments, therefore the probability of systemic financial crises would be lower than traditionally in bank-centred financial systems. Duffie and Zhu (2009) assert that by adding a central clearing counterparty for asset classes such as credit derivatives, it improves the counterparty risk mitigation compared to bilateral netting between dealers.

While many authors highlight the risk in credit derivatives to financial institutions and the broader financial system, Weithers (2007) investigated this phenomenon to a deeper level highlighting an important difference between trading “real” credit and trading the market’s perception of credit. Trading “real” credit is related to the actual act of filing for bankruptcy or defaulting on periodic payments of a loan or when restructuring under financial duress. On the contrary, trading of markets perception of credit is related and influenced by the probability of bankruptcy, default probabilities, recovery rates, credit ratings and its changes or any other circumstance that would influence the market price of credit risk. This difference is commonly reflected in credit derivatives and in particular in total-return swaps. The New York Insurance Department (NYID) (cited in Weithers 2007) state that although credit derivatives are likened to insurance contracts, credit derivatives cannot be marketed as insurance products due to the fundamental difference of a derivative product transferring risk without regard to the actual loss, as the contracts are not dependent on proving an actual loss, while insurance only transfers the purchasers actual loss. Ciro (2004) examines the uncertainty associated with credit derivatives and the law of insurance stating that the real risk still remains that derivatives may be characterised as insurance contracts which would affect their enforceability. The problem of enforceability results from the fact that insurance contracts and credit derivatives primarily involve the transfer of risk. Some critics suggest that insurance contracts should be categorised as risk management products.

The same issue has been considered by the New York Insurance Department (NYID) (Kramer et al. 2009) of whether CDSs are in fact insurance contracts. On 1 January 2009 it issued a circular stating that it would view them as insurance contracts if they are purchased by person’s with material interest in the underlying bonds or assets. This means the CDSs have to be covered, and their buyers also need to hold the underlying asset as such engage
in hedging. This also has created the issue of whether all OTC derivatives that are covered be considered as insurance contracts. Kramer et al. (2009) argue that the fundamental point of differentiation between insurance contracts and CDSs is that where the threat of loss by the insured is “something of value” and before the insured collect the proceeds under the contract should demonstrate that it has actually suffered a loss from an “insurable risk” as a result of the “insured event”. With regard to a CDS, the concept of “risk” has no relevance whatsoever and hence is not the central theme of a CDS contract. This is because in such a contract, whether covered or uncovered, neither party need be at a “risk”, meaning payment is due under the contract without proof of an insured loss as is the case in an insurance contract (Kramer et al. 2009). For these reasons the authors argue that the NYID’s decision to treat CDSs as insurance contracts is inappropriate. Differentiating CDS contracts from being treated and understood as insurance is important as a significant source of risk that CDSs are exposed to comes from their ability to be traded without any exposure to the underlying asset. Such speculation and arbitrage using CDSs on their own can further contribute to risk taking of firms.

Although there are many observers that argue the significant contribution of CDSs to the credit crisis Stulz (2010) argue against this proposition, concluding that CDSs did not cause the series of events in the credit crisis. Furthermore, the regulated exchange trading of credit derivatives, compared to the current OTC trading, could lead to a reduction in social welfare. A common argument with credit derivatives in general and CDSs in particular is that they are traded over the counter which is largely unregulated. This is mainly due to counterparty risk which can contribute to systemic risk, because when one party to a contract fails to meet its obligation it could destabilise the financial system by causing significant losses many other trading partners simultaneously (Squam Lake Working Group on Financial Regulation 2009).

3.6.1 CDSs and Systemic Risk

Contagion or the systemic effect of CRT mechanisms is an important element of CDS markets discussed in the literature. Jorion and Zhang (2007) explore the information effect of credit events across the industry that is captured in CDSs and stock markets. When credit events tend to cluster due to positive correlations it is defined as a “credit
contagion”. These contagion effects are indicated by the increase of spreads of industry competitors. The study concludes that chapter 11 bankruptcies would lead to increase of credit spreads in CDSs, while chapter 7 bankruptcies are associated with significant competitive effects. Das, Duffie and Kapadia (2005) indicate that it is important to check whether the current credit risk models are consistent with the contagion dynamics of CDSs. Persaud (2008) argues that most participants in financial markets have the same data on risk, returns and correlation of financial instruments and use of standard optimisation models which means that they would move into favoured markets and move out of favoured markets based on the results of the models. Due to a random rise in volatility, a firm would want to reduce its exposure and other firms in the same markets would tend to exit from their exposures at the same time. This in turn could create a vicious cycle and prompt further selling and thus a vertical reduction in price. As market-sensitive risk models are increasingly integrated into financial supervision, it has led to all financial firms being exposed to the risk of a market collapse (Persaud 2008).

Neyer and Heyde (2008) explore the impact of CDSs on the stability of the banking sector. The study asserts that CDSs reduce the stability of the banking sector in a recession. The primary reason for the creation of instability is that banks that use credit derivatives increase their investments into risky, illiquid asset portfolios and reduce their investments into safe and relatively liquid assets. As the resulting lower risk, due to diversification of banks’ credit risk, banks may incline to invest in riskier credit portfolios. Secondly, CDSs create a possible contagion due to banks having contingent claims on each other. This means that when these claims materialise, and if one bank fails another bank would realise a loss that it could not absorb. Although currently banks constitute both risks, insurance companies play an important role in CDS markets as protection sellers. Furthermore, the proportion of hedge funds as protection sellers and buyers have increased rapidly (Barrett and Ewan 2006).

Fitch Ratings (2009) show that market participants have recognised, among others that contagion, the failure of a main counterparty, the lack of restructuring credit events and liquidity as the main forms of surprises that would affect CDS spreads to a large extent. The Fitch Ratings survey indicates that market participants highlight that the speed with which credit spreads widen, the volatility of credit spreads and the heightened perception
of counterparty risk that results when many institutions refuse to deal with others in the financial markets as the indicators of contagion. Blundell-Wignall et al. (2009b) stress that contagion risk and counterparty failure as the main features of the current financial and economic crisis (GFC) which has made it different and stronger than preceding crises. An important reason for this is identified as the high leverage in banks. The authors argue that some banks are as highly leveraged hedge funds. In a comparison between Westpac, Citigroup and Deutsche Bank, Blundell-Wignall et al. (2009b) argue that Citigroup and Deutsche banks’ balance sheet structure (on a consolidated basis) is similar to that of highly leveraged hedge funds. As at mid-2009 Deutsche Bank reported a leverage ratio of almost 50, meaning 50% of liabilities on the balance sheet are at fair value through profit and loss.\textsuperscript{44} However, this leverage ratio is said to be effective only when it is provided based on the equity of the firm (on both on and off-balance sheet structures), though yet it would not prevent increased risk taking for a given leverage ratio or exclude contagion risk. Systemic risk can be identified as one of the main features in the financial markets during the GFC that can also be attributed to the CDS market. As identified previously, systemic risk in the banking industry can be identified as a cause of the collapse of the CDS market.

\textit{3.6.2 CDSs and securitisation}

CDSs are also used as part of the process of securitisation. This is known as synthetic securitisation where their advantages are combined with asset securitisation in order to avoid the disadvantages of asset securitisation.\textsuperscript{45} MacKenzie (2010) argues that by buying credit protection on asset backed securities\textsuperscript{46} via CDSs financial institutions can hedge against any adverse movement of the underlying securities. This in turn can create an incentive for firms to monitor the quality of the underlying assets that are used in the securitisation process. ABS CDSs have proved to be extremely popular, where the total number of contracts totalled about $100 billion by the end of 2005, out of which 60% of CDSs were based on subprime mortgage backed securities (MacKenzie 2010).

Some players in CDS markets are both buyers and sellers of protection; i.e. by buying protection of their own loan portfolios and enhancing the diversification of these loan

\textsuperscript{44} A typical hedge fund has a leverage ratio of 4 or 5 (Blundell-Wignall et al. 2009b).
\textsuperscript{45} See Chapter 2 for a detailed discussion.
\textsuperscript{46} Products of securitisation, for example, collateralised debt obligations (CDOs) and ABS.
portfolios by selling protection on other reference entities that may not have access to in
the loan markets (Azarchs 2003). Shadab (2009) asserts that OTC derivative markets are in
important ways superior to securitisation in transferring risk. In this study he explores the
case of AIG\textsuperscript{47} of how the use of credit derivatives to hedge mortgage-backed securities\textsuperscript{48}
would tend to over-concentrate credit exposure. CDS agreements that reference mortgage-
backed securities enable more risk to be taken on and also to make risk more concentrated
in financial institutions. AIG by the end of 2007 accumulated $527 billion in notional credit
risk exposure as a CDS protection seller, of which $61.4 billion of CDSs were referenced to
multi-sector CDOs. With the deterioration of the values of the mortgage-backed securities
AIG’s obligations increased, increasing its risk concentration (Shadab 2009). Complex CDS
products such as ABS CDSs increase risk concentration in financial institutions and
financial markets, amplifying losses from the underlying asset. The effects of a crisis could
be exacerbated through the use of CDSs in the securitisation process.

3.6.3 CDSs and risk taking

Instefjord (2005) questions whether the innovation of credit derivatives and the resulting
trading of derivatives make banks riskier, but this is dependent on how much of extra risk
will be transferred and how much risk will be retained by the bank. This in turn would
depend on the price elasticity of credit markets. For example, if the underlying credit
markets are too elastic banks operate aggressively resulting in derivatives innovation that
will threaten the solvency of the bank. In contrast, if the underlying credit markets are too
inelastic, there is an opposite effect and the banking sector is stabilised. The analysis of the
model developed by Instefjord (2005) identifies two effects on the innovation of credit
derivatives; they enhance risk sharing at the same time they make it easier to acquire further
risk.

Skeel Jr and Partnoy (2007) in their study have identified the likely benefits and dangers in
using CDSs. Among the problems of dealing with CDSs, one important problem is
reducing the incentives for banks to monitor. In the standard account of a bank’s role in
corporate governance would mean that when a borrower defaults, the bank would step in

\textsuperscript{47} American International Group (AIG) was over exposed to credit default swaps and was bailed out by the

\textsuperscript{48} Asset-backed securities generated through the process of securitisation.
and take charge of the company requiring a restructure of the top management. That is, in the event of the bankruptcy of the borrower, the bank would use the loan agreement to dictate the course of the restructuring process. However, there are offsetting benefits when banks hedge this default risk. Lenders’ access to CDSs complicates the assumption that a significant bank presence would mean an active oversight of the borrower. As CDSs could lead to less monitoring oversight this in turn could suggest moral hazard on the part of the borrower who will be subject to less financial discipline by the lenders. The opacity of CDS markets is also considered to be another important problem as OTC markets are largely unregulated. Among other things, this would mean that often the details of these CDSs are not disclosed. Scannell et al. (2006) state that the increasingly sophisticated nature of these financial instruments (i.e. CDSs) has outpaced the ability of regulators to regulate them, with the possibility that some traders could act on inside information. Among banks, managed funds, and insurance companies, hedge funds are notably a large player in credit derivative markets. The problem is that hedge funds are less regulated, which is a concern as they deal in a large number of unregulated transactions. This would increase the systemic implications in the financial system.

Dickinson (2008) argues that CDSs could help create asset bubbles and threaten the wellbeing of the financial system and economy. This is because, with the CDS market, banks are less exposed to a default of the borrower, thus they have a higher incentive to extend loans to borrowers that are default prone. This in turn would lead to an increase in asset prices, creating an asset bubble. In this case asset prices exceed their fundamental value.

Karras (2009) explores the behavioural effects of credit derivatives on bank behaviour. The study shows that the use of credit derivatives could lead banks to reduce their capital base which in turn would have multiple effects on bank behaviour. The author states that size would be an important factor in the amount of capital that a bank would retain based on the level of credit derivatives the bank holds, as large banks use advanced credit risk management strategies that make it able to hold less capital. i.e. as credit derivatives can offset credit risk effectively, banks are able to reduce the capital stock they hold for unexpected losses. The Basel II framework recognises the regulatory capital relief for credit derivatives, in particular, as Basel II introduces enhanced risk-sensitive capital rules, the use
of credit derivatives will lower losses related to default. An important development in bank regulations is that the Basel II framework gives more flexibility to national supervisors to work with the banking industry of their own country and develop national standards (Basel Committee 2005c). The regulatory capital relief provided for credit derivatives used as part of hedging can in turn increase risk taking by financial institutions due to lack of monitoring by the lender. In addition to lenders being less likely to monitor the borrowers, they may also not be concerned with the quality of the loan being accepted due to the possibility of transferring the credit risk to a third party. As a result, credit derivatives can increase risk taking by financial institutions.

In addition to hedging, CDSs are also used as part of trading strategy by financial institutions. Due to their growing use for trading purposes (Fitch Ratings 2010), the following section discusses the implications of CDS trading on the performance of the CDS market.

3.6.4 CDSs as a trading instrument

CDSs were originally developed for hedging purposes (see Chapter 2), as an instrument that hedges credit risk of an asset, but they can also be traded on their own with absolutely no exposure to the underlying asset. The trading of naked CDSs has been argued to have played a pivotal role in the GFC and more recently the Greek debt crisis in the euro zone (NY Times 2011). Banks often acted as market makers in CDS markets, especially in standardised CDSs and credit indices where they earned money via the “bid-ask spread”. Speculation of CDSs were carried out by investment banks and hedge funds predominantly and have proved to be very profitable. In addition CDSs have also been used along with securitised products such as CDOs. These involve the creation of ‘special purpose vehicles’ that construct a pool of assets either by buying or selling protection them through CDSs (MacKenzie 2010). With credit rating agencies awarding higher ratings these securities could be sold at far higher rates than the cost of assembling. Banks could make arbitrage profits through this process. MacKenzie (2010) suggests that in the early 2000s sell-side banks enjoyed profit rates of over 40%. In this process, institutions also use CDSs (buy protection) to predict the probability of the reference entity going bankrupt, thus making profits (NY Times 2011). As they have played a significant role in asset securitisation by

49 Tradable indices references debt of multiple corporations.
bundling mortgages/assets with credit protection, this in turn could lead to a reduction in efforts in analysing the risk and could result in negligence in due diligence. In other words, such a use of CDSs in synthetic securitisation (see Chapter 2 for a detailed explanation) can increase a firm’s risk taking.

Capital structure arbitrage, another profit making mechanism, has been popular with banks as well as hedge funds. This involves making a risk-free profit using the CDSs and the capital structure of a particular institution. In essence it uses a structural model that determines the CDS spread, thus comparing it to the market rates would assess how different the spreads are to its actual worth. If the market spread is substantially higher than the predicted spread and if the equity markets are more objective in the assessment of credit protection, then the arbitrageur could sell protection. In contrast, if the market spreads are expected to be correct and the equity market is expected to be slow in reacting to new information, then the arbitrageur will sell the equity thereby making a profit (Yu 2006). In practice, Yu (2006) suggests that arbitrageurs may take both positions as they are unsure which market is underpriced, and profits when the market spread and the model spread converges. CDSs make it profitable to trade credit risk when such trades were not profitable before.

Another point to note is that when credit risk can be separately traded from the cash bond, where the protection buyer does not own the underlying asset, this could mean that the amount that is traded synthetically can be far greater than the outstanding amount of bonds, due to the increased leverage potential. CDS trading has increased purely for information based reasons. Although equity markets are very sensitive to new information, debt markets have not been very sensitive to firm specific information prior to the existence of CDSs. This important change in how debt markets work means that there is more information on how debt markets work and it pays to find out more information when trading CDSs (Gortern 2010).

Gary Gensler (2010), Chairman of the US Commodity Futures Trading Commission, argues that the free fall of stock prices in 2008 may have resulted CDSs as buyers of CDS protection have an incentive to see a company fail and may engage in activities that help undermine the prospects of the underlying asset. CDSs also could result in an “empty
creditor problem” (Bolton and Oehmke 2011) where bondholders or creditors that have bought CDS protection can benefit once the company has gone to bankruptcy. These bondholders have a higher expectation for the underlying firm to default or to go bankrupt than succeed. Such “empty creditors” have a different interest once the underlying asset defaults as compared to creditors without CDS protection as they have an incentive to force a company into default or bankruptcy (see also Gensler 2010). One can argue that while CDSs were initially considered as an efficient market innovation, assisting in risk management, their application for trading purposes and the resultant extraordinary profit making opportunities have made them increasingly popular, thus encouraging risk taking to a great extent.

Given that CDSs are part of hedging and trading strategies of financial institutions, the institutions risk profile can be largely influenced by their use. It is important to identify how the risk management processes of financial institutions, in particular banks, have had an effect on the overall financial stability on the banking and non-banking system. The following section discusses the impact of use of credit derivatives as part of the risk management process on the stability of the financial system.

### 3.7 Risk Management and Financial Stability

Since the 2007-08 subprime crisis, risk management has been at the forefront of the issues discussed in the finance industry. This is primarily because of the deficiencies of the risk management practices of financial institutions, in particular credit risk management, that have been highlighted as a contributor to the crisis. Wellink (2007) asserts that the role of banks as the ultimate holders of credit assets has become less important due to advances in technology and innovation of new financial products. Nevertheless, global banking institutions together with other securities firms are at the centre of the global credit intermediation process. Through this process, the risks are now widely dispersed outside the banking system. This has meant that there are more tools to manage credit risk and the risks and their pricing is more transparent, which helps manage credit risk of deteriorating exposures more efficiently than before.

Weithers (2007) identifies three issues for consideration of systemic risks in the use of credit derivatives: firstly, whether the ability to transfer credit risk has influenced the
activities related to bank lending and issuance practices; secondly, whether there are macro-
economic factors that act as a catalyst for widespread credit crises and related implications
for credit derivatives markets; and thirdly, whether the greater dispersion of credit risks in
the system is a positive stabilisation development.

The most important problem with credit derivatives is that people do not know where
exactly the danger begins and at what point it becomes a super danger (Warren Buffett,
cited in Waggoner 2008). Although the CDS markets are growing, the market for “lemons”\(^\text{50}^\) still remains for companies that are not well known, because a liquid market only exists for
companies with credit exposures that have low information asymmetries.

The unrestrained use of credit derivatives, particularly CDSs, has increased the
interconnectedness and fragility of the global financial system. In order to counter the
systemic ramifications OTC derivatives trading, post GFC, the US Treasury and the EU
commission have issued legislative proposals pertaining to standardisation of OTC
derivatives and a central counterparty that could facilitate bi-lateral and multi-lateral
trading. The proposals put forward by the US government raise two major issues: firstly,
the stress tests used to determine whether or not an institution is systemically significant
are rather difficult to administer and opaque, adding uncertainty to financial markets; and
secondly, how could reforms address the counterparty risk and systemic risk posed
particularly by credit derivatives? Gerding and Blair (2009) argue that the proposal put
forward by the US Treasury in May 2009 would encourage derivative activities to move to
exchanges which mitigates counterparty risk through transparency, market pricing and
clearing services provided by the exchange. The disclosure of the notional value of an
institution’s credit derivative contracts is important as it is a good indicator of systemic risk
of the financial system. Although notional value is not a good indicator of market values of
credit derivatives, it is a powerful indicator of systemic risk as it indicates the maximum
amount an institution could owe to (or be owed by) other institutions, for example, in a
credit freeze. Ashraf et al.(2007) argue that a large increase of the notional value would
mean that a bank has transacted credit derivatives as an end user in order to hedge credit
risk on its loan portfolio or else it could indicate an increase in customers’ usage of credit
derivatives where the bank acts as an intermediary.

\(^{50}\) “Lemons” are referred to as unsecured loans.
Pelizzon and Schaefer (2002) examine whether risk management and regulatory policy would reduce risk in banking in particular. They found that when banks only earn rents from deposit insurance and can engage in risk management, it is no longer in their interest to increase/maximise risk. This means that when a bank’s franchise value derives entirely from the deposit insurer, but when the franchise value is lost due to default, it will not be optimal for the bank to maximise volatility of their asset portfolio at all times. The ability to engage in risk management would increase the value of deposit insurance and decrease the probability of default.

Boyd and De Nicolò (2005) look specifically at risk-taking behaviour of banks rather than risk management processes. Existing theoretical literature (Dick 2006; Jayaratne and Strahan 1998; Keeley 1990) emphasises that when confronted with increasing competition, banks intentionally take on more risk. The model developed by Boyd and De Nicolò (2005) assumes that borrowers entirely determine the risk of their project which is conditional on the loan rates set by the bank. The banks would use their market power to increase loan rates with increasing funding costs, thus borrowers optimally use high risk projects. Banks become more risky as a result of markets becoming more concentrated rather than an intentional risk taking.

3.8 CDS spreads, price discovery and liquidity

O’Kane and Sen (2005) define CDS spreads as the “contractual spread which determines the cashflows paid on the premium leg of a credit default swap”, which is the contractual premium paid to a protection seller in a CDS contract. Credit spreads generally attempt to measure the difference in credit quality by comparing the return of the credit risk security as a spread to some higher credit quality benchmark such as a government security (which is assumed to be credit risk free). A CDS premium is referred to as a “spread” even though it is not referenced to a particular interest rate curve. The reference curve is implicitly taken as LIBOR (O’Kane and Sen 2005). The CDS spread is calculated as the spread that makes the present value of the CDS equal to zero.

CDS spreads depend not only on the perceived risk of default by a borrower but also on the features of the underlying bond, for example, coupon and maturity. They are always defined in relation to a specific debt structure under consideration (Kalotay et al. 1999).
Although credit ratings have a significant impact on credit spreads, i.e. higher ratings would mean lower spreads and vice versa, it cannot be directly converted to the incremental borrowing cost against the treasury rate. This is because the changes in the market’s perception of risk as reflected in the changes in prices, and spreads, often tend to precede rating changes.

CDSs are considered to provide the easiest way of trading credit risk. For example, many corporate bonds are held to maturity by investors. Secondary market liquidity is often low and those who acquire bonds in secondary markets find it difficult and costly to trade credit risk (Schultz 2001). This is because shorting credit risk is more difficult in the cash market. Credit derivatives and CDSs in particular allow investors to short sell credit risk over a long period of time at a known cost through the process of buying protection (O’Kane and Sen 2005). For this reason, price discovery in CDSs is an important issue discussed in literature. The approximate arbitrage relationship between credit spreads and CDS spreads would mean that the two would normally be closely linked. Hull and White (2000) demonstrate that for a given reference entity there is an arbitrage relationship between credit spreads and CDS spreads.

Price discovery is considered to be one of the most important functions of financial markets. It is defined as being the efficient and timely incorporation of information that is implicit in investor trading into market prices (Lehmann 2002). When closely related assets trade in different markets, as in the cash market and the CDS market, price discovery is split between the two markets. O’Kane and Sen (2005) demonstrate that price discovery primarily takes place in CDS markets for the main reason that their structural factors make it more convenient to trade credit risk and also due to the existence of different investors that trade in the cash and CDS markets for different reasons. The price discrepancy between CDS prices and credit spreads are through the changes in credit spreads also reflecting that CDS markets lead in price discovery. It is through this arbitrage mechanism that CDSs and credit spreads price credit risk equally in the long run.

51 Shorting refers to short selling, that is, selling an asset that an investor does not own (selling a borrowed asset) in the expectation of a price fall in the future.
Zhu (2006) further explores the comparison of credit spreads between bond markets and the CDS market, finding that they tend to be priced equally in the two markets in the long run and there would not be any arbitrage opportunities. However, this study has found that there is strong evidence of market inefficiency in the short run in that the two markets exhibit considerable price discrepancy. Furthermore, the relative importance in price discovery in the CDS market and the bond market varies substantially across entities, especially in the US where the swap market tends to move ahead of the bond market. Some reasons for the discrepancy (known as the basis spread) between the bond market and the CDS market in the short run are the credit ratings and the rating events, the differences in the terms of a CDS contract, changes in credit spreads due to changes in credit conditions, macro-economic conditions and liquidity factors. In relation to macro-economic conditions, the two most important variables that reflect the performance of the economy and financial market conditions on the pricing of credit risk are the treasury rates and the regional stock market indices. If both markets are inefficient in pricing the effect of the macro economic conditions, this could lead to a difference in basis spreads.

Liquidity is another important determinant in CDS premia and bond spreads. Blanco et al. (2005) and Longstaff et al. (2005) confirm that price differentials between bond spreads and CDS spreads could be largely attributed to corporate bond liquidity factors. Credit spreads and CDS spreads are not only a function of credit risk (although CDSs allow separation of credit risk from market risk) but also liquidity risk which is unrelated to the underlying credit risk. High liquidity is often associated with lower bid-ask spreads in both credit spreads and CDS spreads and higher volume of transactions. Lower bid-ask spreads and higher amount of CDS quotes would mean that the liquidity risk and therefore the liquidity premium embedded in the CDS spread are low and vice versa. This in turn lowers the basis spread. A main reason for the pricing difference in spreads in the two markets is the efficiency and accuracy with which credit risk is reflected due to changes in credit conditions. Zhu (2006) argues that this difference is mainly due to the different responses to the changes in credit conditions. Furthermore, market segmentation also is considered to vary between the US and other countries, which leads to a difference in pricing credit risk in the two markets.
In terms of the riskiness of the CDSs, Tolk (2001) identifies that many of the risks in CDSs are driven by moral hazard. This is because the financial institution that is buying protection determines when a loss event has occurred as well as how much of a loss in imposed on investors when a credit event occurs. This means that the sponsor’s incentive will be to construe credit events as expansively as possible and calculate losses as generously as possible. Another risk that has been identified is the inherent difficulty in valuing defaulted credit in order to determine the extent of losses to investors. The ISDA (2003) has defined the credit events that would fall under the category of credit risk as bankruptcy, failure to pay, obligation acceleration, obligation default, repudiation and restructuring. If not structured properly, CDSs could also pass on the loss from *credit deterioration short of default*, for example, which is not part of “credit risk”. Tolk (2001) states that as CDSs are synthetic exposures to the underlying reference obligation, they are riskier than having a cash position on the underlying reference obligation.

Wagner (2007) argues that instruments that transfer credit risks would improve a bank’s ability to sell loans, making it less exposed to liquidity risks. This is because higher asset liquidity increases stability by encouraging banks to reduce risks on their balance sheets. This in turn would encourage them to take on new risks that would more than offset the positive impact on stability.

Tang and Yan (2007) present an empirical study of the pricing effect of liquidity in the CDS market, explaining that liquidity risk is being priced beyond liquidity levels in CDS markets. Several studies illustrate that CDS spreads seem too high to be accounted for default risk alone and suggest that liquidity could be a factor in determining CDS spreads (Berndt et al. 2005; Saita 2006). Tang and Yan (2007) estimate that the liquidity premium on CDSs is around 10.9 basis points and on average liquidity and liquidity risk account for about 20% of CDS spreads. Azarchs (2003) argues in a study by Standard and Poors that institutions that take on credit risk with the use of credit derivatives improve liquidity and convenience as well as pricing of credit risk. The study further outlines that, for net protection sellers, CDSs provide an attractive return for low-risk investments.

The next section discusses the theoretical framework within which this study is based.

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52 In this case, investors may suffer losses that are not covered by a Moody’s rating of the reference obligation.
3.9 Theories addressing the rise and fall of CDS markets: managerial self-interest

3.9.1 Positive accounting theory and managerial self-interest

Positive accounting theory as originally developed by Watts and Zimmerman (1978) is based on the assumption that agents or managers are rational individuals who are concerned with furthering their own interest. It also assumes that individuals are rational and that accounting numbers play a crucial role in the distribution of wealth (Godfrey et al. 2003), thus that individuals attempt to maximise their financial wealth. The theory suggests that the basic motivation for managers to select a given accounting policy is the maximisation of their own utility. Holthausen (1990) identifies three overlapping perspectives in accounting choice, one of which is opportunistic behaviour by managers. In such a setting, managers are assumed to maximise their own wealth, which is related to performance related cash bonuses, the risk of employment (which arises from the possibility of bankruptcy or a takeover) and the value of the firm shares. This value will affect the maximisation of their own wealth if managers are provided with shares or share options, as explained in section 3.9.1.5.2, thus they would be more inclined to increase the return on the shares by increasing risk. Agency theory discussed above forms part of the foundation of which primarily attempts to predict accounting practice. This theory is described in terms of three hypotheses: the compensation hypothesis, the debt covenant hypothesis and the political cost hypothesis. The compensation hypothesis suggests that if the manager’s compensation is linked to the firm earnings, when firm reported earnings increase, the manager’s compensation will also increase. The debt covenant hypothesis is based on the assumption that as the default on a debt contract is costly, larger the debt/equity ratio, the more likely that the manager will use accounting procedures that shift reported earnings to future periods. The political cost hypothesis is based on the assumption that larger firms are more politically sensitive than smaller ones, with managers of large and small firms facing different incentives to shift reported earnings to future periods (Watts and Zimmerman 1978).

Although primarily this theory discusses managerial self-interest and its link to accounting procedures, in this thesis the concept – that is, the fact that managers create incentives to further their own interests – is explored in detail in relation managerial risk taking. As
mentioned in the previous discussion of agency theory, due to managerial incentive structures such as share options, the regulatory environment in which financial institutions operate (such as too big to fail perceptions) and the use of CRT instruments such as CDSs\(^53\) can increase managerial risk taking that is highlighted in the CDS spreads of a financial entity.

3.9.2 Agency theory and managerial self-interest

The origins of agency theory can be traced back to Berle and Means (1932) and Coase (1937) who first highlighted the separation between ownership and control. Other literature exploring risk sharing among individuals and groups developed during the 1960s and early 1970s (Arrow 1971; Wilson 1968). Agency theory has broadened the risk sharing literature to include the agency problem between the principal and agent. The problem occurs when cooperating groups have different goals and divisions of labour. Agency theory (Jensen and Meckling 1976) is concerned with addressing two issues that could occur in the agency relationship. The first is the conflict of interest between the goals of the principal and the agent. This presents difficulties for the principal to verify what the agent does. The second issue relates to the risk sharing between the principal and the agent when their risk preferences differ. As the unit of analysis is the contract governing the principal-agent relationship, the focus of the theory is in determining the most efficient contract governing the contract, subject to basic positive assumptions relating to the people’s behaviour (self-interest, bounded rationality and risk-aversion).

Agency theory has been developed along two lines, the positivist and principal-agent. Positivist researchers focus primarily on identifying the conflicting goals of the principal and agent, thereby describing the governance mechanisms that limit the agent’s self-serving behaviour. Principal-agent theory is concerned with a general theory of the principal-agent relationship, which is a theory that could be applied to any agency relationship, for example, those that exist in banks. The model in its simplest form assumes goal conflict between the principal and the agent. Also, the agent tends to be more risk-averse than the principal as the agent is unable to diversify his/her employment.

\(^{53}\) Due to insider trading and encouraging risk taking, due to transferring risk off-balance sheet.
Agency theory also suggests that this difference in risk preferences can be aligned by using share options based compensation structure for managers. In this case, the risk is transferred to the agent. Crutchley and Hansen (1989) suggest that agency theory dictates three specific ways to reduce agency costs associated with equity: increasing managerial stock ownership, increasing dividends and increasing leverage. Jensen and Meckling (1976) argue that by increasing firm ownership by the managers, managerial opportunism decreases. While increasing managerial share ownership and dividends align the interests of agents with that of shareholders, increasing the levels of debt in the capital structure will increase the agency costs of debt, whereby shareholders may be encouraged to engage in high risk activities that transfer wealth from bondholders to shareholders (Mercado-Mendez and Willey 1995).

3.9.2.1 Agency problems and banks

Although this study explores agency problems in the context of bank and non-bank financial institutions, this section is devoted to the specific agency issues related to banks, as these are large players in CDS markets and have a significant influence on CDS trading.

Previous research confirms that banks conform to the concept of firm used in agency theory (Allen and Cebenoyan 1991; Gorton and Rosen 1995; Saunders et al. 1990). The standard agency models assume normal and competitive markets, that is, the link of information asymmetry being the principal-agent relationship between the manager and the owner of a firm, and the optimal capital structure requires limited leverage. However, the environment in which commercial banks function is more complex. Commercial banks operate in regulated markets. This causes the agency problem to be more intricate and the capital structure of a bank is highly geared, which reflects its role as an intermediary\(^{54}\) (Ciancanelli and Reyes-Gonzalez 2000). In addition to the agency problem between owners and managers, there is an asymmetry of information which lies between depositors and the regulator; owner, managers and the regulator; and borrowers, managers and the regulator. This gives rise to four sources of moral hazard, the first one being the conventional principal-agent problem involving the owner (principal) and manager (agent). The second

\(^{54}\) Owners seldom provide more than 10% of the funds in banks, with depositors and bondholders providing the rest.
relates to the literature in the area of bank regulation where the depositor is the principal
and the bank is the agent. This is due to the regulator insuring the depositor in order to
limit systemic risks. The third and fourth sources of moral hazard are linked to governance.
As regulation is an external governance force, regulations result in the existence of interests
that are separated from the private interests of the firm. This means that banks’ governance
must concern with not only the interests of the owners and shareholders but also the
public interest (Yamak and Suer 2005).

The two main arguments presented in the literature which aims to justify bank regulation
are systemic risk and depositor protection (Polo 2007). Depositor protection and lender of
last resort mechanisms are the tools that governments use to prevent bank runs, contagion
and other strains of systemic risks. Through “lender of last resort” support from the
governments, much attention has been focused on management of exogenous shocks to
the system. The “lender of last resort” operations bail out all banks regardless of their
previous conduct. This means that banks shift the risk to other stakeholders in the system.
The “too big to fail” policy of the government means that regardless of any risky lending
behaviours that banks are engaged in, they would be bailed out inevitably, as failure to do
so would threaten the entire banking system (Goodhart et al. 1998; Long and Vittas 1991).
The effect of regulation in the banking sector has important implications for the structure
and dynamics of the principal-agent relationship in banks.

The main implication is that the commitment of investors in banks would be lower than in
other firms. This is because owners of banks share the risk with the regulator. Therefore
they have less incentive to monitor the excessive risk taken by the managers; rather they
have an incentive to take on greater risks than what is deemed prudent by the regulator
(Ciancanelli and Reyes-Gonzalez 2000). This leads to a problem of moral hazard, which
will increase if principal’s and agent’s interests are aligned through actions such as profit
related bonuses and share options, as the manager’s commitment to the bank would be
reduced. John et al. (1995) argue that managerial compensation affects investment choices
of a firm and the effects are magnified when managerial discretion and moral hazard are
present. Regulators and shareholders have an interest in monitoring the compensation
structure of managers.

Through deposit insurance or other government protection schemes.
The two main forms of agency problems within organisations are moral hazard and adverse selection. Each is reviewed below within a banking context in relation to the use of credit derivatives.

3.9.2.2 Moral hazard

Moral hazard in the banking industry has been identified as a major contributor to the GFC (Hellmann et al. 2000; Mei-Ying 2009; Prescott 1999), particularly in explaining increased risk taking behaviour and the consequently high financial difficulties in banks (Berndt and Gupta 2009; Blundell-Wignall 2008; Keeley 1990). Owner-manager agency problems also provide a reason for such increased risk taking. Gorton and Rosen (1995) have provided a model which assists in explaining the owner-manager agency problems and their contribution to increased risk taking in banks. According to their model, bank managers with expected lower future profits are inclined to increase portfolio risk in order to conceal profits that have not met shareholders’ expectations.

Demsetz et al. (1997) have investigated the risk taking behaviour of banks in relation to the moral hazard problem associated with deposit insurance. As government regulatory agencies such as the Australian Prudential Regulation Authority (APRA) protect depositors from the consequences of risk taking, depositors tend not to have an incentive to control the risk taking and/or monitor shareholder behaviour. This is known as moral hazard in relation to the existence of deposit insurance or other government protections such as being the “lender of last resort”. Kane (1990) asserts that regulators do not have sufficient incentives to monitor levels of risk taking in banks as ultimately it is the taxpayers who bear the risk of bank losses. Gonzalez (2005) further argues that under a “too big to fail” policy, larger banks may have a greater incentive to take on higher risks compared to smaller banks as they enjoy a complete safety net. Notwithstanding this argument, Boyd and De Nicolò (2005) subscribe to a certain extent to the arguments of a large body of literature that, when faced with increased competition, moral hazard is aggravated, thus banks intentionally take on more risk.

As a result of the moral hazard generated by bank bail-outs (Acharya 2009), banks would tend to engage in the use of credit derivatives driven by a profit motive, choosing investments that are of higher return and higher risk. The principal-agent problem between the depositor (principal) and bank (agent) could be used to explain the risk taking
behaviour of banks. When confronted with increased competition also, banks rationally choose more risky portfolios. That is, there is a fundamental risk incentive mechanism that operates exactly in the opposite direction, causing banks to take more risks as markets become more concentrated (Boyd and De Nicolò 2005). Bank risk taking models mark the role of deposit insurance and other government intervention schemes that result in moral hazard on the part of borrowers which misrepresents the risk incentives of banks.

Along with Furlong and Keeley (1989), many academics, bankers and regulators have supported the theoretical predictions that banks that increase capital in order to meet higher regulatory capital standards would tend to shift their portfolio structure from low-risk assets towards high-risk assets that provide a higher return in order to compensate for the higher costs imposed by stringent capital requirements. Jeitschko and Jeung (2005) argue that a bank driven by managerial incentives may increase risk with an increase in capitalisation, as a firm chooses assets that have a higher risk and a higher return. This could explain the use of credit derivatives by banks for speculative purposes. In this context, the principal-agent problems between depositors/shareholders and borrowers/shareholders are examined below.

3.9.2.2.1 Depositor/shareholder relationship

As mentioned previously, deposit insurance reduces the motivation for depositors to monitor the bank and check the risk undertaken. This would provide an incentive for banks to shift from uninsured creditors to insured depositors to obtain funds as they will need to pay a higher risk premium in order to generate funds through an uninsured system (Jordan 2000; Yamak and Suer 2005). A consequence of the distortion between the uninsured creditors and insured depositors is moral hazard on the part of the depositors. This means that the bank shareholders would be able to pass on the risk to other stakeholders, and finally the taxpayers would effectively contribute to bank bail outs.

3.9.2.2.2 Borrower/shareholder relationship

Although the borrower/shareholder relationship is more or less similar to the depositor/shareholder relationship, the fundamental difference is that the role of shareholder becomes that of a borrower than a lender which is the case in a depositor/shareholder relationship (Yamak and Suer 2005). Using insured deposits to
finance a risky portfolio of loans can lead to an alteration of borrowers’ as well as lenders’
behaviour. As the ultimate responsibility of default lies with the government (i.e. regulators)
instead of the shareholders, bank owners have an incentive to take on more risk. Similarly,
borrowers will also be encouraged to take on more risk as they will benefit from the upside
of taking on greater risk, while still being protected on the downside (White 1999). This
situation gives rise to problems of moral hazard and adverse selection56 (see also Demirgüç-
Kunt and Detragiache 2002).

3.9.2.3 Adverse selection

Adverse selection57 is a problem caused by pre-contractual information asymmetries in a
firm due to the separation of ownership and management. Credit derivatives, as in all
forms of insurance, are subject to asymmetric information risks (Acharya and Johnson
2007). As banks have private information on the likelihood of default of a particular
borrower, they could exploit this information by buying protection on the borrower from a
less informed counterparty. This results in adverse selection on the part of the counterparty
(i.e. seller of protection). The problem is further aggravated as banks are likely to pass on
the credit risk for loans on which they have less information (through the use of credit
derivatives) and keep those on which they have more information (Duffee and Zhou 2001).
This would lead to a bank intentionally taking on more risk and being less concerned with
the credit quality of the assets as the credit risk could be passed on to someone who is
willing to accept it.

With the introduction of a CDS market, a bank has the choice of transferring the risk off-
balance sheet or holding it on balance sheet. If the bank holds the risk on balance sheet, it
has a greater incentive to monitor the loan than if it sells credit risk. By transferring credit
risk, banks have a lesser incentive to monitor the loan, hence creating moral hazard.
The following sections explain in more detail the agency problems in banks and their
effects on bank risk aversion and risk taking behaviours.

56 See Demirgüç-Kunt and Detragiache (2002) for an extended discussion on how deposit insurance is likely
to decrease the stability of the banking system.
57 Also refers to misrepresentation of ability by the agent.
3.9.2.4 Agency theory and risk management/hedging

Agency theory argues a case for risk management from two main different perspectives: from the agency relationship between shareholders and managers and between shareholders and debtholders (Godfrey et al. 2010). The former concludes that managers (agents) primarily engage in risk management due to risk aversion, meaning as compared to shareholders, managers are not in a position to diversify their risk, hence they prefer less risk than shareholders (Jensen and Meckling 1976). Agency theory postulates that, as individuals are self-interested, there are bound to be conflicts of interest in cooperative endeavours (Jensen 1994). Principals are considered to be risk neutral as they can diversify their shareholding across multiple firms. However, as agents’ employment security and income are inextricably linked to each other, they are assumed to be risk averse in relation to the firm, thereby lowering the risk to their personal wealth (Wiseman and Gomez-Mejia 1998).\footnote{Wiseman and Gomez-Mejia (1998) build a behavioural agency model that explains managerial risk taking through the linkage of corporate governance mechanisms and elements of prospect theory.} Smith and Stulz (1985) argue that as managers are risk-averse they will choose to bear risk only if rewarded for doing so with a higher expected income. This would mean that they are more inclined to pursue risk management policies/hedging in order to protect themselves thereby reducing the risk on the wealth of the manager.

The agency relationship between the shareholders and debtholders results in, among other things, “underinvestment” and “asset substitution”. Underinvestment occurs when owners have an incentive not to undertake projects that add value. It is suggested that doing so would increase the funds available to the debtholders and not to the owners. Asset substitution is based on the assumption that lenders are risk-averse. The funds are lent with the expectation that they are not invested in risky projects. Contrarily, shareholders prefer risk as they have diversified portfolios with limited liability. Managers have the incentive to obtain debt funds and invest in high risk assets in order to increase returns to shareholders (Godfrey et al. 2010). This means that owners do not have an incentive to undertake projects that add value to the organisation as it would increase the funds available to debtholders. Bondholders protect themselves against expected losses from opportunistic behaviour of shareholders by demanding higher returns or by designing debt covenants.
accordingly. Risk management may reduce the risk of the value of the firm dropping to levels where there are strong incentives by the managers to increase risk.

Literature on corporate hedging has identified the mitigation of a firm’s underinvestment problem as a rationale for risk management. As argued by Dadalt et al. (2002) and (Froot et al. 1993a), hedging can reduce a firm’s underinvestment problem by increasing the likelihood that it can fund projects through internally generated funds which cost less.\(^{59}\)

Banks may pursue risk management policies such as using CDSs in order to hedge credit risk.

3.9.2.5 *Agency theory and managerial risk taking: sources of agency problems*

Agency costs represent important issues in managerial risk taking, particularly in the banking industry. Excessive risk taking is another unintended adverse consequence that results particularly from the separation of ownership and control, the existence of an external governance force (i.e. regulator) that secures the public interest, and provides share options based compensation to bank executives. The agency problems are further heightened with the use of credit derivatives by banks. The following sections discuss each of these sources of bank risk taking.

3.9.2.5.1 Agency problems related to bank regulation

Agency costs and capital structure issues are particularly important in the banking industry. This is mainly because the industry plays a crucial role in the economy in providing credit to non-financial firms, transmitting the effects of monetary policy and providing stability to the economy as a whole. Due to their very nature, banks are informationally opaque, i.e. they hold private information on customer loans and other credit counterparties and bank loan portfolios concentrated within business sectors and geographic locations. As a result of this opacity, agency costs will be particularly large in the banking industry. Banks also have other safety net protections such as the Central Bank acting as the “lender of last resort”, which results in increasing incentives for risk shifting, or reduced risk management, potentially increasing the agency costs of debt. The opacity of banks also results in an information asymmetry in dealing with CDS transactions. Government protection schemes and other safety net protection schemes create increasing incentives to transfer risk or to

\(^{59}\) That is, a lower level of information asymmetry could increase the probability of a firm obtaining funds at a lower cost.
reduce risk management, thereby increasing the agency costs of debt as a result of moral hazard. For example, the US deposit insurance scheme provides an explicit guarantee in the event of failure. In addition, the notion of “too big to fail” provides an implicit guarantee against failure, thereby subsiding debt financing and effectively transferring the consequences of risk taking from banks to shareholders, insurers, the government and finally the taxpayers.

Agency theory suggests that the choice of capital structure would help mitigate agency costs. For instance, high leverage or a low equity/asset ratio would reduce the agency costs of outside equity and increase firm value by constraining or encouraging managers to act more in the interests of the shareholders (Jensen and Meckling 1976). Berger and Bonaccorsi di Patti (2006) argue that increased leverage would reduce the agency costs of outside equity, but the opposite effect would occur for the agency costs of outside debt due to conflicts between debtholders and shareholders. When leverage becomes high, additional leverage may generate significant agency costs of outside debt. However, due to minimum capital regulatory requirements, such as capital adequacy requirements, the expected costs of financial distress are lowered, reducing the agency costs of debt.

3.9.2.5.2 Agency problems related to managerial incentive structures

According to Jensen and Meckling (1976), ownership structure, management incentives and monitoring of management are important determinants of risk taking (see Fama and Jensen 1983). Theoretically, it is unclear as to whether managerial stock ownership would increase or decrease risk taking. When managerial share ownership increases, the interests of managers and shareholders are aligned, and shareholders have an incentive to increase the value of their call options by increasing risk (Saunders et al. 1990). Nevertheless, Smith and Stulz (1985) argue that managers will not hold a well-diversified portfolio, hence will become more risk averse as share ownership increases. Aggarwal and Samwick (2003) have developed a model in which diversification, performance and incentives are endogenously determined. They concluded that managers diversify their firms in response to changes in private benefits rather than reducing their exposure to risk. Thus, managerial risk aversion may not necessarily be a serious agency problem.

Managerial incentive structures can have an adverse impact on risk taking. For instance, option-based incentives can create a problem during a crisis as they provide an incentive to
increase risk to unacceptable levels. Jensen and Meckling (1976) argue that the value of option based compensation is positively related to the underlying share variance.\(^6\) Agency theory suggests that this will motivate managers to take on higher levels of risk.

In the context of the functioning of a bank, regulatory, tax and structural distortions can create agency problems. The principals are the shareholders, depositors, bondholders and taxpayers and the agents are the central banks, regulators/supervisors, treasury/tax/competition authorities and CEO’s/boards of banks. Blundell-Wignall et al. (2009a) suggest that together the agents have failed the principals by creating incentives that have led to excessive risk-taking. Such incentives in order to maximise private benefits while not bearing the consequences can be considered as a contributing factor to the GFC. As identified by Blundell-Wignall et al. (2009a), a special agency issue arises when the decisions are made on behalf of others without having to bear the consequences, socialising most of the costs. The incentives are not aligned with the interests of the stakeholders such as depositors, shareholders, bondholders and taxpayers. Even with the use of credit derivatives, especially when CDSs are used for trading purposes and in an intermediary role generating fee income, the incentives for using these instruments are not necessarily aligned with the interests of the shareholders and depositors/bondholders. With incentives based on generating higher returns, attention has been moved away from credit derivatives used for risk management to those that generate a higher income/return that comes with a higher risk.

Although, in agency theory, goal conflicts between the principal and agent are expected to be resolved through co-alignment of incentives, as explained above, the type of compensation structure can affect firm risk taking. For instance, Chen et al. (2006) argue that stock-option based executive compensation would induce bank risk taking. As executive compensation in the form of stock options increases, the interests of shareholders and bank managers would converge, and managers would tend to increase the value of their call option by increasing risk.

\(^6\) That is, the variance of the outcome distribution rises with the value of the share (i.e. call option rises).
Dong et al. (2010) argue that the potential value appreciation of executive stock options due to assuming higher risk can be considered as a private benefit that induces managers to take on excessive risk by increasing leverage, despite the fact that firms are over levered. Stock options that are expected to align the interests of shareholders and managers present a potential source of agency conflicts in this case. Jensen and Meckling (1976) have pointed out that shareholders have an incentive towards inefficient risk shifting. For this reason, Bolton et al. (2010) argue that the CEO incentive structure for levered firms with risky debt should be different, with the compensation structured to maximise the whole value of the firm and not just the value of equity.

Bliss (2004) identifies market discipline as the solution to the natural conflicts of interest between managers who direct firms and financial market participants who invest funds, thus the principal-agent problem. In practice, agency costs are reduced to a large extent through various mechanisms: delegated monitors (boards of directors/regulatory supervision), reducing information costs (required disclosure of relevant information) and reducing manager's incentives to abuse their position (fiduciary, fraud and insider trading laws etc.). However, they cannot be completely eliminated.

The risk differential between the manager and the shareholder creates a moral hazard problem in the principal-agent relationship. The challenge is to set up a supervisory and incentive alignment that alters the risk orientation of the agents and aligns with the interests of the principal (Tosi Jr and Gomez-Mejia 1989). The “compensation design” view argues that agents are motivated to increase personal wealth and, when this wealth is strongly linked to the owners, managers will exhibit risk preferences similar to those of the owners by selecting riskier projects (Hamid 1995).

As agents are concerned with protecting their current wealth, then compensation schemes that simultaneously protect the future and the present base pay and provide strong variable pay incentives for agents may be in the principal’s best interest as they will provide the agent with incentives to align their interests with the principal (firm performance) without the risk of loss by pursuing higher return projects (Arrow 1996).
Shareholders in a limited liability bank have an incentive to increase the risk of the bank by increasing leverage as the debtholders (i.e. depositors) can only monitor and control shareholders actions imperfectly, therefore shareholders can increase their value of their equity call option by increasing the risk of the underlying assets of the bank. In contrast, Saunders et al. (1990) argue that risk taking incentives for bank managers will depend on the best interests or preferences that are tied to those of value-maximising shareholders. Although due to non-diversifiable human capital of managers, which may result in managers acting risk-averse, hence not value maximising, through the provision of managers’ shares or share options in the bank, their interests will be more aligned with those of the stockholders. This is subject to the condition that the non-human wealth investment is not so large that it makes managers increasingly sensitive to the non-systematic risk of banks. Executive compensation for highly levered firms such as banks that are also recipients of deposit insurance and other government protection schemes is fundamentally different to the typical principal-agent problem considered in agency theory for a publicly traded firm with all equity and dispersed ownership (Bolton et al. 2010). Although shareholder wealth maximisation is a primary concern for managers in a banking firm as the risk is spread among depositors, debtholders, insurers, the government and finally taxpayers, the shareholders have an incentive to take on excessive risk. Bolton et al. (2010) argue, that in conjunction with the stock price, banks’ CDS spreads should be used to regulate CEO compensation. As the spread widens, the compensation would decrease and vice versa.

Although managerial compensation is not used as a variable in this study (due to the inaccessibility of this data), excessive risk taking due to managerial compensation structures is expected to be reflected in equity volatility. Knopf et al. (2002) particularly argue in a study that investigates the volatility and price sensitivities of managerial stock option portfolios and hedging activities that, as the sensitivity of a manager’s share option portfolio (compensation) to stock returns volatility increases, the firm tends to hedge less. This could lead to an increase in risk taking. As such returns volatility is used as a proxy for the sensitivity of share option portfolios of managers.

61 With the existence of a regulator and other government safety net protections.
3.9.2.6 Agency problems related to CDSs

Agency problems arise in banks when dealing with CDSs primarily due to the opacity of banks. CDSs are said to essentially affect the relationship between lenders and borrowers and to create new relationships between lenders, borrowers and the buyers and sellers of credit protection. The incentives of these credit transaction parties are influenced by asymmetric information, principal/agent problems and incomplete contracts. Issues of information asymmetry such as moral hazard and adverse selection determine the behaviour of banks in credit risk management. Duffee and Zhou (2001) consider that as the magnitude of asymmetric information varies during the life of the loan, credit derivatives could be used by banks to transfer credit risk when the market for risky loans is the smallest. This is because the relationship between the credit protection buyer and seller can become a principal/agent problem when the protection buyer acts as an agent of the protection seller. They construct a model that analyses the effects of the introduction of a market for credit derivatives when making a loan. The agency relationship between protection buyers and sellers creates adverse selection and moral hazard due to banks having more information about their loans than the protection sellers, and having less incentive to monitor loans once the risk is transferred off-balance sheet.

The agency problem is also evident in the banks’ use of CDSs. According to Acharya and Johnson (2007), there is a definitive information asymmetry between banks and firms who seek to buy and sell protection and significant information revealed in the CDS market, are consistent with non-public information by informed banks. Credit derivatives markets are more susceptible to asymmetric information as by definition most players are insiders. As firms generally have a close relationship with banks for funding purposes, banks would have access to price sensitive information before the information is in the public domain. This could mean that they can use this information to trade in CDSs to their own advantage. Furthermore, this situation can give rise to excessive risk taking and could also result in competition among informed agents, whereby large numbers of informed agents trade aggressively in CDS markets.

In a global credit derivatives survey undertaken by Fitch Ratings (2010), as shown in Figure 3.4, 87% of banks surveyed cite trading/market making as their dominant/active
motivation for using credit derivatives as compared to hedging or risk management. This indicates that banks tend to use credit derivatives more in their role as a market maker or trader rather than for risk management purposes.

**Figure 3.4 Global banks’ motivations for using credit derivatives**

Managerial risk aversion has long been highlighted in agency theory argues that, as managers are risk averse, they would tend to pursue risk management policies. In the context of a bank, the management risk taking hypothesis could override the risk aversion hypothesis, due to the existence of a regulator in the banking industry, share-option based executive compensation and the use of CDSs where banks in their role of market makers are insiders.

### 3.10 Managerial self-interest, managerial risk-taking and credit default swaps

As described in Chapter 2, CDSs are bilateral contracts between protection buyers and sellers referencing a particular credit/underlying asset. Although they were initially developed as a means of hedging credit risk, many financial institutions (particularly banks)

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62 Note that this survey does not cover the entire universe of active banks, nor does it cover hedge funds, asset managers and pension funds.
were mainly protection buyers. Due to the protection buyer that is risk-averse, that seeks protection against a seller, that is risk neutral, the buyer is essentially exposed to balance sheet risk of the protection seller (Biais et al. 2010). Not controlling the balance sheet risk of the protection seller and thus risk taking would result in the protection buyer being exposed to counterparty risk which in turn creates a moral hazard problem between buyer and seller. Biais et al. (2010) suggest that when entering a hedge position, protection sellers would at least want to break even and would not want a credit event to occur. With unfavourable news of the reference entity, protection sellers are less inclined to control balance sheet risk as this would mean that the benefit is then accrued to the protection buyer. Although CDSs are designed to provide risk sharing, they can provide incentives for risk taking. Applying the notion behind positive accounting theory/agency theory of managerial self-interest, it can be argued that self-interested managers, in this case, protection sellers, are more likely to increase risk taking and reduce balance sheet hedging, placing more weight on their own interests rather than on controlling risk and providing the benefit to the protection buyer.

Ashcraft and Santos (2009) suggest that institutions that are hedged with CDSs have less incentive to monitor the creditors, therefore firms may take on more risks upon the use of credit derivatives such as CDSs. The reason for this is due to hedging credit risks or transferring risk to a third party, the firm is no longer exposed to that risk. Hence, they can have a higher incentive to take on more risk, thereby increasing return as this risk could always be transferred off balance sheet. This is also highlighted in the “empty creditor problem” (Bolton and Oehmke 2011) where holders of debt and CDSs no longer have an interest in the efficient continuation of the debtor (i.e. monitoring), thus leading the borrower into bankruptcy. The existence of CDSs can enhance excessive risk taking by managers pursuing their own interests.

John et al. (2008) investigate the relationship between corporate governance and risk choices in a firm and argue that better investor protection may induce risk taking behaviour which can in turn increase growth rate. This is mainly because, by aligning the interests of managers and shareholders, for example, through the provision of stock options, managers tend to take on more risk, thus providing higher returns to shareholders. Better investor protection can lead firms to engage in riskier investments. In contrast to the argument that
self-interested managers may further their own interests by increasing returns, thereby increasing the value of their stock options for example, John et al. (2008) argue that better investor protection lowers the expected private benefits, thereby causing insiders or managers to be less risk averse. Along the same line, one can also argue that better investor protection could result in the hedging of associated risks in investments, through products such as CDSs. As these investor protection mechanisms would mean that managers have less at stake, they may have an incentive to increase risk taking.

Bolton et al. (2010) argue that risk taking is particularly heightened in the banking sector as banks are highly levered and the compensation structure of managers does not necessarily reflect the interests of other stakeholders. They further argue that as CDS spreads reflect the market price of risk, they would reflect managerial risk taking to a large extent. In this study, excessive risk taking is addressed as the price of debt that is proxied by CDS spreads. The authors propose linking executive compensation to CDS spreads in the aim of reducing executive risk taking in financial institutions.

Having discussed the theoretical framework within which this research is based, the following section discusses the apparent gap in the literature.

3.11 Paucity in the literature

CDSs have received much attention from academics, practitioners, policy makers and the general public for contributing to and exacerbating the GFC, with many studies focusing on their risky nature. Much attention has also focused on risk management and risk taking behaviour of financial institutions, in particular within banks. There are many studies on the incentives of financial institutions that create such managerial risk taking (Bolton et al. 2010; Boyd and De Nicolò 2005; Chiu and Wagner 2010; Demsetz et al. 1997; John et al. 2008). However, it does not appear to have been fully explored in relation to the phenomenal growth and eventual collapse of the CDS market. Although there are studies on the determinants of CDS spreads, and these have provided an understanding of the factors that affect risk as indicated by CDS spreads in firms (see for example Chiaramonte and Casu 2010), none, to the knowledge of the researcher, have explored the risk indicated in CDS spreads that highlights managerial risk taking and its link to the CDS market’s growth and collapse. The link between managerial risk taking and the rise and fall of the
CDS market is also not fully explored using the concept of managerial self-interest which is drawn together by *agency theory* and *positive accounting theory*.

Given this perceived paucity in the literature, the following research questions are developed:

- Why did the CDS market increase in popularity up until the GFC?
- Why did the CDS market almost completely collapse during and after the GFC?

In line with these two basic research questions, this research integrates agency theory (Jensen and Meckling 1976) and positive accounting theory (Watts and Zimmerman 1978) in creating a conceptual framework that helps understand the possible causes for the rise and fall of the CDS market. To the author’s knowledge, this is the first study to explore this within an agency theoretic and positive accounting theoretic perspective and which proposes that the concept of managerial self-interest leads to managerial risk taking. The conceptual framework is developed from the perspective of financial institutions that use CDSs and explores the factors that contribute to CDS spreads which are used as proxy for managerial risk taking. This study assesses the applicability of the above mentioned theories that highlight the concept of managerial self-interest, to investigate how managerial risk taking in financial institutions as proxied by CDS spreads could explain the rise and fall of the CDS market.

**3.12 Conceptual framework**

Figure 3.5 outlines the framework within which the key phenomena in this research are investigated. This study particularly concentrates on highly levered financial institutions such as bank and non-bank financial institutions that are exposed to credit risk.
Credit risk, which is the primary source of risk inherent in financial intermediaries, has been managed by financial institutions in many ways. Prior to the GFC, the use of credit derivatives had become increasingly popular as a means of transferring/managing credit risk in financial institutions. Within the context of agency theory and positive accounting theory that are based on the fundamental assumption of managerial self-interest, it is argued that managerial risk taking in financial institutions is more prevalent than in non-financial all-equity firms. It is further enhanced by regulatory policies such as “too big to fail” that encourage managers of such organisations to take on risky projects as they will be bailed out irrespective of their conduct. In addition, the managerial compensation structure, i.e. remunerating managers with share options for example, can create incentives.

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63 Financial intermediaries are mainly deposit taking institutions such as commercial banks, credit unions and loans and savings associations. However, the scope of this research extends to bank and non-bank financial institutions.
for increased risk taking by increasing the value of the share options. Another reason for increased risk taking identified in the literature is the use of CRT instruments such as CDSs (see sections 3.9 and 3.10). Irrespective of the intent of the use of credit derivatives, for example, either hedging or speculative purposes, instruments such as CDSs can increase risk taking. Hedging with CDSs allows risk to be transferred off-balance sheet and this can provide a disincentive for managers to monitor the loans or the quality of the borrowers as the risk is transferred to a third party. The issues of asymmetric information, moral hazard and adverse selection are some of the factors highlighted in the literature that affect the degree to which the use of credit derivatives could affect managerial risk taking. Managerial risk taking is proxied using CDS spreads of financial institutions, consistent with Bolton et al. (2010).

This research explores the link between managerial risk taking in financial institutions and the CDS market, where it can be reflected in a firm’s credit rating (which represents credit risk), returns volatility (indicating equity/market risk), profitability (which is indicated by ROA, ROE and Equity returns) and total assets (which indicates the size of the company). The research aims to answer the research questions of why did the CDS market increase in popularity and eventually collapse by testing whether and how the above mentioned variables determine CDS spreads and therefore managerial risk taking. Agency theory and positive accounting theory are used to explain whether managerial risk taking contributed to the rise and fall of the CDS market within the context of the GFC.

3.11 Summary of the chapter

The purpose of this chapter was to provide a synthesis of the literature that relates to the use of CDSs by financial institutions and the relationship between risk taking in these firms and the use of CDSs. It presented a detailed discussion of some of the more noted scholarly arguments for the use of CDSs and the relation of CDSs to risk-taking by financial institutions. The literature reveals that although CDSs were originally developed for hedging purposes, prior to the GFC, they were increasingly used for trading or profit making purposes by financial institutions. Even risk mitigation activities such as synthetic securitisation and empty creditors can have an adverse risk taking incentive. Risk taking behaviour was analysed through agency and positive accounting theoretic perspectives. From the review of the above literature, it is clear that several themes are significant, including the following:
1. CDSs are predominantly used for profit making purposes, via such activities as naked trading, capital structure arbitrage, even hedging such as in synthetic securitisation and empty creditors. They are used to a lesser extent for pure risk mitigation activities.

2. The issue of risk in the use of CDSs and the resultant contagion and systemic effects in the global finance markets and the ‘real economy’ has been identified as a key issue with the growth in the CDS market.

3. The phenomenal growth in the CDS market prior and its collapse with the onset of the GFC have led to the important research questions of why this growth and collapse occurred.

4. The concept of managerial self-interest has been identified as a key reason for risk taking by financial institutions with the use of CDSs. This has been particularly highlighted through the use of *agency theory* and *positive accounting theory*, based on the foundation of managerial self-interest. In particular, managerial self-interest that results through perceptions such as “too big to fail” and depositor protection schemes as in the case of commercial banks, incentive structures for managers such as stock options, and the use if CDSs emerged as sources of such managerial risk taking.

5. The sources of managerial risk taking are considered to have an effect on an entity’s credit rating, equity volatility and profitability among other variables. Following Bolton et al. (2010) among others, CDS spreads have been identified as a proxy for managerial risk taking.

Finally, the apparent gap in the literature has assisted in developing a conceptual framework for this study. In the conceptual framework within the context of managerial self-interest (drawn by agency theory and positive accounting theory), the use of credit derivatives by financial institutions and the resultant managerial risk taking is used to explore the research questions relating to the rise and fall of the CDS markets. The issues of asymmetric information, moral hazard, adverse selection and counterparty risk are factors that were highlighted in the literature that affect the degree to which the use of credit derivatives could affect the riskiness in firms and therefore the value of CDSs.
Many studies have explored managerial risk taking, in certain cases through agency theory. However, rarely or not at all has it been applied to the use of credit derivatives by financial institutions and the exploration of the rise and fall of the CDS market.

In the following chapter, the research design and methodology of this study are explained in detail. Several of the above themes will be used as the primary basis for the development of the hypotheses, particularly, those related to managerial risk taking and its determinants.
CHAPTER 4
HYPOTHESIS DEVELOPMENT

4.1 Introduction

This chapter follows on from the literature review in Chapter 3 by providing a detailed discussion of the development of the hypotheses for the study. In particular, it presents the theoretical framework upon which the hypotheses are founded. As discussed in Chapter 3, the major themes in the literature provide some explanation for the “rise and fall” of CDSs that lie within the positivist theoretic paradigm, i.e. positive accounting theory and agency theory. This section describes the six hypotheses that are tested in this research. Although some are tested in previous literature, based on the extensive literature review, this thesis develops them within the unique theoretical framework of agency theory and positive accounting theory.

The chapter is structured as follows: Section 4.2 discusses the rationale for the research objectives, Section 4.3 provides a detailed discussion of the hypotheses and Section 4.4 presents the conclusion.

4.2 Research objectives

As mentioned in the literature review, CDSs received much attention during the GFC, with particular emphasis on the riskiness of their use for hedging and speculative purposes (Instefjord 2005; Stulz 2010). In addition, to their risky nature per se, attention focused on the risk management and the risk taking behaviour of firms that use them, in particular, financial institutions. For instance, firms that are highly leveraged such as financial institutions have incentives to shift risk to debt holders (Jensen and Meckling 1976). As a result, managers of such firms would have a higher incentive to take on more risk. Due to perceptions such as “too big to fail” and regulatory policies such as depositor insurance and “lender of last resort” schemes, financial institutions in general and banks in particular are subject to excessive risk taking due to the problem of moral hazard on the part of depositors and other stakeholders (Demsetz et al. 1997). Due to this, larger financial institutions, especially banks (i.e. major players in CDS markets), are not concerned with the level of risk taking as they would be eventually bailed out, irrespective of the level of
risk taking (Long and Vittas 1991). Arguably, such firms would have more incentives for risk taking.

There are also risk-taking incentives associated with the use of CDSs. For instance, as CDS contracts provide an effective way for creditors to hedge credit risk exposure to firms, the buyers of credit protection have less incentive to monitor creditors’ activities. This would increase risk-taking incentives of firms due to the ability of transferring the risk to a third party (Ashcraft and Santos 2009). In addition, the speculative properties of CDSs would mean that CDSs propagate risk taking behaviour through the manipulation of variables of the underlying asset that determines their value (Stulz 2010). Agency theory (Jensen and Meckling 1976) and positive accounting theory (Watts and Zimmerman 1978) articulate that this managerial risk taking is primarily driven by the underlying self-interest of managers, seen as rational individuals concerned with furthering their own interest. It can be argued that managers of financial institutions that are less affected by the consequences of risk taking (due to the above mentioned reasons64) have much to gain through increased risk taking. Although there are many studies related to managerial risk taking in financial institutions (i.e. Boyd and De Nicolò 2005), none have explored the risk taking incentives and its relation to the “rise and fall” of the CDS market. The phenomenal growth in the CDS market and its eventual collapse has not been examined with respect to the concept of managerial self-interest that has led to excessive managerial risk taking. This research aims to empirically examine the relation that exists between managerial risk taking and the “rise and fall” of the CDS market in the period surrounding the GFC.

Hence, this research addresses two major objectives:

1) Why did the CDS market increase in popularity up until the GFC?
2) Why did the CDS market almost completely collapse during and after the GFC?

In the following section, the research hypotheses to be tested are formally stated. The hypotheses are developed in line with the conceptual framework and the theoretical arguments from the literature review and the theoretical framework. In particular, they are

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64See also arguments in Chapter 3.
formulated based on the determinants of the CDS spreads (i.e. price of a CDS contract) and their relation to risk taking that are identified in the literature.

The extensive literature review identifies the key accounting and market variables that influence managerial risk taking. The six hypotheses developed in this chapter test whether these variables affect managerial risk taking (proxied by CDS spreads) in a positive or negative manner.

Prior to developing the hypotheses, the following section discusses the link between CDS spreads and managerial risk taking, indicating the reason for the choice of CDS spreads as a proxy for managerial risk taking. The subsequent sections hypothesise the main variables that are identified in the literature as factors that affect CDS spreads and thus managerial risk taking.

4.3 Development of the hypotheses

4.3.1 CDS spreads and managerial risk taking

The price of debt as indicated by the CDS spread (i.e. the premium paid on a CDS contract) is liquid and is reflective of the fundamental risk of the underlying asset. Theoretically a CDS spread represents the pure credit risk of the underlying firm. They are also considered as an interesting alternative to bond prices, therefore it is more suited to conduct empirical research related to credit risk of the underlying asset. This is mainly because CDS spreads data provided by brokers are the firm quotes from dealers, whereas bond yield data available to researchers are usually indications from dealers (Hull et al. 2004). Secondly, CDS spreads do not require any adjustments as they are already credit spreads. However, bond yields require an assumption of the appropriate risk-free rate in order to be converted into credit spreads. Callen et al. (2009) argue that small changes in profitability that affect default risk are unlikely to cause significant changes in bond yield spreads as compared to CDS spreads. In addition, CDS spreads are not distorted by embedded option features such as calls and covenants as compared to bond yields. Hence, as an indicator of default risk of the underlying asset, they can be considered as a better proxy than credit spreads/bond yields. Driessen (2005) further argues that credit spreads vary to a large extent due to time-varying compensation for liquidity and to a certain extent due to the tax treatment of bonds. However, CDS spreads are not distorted by tax issues.
and according to Fabozzi et al. (2007) do not contain a liquidity premium. Clearly the above arguments support the use of CDS spreads as a measure of credit risk rather than credit spreads. Bolton et al. (2010) argue that as CDS spreads can be considered as a market price for risk, they can be used as a proxy for risk taking in financial institutions.

The issue of risk taking is heightened particularly in the financial sector, due to financial institutions being highly levered. In addition, as mentioned in the theoretical framework discussed in Chapter 3, managers in financial institutions are prone to risk taking due to regulatory policies such as “too big to fail” and depositor protection schemes, the compensation structure that aligns managerial incentives with shareholders, and the use of CDSs as hedging or trading instruments (Berger and Bonaccorsi di Patti 2006; Bolton et al. 2010; Duffee and Zhou 2001). It can be argued that this managerial risk taking can be reflected in the financial entity’s CDS spread. Chiaramonte and Casu (2010) find that CDS spreads are a good indicator of bank riskiness. Further, as credit default swaps can be used for isolate and transfer credit risk (Ashraf et al. 2007), CDS spreads are increasingly popular and simple means of a direct indicator of a firm’s credit risk. As a result, this study uses CDS spreads as a proxy for firm risk and managerial risk taking.

The main hypotheses developed in this chapter are:

- **H1**: Higher credit risk, as indicated by a lower credit rating, is negatively associated with higher managerial risk taking of firms.
- **H2**: Firm size is positively related to CDS spreads and thus managerial risk taking.
- **H3**: ROA is negatively related to CDS spreads and thus managerial risk taking.
- **H4**: ROE is negatively related to CDS spreads and thus managerial risk taking.
- **H5**: Equity returns are negatively related to CDS spreads and thus managerial risk taking.
- **H6**: Returns volatility is positively related to CDS spreads and thus managerial risk taking.

The following sections identify the main drivers and movers of CDS risk premia, i.e. credit ratings, firm size (as proxied by total assets), ROE, ROA, equity returns and returns volatility, upon which each of the hypotheses are developed. As mentioned above, if CDS spreads can be used as a proxy for managerial risk taking, then their drivers can be analysed.

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65 See also arguments related to managerial risk taking incentives arguments developed in the literature review (Chapter 3).
in terms of their effect on managerial risk taking. The following sections provide a detailed discussion of the selected drivers of CDS spreads and their expected relation to managerial risk taking, forming the hypotheses of this study.

4.3.2 Credit Rating

A central concept in the literature on CDSs is that there is a relation between a premium paid on a CDS (CDS spread) and the credit rating of the underlying asset. CDS contracts provide an effective way for creditors to hedge credit risk exposures.

A company’s CDS premium is the cost per annum for credit protection paid against the default of the company. Academic research on the determinants of CDS spreads identifies credit ratings as a primary determinant of CDSs. Bhar et al. (2008) state that credit rating is a very important determinant of credit related securities including CDSs. As both the CDS for a company and the company’s credit rating are driven by credit quality, which is an unobservable attribute of a bank, CDS spreads data could help analyse whether banks are more/less inclined to use CDSs based on their underlying credit quality. There is a negative relationship between CDS spreads and credit ratings. If the latter rises, for example, it would result in a lower CDS spread. According to agency theory and positive accounting theory, if self-interested managers have less incentive to monitor creditors, this could further increase the credit risk of the firm, resulting in a lower credit rating. In addition, due to the problems of moral hazard and adverse selection that arise from the CDS contract, with the protection buyer being likely to have more information about the quality of the underlying asset (loan/bond) than the protection seller, the protection seller has a lower incentive to control balance sheet risk. This increases the credit risk of the firm. In addition, the lack of monitoring by the lender (protection buyer) may lead the borrower to engage in risky activities as the consequences of a default will not be borne by the borrowers, instead the lenders are more likely to be affected by such a default. This may push already distressed firms into bankruptcy.

Since the beginning of public issuance of debt, managers have been concerned with the extent of creditworthiness of firms. Credit ratings have particular levels that provide information acquisition about a firm’s prospects and therefore have opportunities to warn
investors when the information given differs to the impression provided by the management (Kuang and Qin 2009). They are consequently interpreted as a signalling to the market on the quality of the firm based on perceptive information that also includes non-public information (Ederington et al. 1987; Goh and Ederington 1993). Firms are concerned with maintaining good credit ratings in relation to debt. Despite the relevance and the importance of the use of credit ratings in the market place, their reliability and quality have been under public scrutiny in recent times, especially during the GFC. There has been significant criticism related to the value of credit ratings provided in assessing the credit risk of mortgage backed securities as these they have been observed to have considerably contributed to the decline in the credit markets (Bernanke 2008). However, the newly issued stricter regulations by the US Securities and Exchange Commission (SEC) such as prohibiting credit rating agencies from helping to structure the same financial instruments they rate, maintaining better records of rating processes and third party complaints, and sharing of client information of among nationally recognised statistical rating organisations imply that the importance that has been placed on credit rating agencies (Bernanke 2008; Kuang and Qin 2009). This suggests that maintaining high credit worthiness remains a goal in firms, especially financial institutions that are major players in credit markets. Covitz and Harrison (2003) suggest that rating changes do not appear to be importantly influenced by the conflicts of interests, rather, ratings agencies are primarily motivated by reputation related incentives.

Credit rating agencies have acknowledged that executive compensation as being an important factor in ascertaining credit risk in institutions (S & P 2008). Mann (2005) of Moody’s Investor Services argue that there is an empirical relationship between CEO compensation and credit risk. In particular, large compensation packages can induce managers to deliver short-term financial results and to obscure long-term structural problems, while pursuing high risk strategies that have higher payoffs and a higher risk. This study provides evidence that CEO compensation structure that is reflected in firm credit ratings has an impact on managerial risk taking. With highly levered financial institutions, structuring managerial compensation that aligns the interests of managers and shareholders can result in managers increasing risk (Jensen and Meckling 1976). Although such structures would adjust managers’ risk aversion and encourage them to take greater risks on behalf of the shareholders (Barron and Waddell 2008; Hemmer 1993), this may
not be desired by bondholders as such risky investment projects may increase the probability of financial default (Kuang and Qin 2009). Managerial risk taking can increase the uncertainties of future operating cash flows; as a result, the credit worthiness of the firm may deteriorate when there is a managerial preference towards risk taking. Kuang and Qin (2009) argue that credit rating agencies would estimate the sensitivity of managerial wealth to the volatility of firm performance, with firms that have compensation structures aligned to shareholders having higher uncertainty of future cash flows and a higher level of credit risk. Hence, an increase in credit risk could be portrayed as an increase in managerial risk taking. As this study uses CDS spreads as a proxy for managerial risk taking, it can be argued that higher credit risk would result in a higher CDS spread thus indicating higher managerial risk taking. Although many studies investigate the relationship between credit ratings and CDS spreads (Abid and Naifar 2006; Daniels and Jensen 2005; Hull et al. 2004; Norden and Weber 2004), they do not examine the effect of the lower vs. higher credit rating on the likelihood of being a risk taker. Therefore the first hypothesis states:

\[ H_1: \text{Higher credit risk as indicated by a lower credit rating is negatively associated with higher managerial risk taking of firms} \]

4.3.3 Size

The size of a financial institution can be considered as an important variable that affects the level of risk taking in the finance industry. For example, financial institutions can be prone to a problem of moral hazard due to perceptions such as “too big to fail”. Moral hazard is related to the distortion of incentives that arise due to the firm being insulated from risk and thus behaving differently from one that is fully exposed (Hellmann et al. 2000; Mishkin 2006). Hellmann et al. (2000) in particular argue that moral hazard can undermine prudent bank behaviour. Although capital requirements in banking firms can reduce risk taking incentives as it places equity investors at risk (thus shareholders are less inclined to encourage risk taking), the issue of moral hazard can have a perverse effect by harming banks’ franchise values by encouraging excessive risk taking. While “too big to fail” perceptions can prevent systemic risks among financial institutions, the moral hazard creates incentives for banks to take on greater risks.
Larger financial institutions in particular are considered “too big to fail” due to their high systemic importance. Their failure can not only cause immediate failures of counterparties of banks and financial institutions, but also can lead to a crisis of confidence in the entire financial system, with ripple effects in the real economy (Mishkin 2006). Jeong and Joh (2010) contend that “too big to fail” policies can create wrong incentives for the stakeholders of financial institutions, especially banks. As banks receive implicit or explicit credit protection in the case of financial distress, creditors can provide more capital to such financial institutions. Due to the protection received from financial regulators, such creditors would have limited monitoring. This would mean that “too big to fail” financial institutions can take on excessive risk without calling upon creditor monitoring. This could be more pronounced in non-commercial bank financial institutions as commercial banks are subject to more regulation in terms of capital requirements. Therefore, it can be argued that firm size is positively correlated to firms that are “too big to fail” and hence excessive managerial risk taking.

As stated by Ashraf et al. (2007), the use of credit derivatives is linked to the size of the financial institution. As larger banks, for example, have more extensive lending opportunities, they are likely to use credit derivatives. Nguyen and Faff (2002) confirm the positive relationship between firm size and derivatives usage as larger firms have economies of scale in setting up a hedging operation. Minton et al. (2005; 2009) investigate pre- and post-GFC whether credit derivatives make banks sounder. Using a probit regression model they explore the relationship between firm size (used as the natural logarithm of total assets) and the probability of being a protection buyer/seller (using the net protection bought/sold of each entity). The results confirm previous research that larger firms use credit derivatives more. This is also due to larger banks having economies of scale in using derivatives in their capacity as dealers or market makers. In comparison to Minton et al. (2005; 2009) this study explores the effect of firm size on CDS spreads.

Carter and Sinkey (1998) state that banks with high franchise values are more likely to participate in credit derivatives markets due to a better reputation among investors. Larger banks also have better control systems, trained personnel and the scope of activities necessary to engage in derivatives usage, therefore they would have a higher tendency to use derivatives such as CDSs. As argued in the literature review chapter, such use can
provide incentives firms to engage in excessive risk taking. Due to the CRT properties of CDSs, firms that use them have the opportunity of transferring credit risk off-balance sheet, thus not facing the consequences of a default of the underlying borrower. This means that they can engage in higher risk taking due to the ability of the risk being transferred through CDSs (Instefjord 2005). Larger firms that are more involved in the use of derivative products such as CDSs can engage in excessive risk taking in addition to the moral hazard relating to “too big to fail” policies. Therefore the second hypothesis states:

\[ H_2: \text{Firm size}^{66} \text{ is positively related to CDS spreads and thus managerial risk taking.} \]

4.3.4 Profitability

CDS literature time and time again has highlighted the importance of earnings potential represented by profitability measures in determining CDS spreads. Profitability in general is expected to have a negative relationship with CDS spreads as more profitable firms have a lower probability of default, thus lower CDS spreads (Inci and Podpiera 2010). Profitability can be measured by Return on Assets (ROA) and Return on Equity (ROE). ROA is an indicator of the return of the firm’s assets/investments. Chiaramonte and Casu (2010), however, contend that the sign linking ROA to CDS spreads is uncertain, in that ROA could affect CDS spreads negatively or positively. For instance, firms that have higher level of assets, thus a low ROA, would be perceived as very risky. This could result in higher CDS spreads. On the contrary, a higher level of assets could mean that these assets could create positive income and future cash flows. As a result, lower ROA values would lead to lower CDS spreads. Lower level of assets would also mean that the operating income would be lower. This can reduce ROA further; corresponding to an increase in CDS spreads, due to the perceived increase in risk, mainly due to the decrease in operating income at the same level of investment. Das et al. (2009) state that accounting variables such as ROA have significant explanatory power, which is comparable to market variables, when explaining CDS spreads. They find a strong negative relationship between profitability as measured by ROA and CDS spreads.

\[ ^{66} \text{As proxied by total assets.} \]
The ratio of ROE is expected to have a negative relationship with CDS spreads, as higher ROE would result in a lower perceived default risk, leading to a lower CDS spread (Chiaramonte and Casu 2010). A study carried out by BlackRock Investment Institute (2011) suggests that higher capital requirements that are imposed on banks (as compared to non-bank financial institutions) could generally mean dilution, as when new capital is raised and leverage is lowered, it would result in a lower ROE. This study finds a significant negative relationship between ROE and CDS spreads, where the lower profitability results in higher volatility of future cash flows and therefore higher credit risk.

It is also expected that higher profitability would lead to a lower usage of CDSs. Bartram et al. (2009) emphasise that firms with higher profitability have lower financial distress costs, hence are less likely to use derivatives for hedging purposes. Das and Hanouna (2006) highlight that high profitability as measured by higher ROA and ROE would dictate lower CDS spreads. Callen et al. (2009) evaluate the impact of earnings on credit risk in the CDS market. Their analysis finds that a 1% increase in ROA decreases CDS spreads significantly by around 5%, highlighting a negative relationship between profitability and CDS spreads (see also Benkert 2004). As argued, earnings can convey credit risk related information, as they are informative of the current wealth of the firm operating and equity performance and the dynamics of the asset structure. Due to increased profitability of the underlying reference entity as measured by ROA or ROE, the credit risk should decline as there would be a lower probability of bankruptcy of the underlying reference entity. Callen et al. (2009) also argue that for shorter-term maturities of CDSs, an increase in profitability is more likely to produce positive information of the creditworthiness of the underlying asset as compared to longer-term maturities of CDSs.

Stock returns are another market measure of profitability that explains the variation of CDS spreads. Merton (1974) develops a model for pricing corporate liabilities which can be used to price any type of financial instrument. In this model, an increase in the firm’s value would affect its leverage ratio and would increase the equity price. Theoretically, a positive stock return would indicate a decrease in leverage. Cremers et al. (2008) argue that equity returns can be interpreted as an indication of the firm’s health and also as a high frequency proxy for leverage. This means that increasing stock returns can be interpreted as showing better health of the firm and therefore lower risk resulting in a lower CDS spread. There
are several studies that find a negative relationship between the CDS spread change and stock returns (Chiu and Wagner 2010; Kwan 1996; Norden and Weber 2009). This would mean that higher expected profitability (i.e. equity returns) will be associated with lower probability of default, therefore a lower CDS spread. In addition, Byström (2005) finds that CDS spreads are significantly negatively related to equity returns at the index level.

In general, if CDS spreads are considered as a proxy for managerial risk taking, then lower CDS spreads as a result of higher ROA, ROE and Equity market returns could indicate lower risk and thus lower risk taking.

Therefore the third, fourth and fifth hypotheses state:

$H_3$: ROA is negatively related to CDS spreads and thus managerial risk taking

$H_4$: ROE is negatively related to CDS spreads and thus managerial risk taking

$H_5$: Equity returns\(^{67}\) are negatively related to CDS spreads and thus managerial risk taking

4.3.5 Returns volatility

Returns volatility or equity volatility is considered to have a significant influence on CDS spreads. Volatility in equity returns indicates uncertainty of the security’s value or the value of the underlying asset, hence higher volatility is indicative of higher default risk (Hassan et al. 2011). Campbell and Taksler (2003) argue that volatility has the opposite effects on stock prices and bond prices. For instance, given higher expected profits, volatility of the firm’s value can hurt the bondholders due to an increase in the probability of default; however it has a positive effect on shareholders. This means that higher equity volatility could indicate higher default risk of the underlying asset which leads to higher CDS spreads. The model developed by Merton (1974) that helps price corporate liabilities indicates that risky corporate bonds could be thought of as owners of riskless debt that have issued put options to the holders of equity. The increase in volatility would increase the value of the put option which benefits the equity holders as compared to debt holders. This volatility would affect equity holders positively, with higher volatility leading to higher returns, and would affect bondholders negatively.

\(^{67}\) Measured by the total returns index.
Theory suggests that equity volatility should exhibit a positive relationship to CDS spreads. Alexander and Kaeck (2008) demonstrate by using a Markov switching model of the determinants of the changes in the iTraxx Europe indices that these determinants are extremely sensitive to stock volatility during periods of turbulence in the CDS market. This positive relationship also has been detected by Hassan et al. (2011), Abid and Naifar (2006), Byström (2005) and Ericsson et al. (2009). The underlying reasoning is as follows. Equity bears the ultimate form of credit risk as it represents the most subordinate in the capital structure of the firm. Therefore, CDS spreads changes are strongly linked to stock returns and hence returns volatility. This is confirmed by Byström (2005), suggesting that the most important determinant of the CDS price is the likelihood that a credit event related to the underlying reference entity occurs and consistent with Merton (1974), they argue this probability is linked to the stock market returns volatility of the underlying asset.

Another important aspect of using returns volatility as a determinant factor of CDS spreads and thus managerial risk taking is its link with the managerial compensation structure. Knopf et al. (2002) argue that managers that are compensated in the form of equity options are less likely to engage in risk mitigation activities such as hedging. This is expected to occur mainly when the sensitivity of the stock option portfolio increases to stock returns volatility. It can be inferred that in institutions where managers are compensated in terms of stock options, hedging of risk would be less likely, as a higher volatility in equity returns would translate into higher returns on the stock options. This could mean that such firms would increase risk taking.

The knowledge of the relationship between CDS spreads and equity volatility is also crucial for arbitrageurs in the CDS market. Since the most important determinant of a CDS spread is the likelihood of the credit event of the underlying asset, this probability could be linked to the stock returns volatility of the reference entity. Capital structure arbitrageurs mainly detect the pricing inconsistencies in the stock market, bond market and the credit derivative market and profit from such inconsistencies (Byström 2005). As the CDS market is more informationally efficient in price discovery than the bond market, it would be more sensitive to pronounced increases in equity volatility of the firm.
Managers can affect equity volatility in many ways. Cohen et al. (2000) argue that as the introduction of stock options for managers would help align their interests with those of shareholders, they would increase volatility of the firm. This is because the asymmetric payoff of the option holder prefers high volatility of the underlying security as this would increase the value of the option. If the effects of risk taking sufficiently increase the value of the option, it can lead to excessive risk taking by managers.

Therefore the sixth hypothesis states:

\[ H_6: \text{Returns volatility is positively related to CDS spreads and thus managerial risk taking.} \]

4.4 Conclusion

This chapter provided details on the development of six hypotheses that will be used to test the determinants of CDS spreads and, therefore, the determinants of managerial risk taking. Three broad categories that would have an effect on managerial risk taking were identified in this chapter; namely, firm risk (measured by credit ratings and returns volatility), profitability (measured by ROE, ROA and equity returns) and firm size. A positive relationship is envisaged between CDS spreads and firm size/returns volatility and a negative relationship is predicted between CDS spreads and profitability measures/credit ratings. The following chapter will elaborate the research methodology of this study and the econometric methods used to test the hypotheses.
CHAPTER 5
RESEARCH DESIGN, METHODOLOGY AND PROCEDURES

5.1 Introduction

This chapter explains the specific research design and plan together with the research methodology and procedures used to test the hypotheses of the study. These hypotheses were developed in Chapter 4 for the purposes of explaining why the use of CDSs became increasingly popular before the GFC and declined in popularity during the GFC and the period immediately following. This chapter also explains the statistical methods and validation procedures used, all of which feature prominently in the literature, particularly the approaches used by Blanco et al. (2005), Hull et al. (2004) Norden and Weber (2004), Fabozzi et al. (2007), Alexander and Kaeck (2008) and Inci and Podpiera (2010) among others. The statistical methods include the use of a panel data regression to identify the determinants of CDS spreads and to explain the effects of the CDS market on global financial markets. By utilising a quantitative analysis of panel data regressions for 319 global financial institutions’ CDS transactions (from 2001 to 2010), the factors known to influence the extent of CDS spreads are identified, which will assist in explaining the potential reasons for the phenomenal growth and the eventual near total collapse of the CDS market.

The remaining sections in Chapter 5 include the following: Section 5.2 discusses the objectives and aims of the research, Section 5.3 explains the research design and the main dataset obtained from the Markit Group (an independent private database), Section 5.4 explains the econometric modelling and the estimation methods used in analysing the data and also details the operationalisation of the all variables used in the study, Section 5.5 further explains the nature and specific details of all variables used in the study, Section 5.6 describes the potential limitations associated with the data, Section 5.7 discusses the specific data collection and screening procedures used, and finally, Section 5.8 provides a summary of the major issues discussed in the chapter along with a brief conclusion.
5.2 Research objectives

As explained in Chapters 3 and 4, financial institutions are known to be less concerned with the level of risk taking, mainly due to perceptions that banks are “too big to fail” and policies such as depositor protection (particularly in banks) and “lender of last resort” schemes. Arguably, these mechanisms mean that irrespective of the level of risk taking, financial institutions will be bailed out when faced with significant financial difficulty. In addition, the use of CRT instruments such as credit derivatives is also seen to increase risk taking in financial institutions, as the ability to transfer risk to a third party means that lenders do not concern themselves with the quality of the loans they are accepting or the need to monitor the borrower (Ashcraft and Santos 2009). Further, due to higher fee income generated by acting as dealers for credit derivatives and the ability to trade credit risk through CDSs without holding the underlying asset, self-interested managers of financial institutions can increase risk taking. Such managers would be less concerned with increased risk taking due to shareholders of highly levered firms such as financial institutions being able to shift risk to debtholders (Jensen and Meckling 1976) and other stakeholders such as the taxpayers. If managers of financial institutions are driven by self-interest, they are likely to increase risk taking (expecting higher returns) with the increased use of instruments such as CDSs.

If managerial risk taking has been prevalent in financial institutions for the above mentioned reasons, then this study questions whether managerial risk taking also contributed to the phenomenal growth and the eventual collapse of the CDS market.

There are two main objectives of this study, both of which relate to the reasons for the use of CDS derivatives:

1. Why did the CDS market increase in popularity up until the GFC?, and
2. Why did the CDS market almost completely collapse during and after the GFC?

To answer these questions, the study relies on agency theory, particularly managerial risk taking theory which focuses on the role of the manager in context of a financial institution. It is posited that institutions with certain attributes (such as size, credit rating, profitability and share returns volatility) are more/less likely to use credit derivatives and thus can increase/decrease the levels of risk taking in financial firms.
In order to achieve the research objectives, econometric-based techniques and procedures are utilised. This quantitative approach is consistent with the study’s positivistic nature. Statistical techniques are used to test the variables that may or may not contribute to managerial risk taking, and the findings are interpreted using theories that predict human behaviour given certain circumstances. In this sense, this research captures a post-positivist research paradigm (Lather 1986), due to the engagement of subjective interpretation by the researcher and the theory.\(^{68}\) The models and analytical techniques used in are based on secondary data. This study is primarily explanatory in nature, particularly in testing and explaining secondary data and the determinants of CDS spreads and their link to managerial risk taking.

To ensure that all objectives are met, a number of econometric techniques are utilised to maximise the accuracy of the models, thereby identifying the best models that fit the data which are statistically robust. For instance, ordinary least squares regression (OLS), static panel models such as fixed effects and random effects models and dynamic panel models (i.e. generalised methods of moments (GMM)) are used for the purpose of analysis. Then the most appropriate model, given the characteristics of the data, is used. Essentially this entailed the use of secondary data sources from databases such as the Markit Group and DataStream. The use of specific analytical techniques is explained in detail later in this chapter.

5.3 Research design and data

5.3.1 Research design

This section describes the basic research design used to test the hypotheses developed in Chapter 4. The research design develops the overall plan for collecting, classifying, coding, measuring and analysing the data. Several aspects are covered, in this Chapter; including the setting of the study, assumptions used by the researcher, types of data and methods of data collection, operationalisation of the variables, econometric methods and diagnostics used. This research is primarily an explanatory research, which is set within a positivistic

\(^{68}\) See also the discussion of “conceptions of risk” in Chapter 3.
paradigm and uses cross-sectional and time series data (panel data) in order to test the hypotheses, thereby answering the research questions.

In the first phase of the research design, an extensive review of the literature was conducted in order to determine common themes that highlight the key aspects of managerial risk taking and their relation to CDS spreads. A theoretical framework is identified in order to determine whether these themes could be supported by authoritative theories and principles embodied in finance theory. This thesis limits the analysis of managerial risk taking and its relation to CDS spreads to financial institutions, primarily because these are large players in the CDS market and because the majority of the players in CDS markets are financial institutions. In addition, as explained in Chapter 3, the systemic risk or contagion is far more pronounced in the finance/banking industry as compared to other industries, which can lead to adverse consequences to the real economy. As a result, the finance industry is assumed to provide more important reasons to investigate managerial risk taking practices by the participants in CDS markets.

The second phase of the research design involved collecting secondary data for explanatory purposes. For example, existing data on CDS spreads (i.e. premium paid on a CDS contract) and other independent variables were collected from two different sources. The data consist of both cross-sectional and time series information. The use of time series data can be considered as a longitudinal study. This phase also involved examining the effect on managerial risk taking of financial institutions over a period of ten years. Hence, this reflects a panel design (i.e. cross-sectional and time series dimensions) as the dependent and independent variables are measured several times over the 10-year period. This panel design is dynamic in nature due to the use of a lagged dependent variable (CDS_{t-1}). The research procedures test the associations between factors that are likely to affect the level of risk taking in financial institutions (e.g. ROE, ROA, equity returns, returns volatility, credit ratings and firm size) and the measure used as a proxy for managerial risk taking (CDS spreads). The statistical procedures used are primarily econometrics based methods (i.e. panel models). Although the data require the analysis of a dynamic panel model, ordinary least squares regression and static panel models are also conducted in order to

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69 The global finance industry is considered for this purpose.
understand the differences of these models and why they are not suitable. As indicated in the previous section, the data were collected through two different reputable sources: the Markit Group, which is a leading global information services company and DataStream (one of the world’s largest financial statistical databases). Hence it is assumed to be consistent, reliable and accurate data.

In deciding the sample period of the selection of financial institutions, systematic influences were considered. For example, the ten year period selected was inclusive of the GFC. The main reason for this is that the research objectives of this study are to investigate the reasons for the “rise and fall” of the CDS market. Due to the CDS market’s collapse with the onset of the GFC, the data requires to be inclusive of this period. Although this period was relatively turbulent, there were many periods of high market activity in the period leading up to the GFC. The problem was factored into the research design by the selection of a ten year period that resulted in 319 financial institutions. Here, the attrition was treated as a missing observation which in turn reduced the sample size.

5.3.2 Data

This study performs a secondary data analysis of CDS spreads obtained from a comprehensive database from Markit Group. This is a global financial information services company that provides independent data, valuation and trade processing across all asset classes, especially related to CDSs. As this study particularly concentrates on the financial sector, the quotes are collected from the global banking and shadow banking industries. In addition to CDS spreads data, credit rating information is also obtained from this database. CDS spreads are end of day quotes, and these are collected for a period of ten years for 319 financial institutions. Markit (2010) uses a particular data cleaning methodology in the calculation of the end of day CDS quotes, focused around three primary enhancements as explained below.

1. Curve cleaning – Markit’s original data cleaning process separately cleans each data point on the spread curve. In this case, while some points could pass the data cleaning tests, the others will fail and hence were rejected in the data cleaning process. This can lead to composites in different maturity points in the same curve consisting of different
sets of contributors. Markit believes that in certain cases that this could result in unusual curve shapes and also cause difficulties in valuing CDSs. In order to avoid this, Markit cleans data on a curve basis (i.e. the curve is now accepted or rejected in its entirety rather than accepting some points on the curve and rejecting others). The curve is more importantly considered to consist of the price points and the associated recovery rate. The most important benefit of this method is that there is a significant improvement on the composite curve shape.

2. Cleaning in upfront units – Markit receives CDS spreads submissions from dealers as par spreads rather than upfront or conventional spreads. Previously par spread composites were converted to upfront spreads. Accurate upfront composites are arrived at due to the following changes: Performing most data cleaning tasks in the pricing type which matches the trading convention, i.e. if the trading convention of a particular entity is upfront then the key data cleaning tasks are performed on upfront prices. The composite prices are then compiled by these clean contributions. The accuracy of upfront contributions also is arrived at by allowing contributors to submit prices in different pricing formats (par, upfront or conventional spreads). There is a significant advantage in upfront cleaning in high yield or distressed names. In this case, par spreads that are converted from upfronts become very sensitive to small changes in upfront levels which mean that although par spreads can exhibit a wide variation, the corresponding upfront spread values have far less variation.

3. Non-standard composite creation – In addition to producing composite pricing based on trading convention for a particular market standard restructuring clause and currency, Markit produces composites for other non-standard restructuring clauses and currencies. However, in many cases the data is calculated based on the standard curve. Nevertheless, now Markit only produces non-standard composites where sufficient contributed data is available. Although this change reduces the non-standard composites by around 60%, the remaining non-standard composites are those where supporting contributed data is available and therefore should be of high quality and also reflective of more actively traded non-standard curves.
Figure 5.1 provides a snapshot of the methodology used by Markit in order to form CDS composites.

**Figure 5.1 Markit methodology for CDS data cleaning and composite formation**

- **Data submission**
  Books of record CDS curves from contributors

- **Data conversion**
  For each entity-tier normalise pricing data to a common pricing unit (upfront or par)

- **Contributor level cleaning**
  Includes checking for implausible data and curve buildability

- **Pooled data cleaning**
  Apply curve level tests to remove stale curves and outliers

- **Composite calculation**
  Create composite prices using clean data set

*Source: Markit (2010)*
A second dataset is obtained from DataStream\textsuperscript{70} which includes total assets, ROA, ROE, total returns index and returns volatility. These are mainly accounting and market data. As such data are only available for publicly listed entities, these variables are not available for non-public companies. The 319 companies for which CDS spreads and credit rating information were obtained from the Markit database have limited information on the above indicated accounting and market variables due to several institutions being non-public entities. The details are explained in Chapter 6. As additional variables, region and the lagged value of the dependent variable (CDS spreads) are considered.

5.3.3 Panel data methodology

5.3.3.1 Empirical studies

This section provides a brief review of the results and empirical methods of five major studies carried out previously in this area. With specific focus on studies that carry out panel data methods (with dynamic specifications), it reports on the econometric methodology and diagnostic tools used.

The studies mentioned here specifically relate to the use of dynamic panel models. While Blanco et al. (2005), Inci and Podpiera (2010), Aizenman et al. (2011) and Imbierowicz (2009) are based on studies related to CDS markets, Bierens et al. (2003) concentrate on dynamic behaviour of credit spreads on corporate bond portfolios. Although Bierens et al. (2003) provide an econometric model of credit spreads that incorporates portfolio rebalancing and thus incorporating jumps into ARCH type conditional variance, they highlight the importance of lagged market factors that could help understand the dynamic behaviour of credit spreads. Blanco et al. (2005) examine the validity of the implications of the theoretical relationship between CDS prices and credit spreads with particular emphasis on price discovery in CDSs using a dynamic model that uses lagged values of CDS prices and credit spreads in order to investigate the mechanics of price discovery taking into account the correlation between the two markets. Inci and Podpiera (2010) use a dynamic specification of CDS spreads that account for the persistence in CDS spreads and bank-specific credit risks. This is specifically motivated by the unit root and heteroskedasticity in credit spreads. Aizenman et al. (2011) investigate the pricing of risk associated with the

\textsuperscript{70} Courtesy of School of Applied Statistics and Actuarial Studies, Australian National University.
European sovereign debt crisis as seen in the market pricing of CDS spreads. A dynamic panel GMM estimator with exogenous and lagged values which is well suited for the problem with substantially large number of countries and relatively fewer time periods is used in this study that explains the effect of fiscal space and economic fundamentals on market priced risk, such as CDS spreads. Imbierowicz (2009) use a dynamic panel framework in order to control for macroeconomic, liquidity and implied volatility factors in order to highlight the market and model CDS spreads. According to the authors this dynamic panel regression captures the persistence in deviation and ensures this does not realise due to the pure noise.

Following the methodology adopted in the above mentioned research, this study uses a panel data methodology, due to data consisting of time series and cross-sectional data which contains a space and a time dimension. A panel data methodology controls for individual heterogeneity, reduces problems associated with multicollinearity and estimation bias, while specifying the time varying relation between dependent and independent variables (Baltagi 1995). It further provides more informative data with more variability and more efficiency (Gujarati 2003). The dataset used in this study is expected to present characteristics of groupwise heteroskedasticity and autocorrelation. Therefore, an appropriate econometric model needs to be chosen in order to account for these factors.

The general form of the model used in this study is based on the building blocks of CDS spreads that are identified in Chapter 3 and in this chapter. Drawing on the literature, three building blocks or categories have been identified; profitability, firm risk (indicating probability of default) and firm size. This study empirically investigates how these affect CDS spreads, hence the extent of firm/managerial risk taking. It models different indicators of profitability and firm risk in order to understand how they determine CDS spreads, thus the firm’s risk taking levels. The CDS spread indicators are defined as follows:

\[ \text{CDS spreads} = f(\text{Profitability}_i, \text{firm risk}_i, \text{size}_i) \]
As profitability indicators ROA, ROE and total returns index have been used, while as indicators of firm risk credit ratings and standard deviation of returns are used. Total asset values are used as an indicator of firm size. Region is also considered as a variable.

As panel data relate to (in the case of this research) individual global financial entities that vary over time, there is bound to be heterogeneity\(^{71}\) in these units. The techniques of panel data could take such heterogeneity into account in the analysis. Panel data combines time series and cross-sectional observations. Due to the different space and time dimensions of the data in this study, which is not captured in the standard OLS regression, a panel data analysis is considered. Gujarati (2003) states that panel data provides more informative data, with more variability, less collinearity among variables, more degrees of freedom and more efficiency.

**Pooled OLS, Fixed and Random Effects models**

The standard Ordinary Least Squares (OLS) pooled regression disregards the space and time dimensions of the pooled data. Although it is subject to many types of errors, a pooled OLS regression is a quick and simple benchmark to which more sophisticated regressions can be compared. In this model the intercept is assumed to be the same and it also assumes that the slope coefficient of each dependent variable is same for all entities. Thus the reported results may overstate the true cross-sectional relationship and overlook the longitudinal patterns within data that are not inconsistent (Wilson and Butler 2007).

Dynamic panel models cannot be estimated from observations at a single point in time. The advantage of dynamic panel models over aggregated time series data is related to the possibility that the aggregated data may obscure the underlying microeconomic dynamics. In such cases there is no scope for investigating heterogeneity (Bond 2002) among individual entities that could provide dynamics of the different firms, in this case financial institutions.

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\(^{71}\) Heterogeneity means that entities differ in ways not explained by observed independent variables. With standard pooled OLS it means that potential important local factors are assumed non-existent by the researcher (Wilson and Butler 2007).
In panel data models, the fixed effect model (FE) takes into account the idiosyncrasies of each entity by letting the intercept vary for each company but still assume the slope coefficients are constant across firms (see the following model), meaning the differences across entities of observation is assumed to be captured by differences in the constant term. These individual differences are not expected to vary over time, hence are time invariant. Thus FE removes the effect of the time-invariant characteristics from the independent variables (Gujarati 2003).

The fixed effects model:

$$Y_{it} = \beta_{1i} + \beta_{2i}X_{2it} + \beta_{3i}X_{3it} + u_{it}$$

The random effect model, in contrast assumes that the variation across entities is random and uncorrelated with the independent variables. This model includes time invariant variables. In the fixed effect model these time invariant variables are absorbed by the intercept.

The random effects model:

$$Y_{it} = \beta X_{it} + a_i + \epsilon_{it}$$

Where,

- $u_{it} =$ between entity error
- $\epsilon_{it} =$ Within entity error

The findings of Byström (2005), Blanco et al. (2005) and Zhang et al. (2009) suggest that the variation of the CDS spread could be explained by the lag of a CDS spread. A one-year lag of the dependent variable is introduced in this study. Therefore, the above static panel models such as FE and RE models cannot be used. Hence, in the dynamic specification the variation in the time dimension of CDS spreads is to a certain extent explained by the lagged dependent variable. The following section presents the dynamic specification and briefly explains the model specification.
5.4 Econometric model

\[ LAVGCDS_{i,t} = \beta_0 + \beta_1 LAVGCDS_{i,t-1} - \beta_2 CR_i - \beta_3 RROA_{i,t} - \beta_4 RROE_{i,t} - \beta_5 TRI_{i,t} + \beta_6 SQRETVOL_{i,t} + \beta_7 LTA_{i,t} + \sum_{y=1}^{n} \beta_p DREG_y + \sum_{t=1}^{n} \beta_t DY_t + U_{i,t} \]

(Equation 5.1)

Where,
- \( LAVGCDS_{i,t} \) = Natural Logarithm of the annual average CDS premium where \( i \) = entity and \( t \) = time
- \( LAVGCDS_{i,t-1} \) = One year lagged value of the natural logarithm annual average CDS spread for entity \( i \)
- \( CR_i \) = Average credit rating of S&amp;P, Moody’s and Fitch Ratings calculated as an average credit rating by Markit (Markit Avrating) for entity \( i \)
- \( DREG_y \) = Dummy Region, \( y \) = North America, Europe and Other for each entity, categorised as 1, 2 and 3 respectively. Each region dummy coded into 0 and 1
- \( RROA_{i,t} \) = Rank transformed ROA for entity \( i \) and time \( t \)
- \( RROE_{i,t} \) = Rank transformed ROE for entity \( i \) and time \( t \)
- \( LTRI_{i,t} \) = Natural logarithm of the total returns index for entity \( i \) and time \( t \)
- \( SQRETVOL_{i,t} \) = Square root of the standard deviation of the total returns index for entity \( i \) and time \( t \)
- \( LTA_{i,t} \) = Natural logarithm of total assets for entity \( i \) and time \( t \)
- \( DY_t \) = Year dummies where \( t = 2001 \) to \( 2010 \)

\( U_{i,t} = v_i + e_{i,t} \) where \( v_i \) is the unobserved time –constant entity specific effects and \( e_{i,t} \) represents time varying observation specific effects.

5.4.1 Estimation methods

This study conducts five different specifications/models. The choice of each model is explained below.
5.4.1.1 Pooled OLS

In order to estimate the determinants of CDS spreads, first a pooled OLS method is conducted. This method pools the time series observations of each variable and then performs linear regressions. Hence, the pooled observation model provides more variation due to the data points being treated as separate observations. One of the weaknesses of the OLS model is that it does not explore further financial institution specific information, which is overcome in panel models. The OLS model essentially discards entity-specific effects into the error term, which leads to an omitted variable bias (Jargowsky 2005). In addition, when regressors are correlated with the error term, it results in the problem of endogeneity. This problem cannot be addressed in pooled OLS. Despite these limitations, the analysis in this study is started with a pooled OLS, as it provides an initial suggestion of the coefficients of the parameters.

5.4.1.2 Fixed and random effects models (FE and RE models)

Due to the fact that the data used in this study consists of time series and cross-sectional data, popular static panel models of FE and RE specifications are conducted. The FE and RE estimates allow for individual heterogeneity across panels as well as across time (as year dummies are considered in the analysis). Generally, FE and RE estimates provide unbiased and consistent estimates provided the explanatory variables are strictly exogenous. If this assumption is violated due to the existence of a lagged dependent variable, a dynamic panel specification should be used as the GMM.

5.4.1.3 Rationale for the choice of a dynamic panel model (GMM)

There are several reasons for the choice of this model. First, some explanatory variables are endogenous to CDS spreads and therefore need to provide the instruments used accordingly. In this study the following variables such as the lagged dependent variable, credit ratings and returns volatility are considered as endogenous variables. The reason for credit ratings and returns volatility to be considered as endogenous is the fact that their causality could set out both ways with the dependent variable. This observation is consistent with the examination of Inci and Podpiera (2010). The inclusion of the lagged dependent variable as a regressor enables capture of the inertia in the behaviour of CDS spreads (Stapleton 2011). The dynamic specification is motivated by findings of Bierens et
al.(2003), Blanco et al. (2005) and Inci and Podpiera (2010). Secondly, entity-specific time invariant firm risk factors may be correlated with other explanatory variables. Thirdly, due to the presence of a lagged dependent variable, it introduces autocorrelation. Finally, Arellano-Bover (1995)/ Blundell-Bond (1998) estimators are designed for a small T, large N panels, meaning fewer time periods with many entities (i.e. in this study $T=10$, $N=319$). Given that a dynamic panel model has been shown to addresses all the above situations, a dynamic panel model specification is used in this study.

To address the first research question of why the CDS market grew exponentially up until the GFC, first the determinants of CDS premia are examined. The panel data regression investigates the role of the determinants of CDS premia that contributes to the dynamics of the increase in usage of CDSs on a global scale. The choice of the fundamental determinants in the baseline regression model is motivated by the literature as explained in the section on the development of hypotheses. As financial institutions can be viewed as highly levered and thus having high risk portfolios, the risk as judged by the CDS premium centres on the level of risk in the bank’s portfolio. Hence, the following information is considered.

In relation to firm information, accounting variables such as ROA, ROE, total assets and market variables such as equity returns, returns volatility and credit ratings are collected for ten years (2001-10) for all publicly listed companies in the list of entities. In addition, market based measures such as equity returns, measured by the total returns index, $f$ are obtained on a monthly basis. Table 5.1 provides the list of operationalised variables that are used in this analysis. Data analysis is conducted using the statistical software STATA, which is an integrated statistical software package for data analysis, data management and graphics.
Table 5.1 Operationalisation of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
<th>Expected effect on CDS spreads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAVGCDS</td>
<td>Log of CDS spreads – which provides the price of a CDS contract in number format as provided by Markit(^2) (daily prices are converted to an annual average)</td>
<td>Markit Group</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAVGCDS(_{t-1})</td>
<td>Lagged dependent variable expressed as the one-year lag of the CDS spread (LCDS)</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>CR</td>
<td>Average credit rating of S&amp;P, Moody’s and Fitch ratings calculated as an average credit rating by Markit. Dummy coded using a scale of 1 – 19 (Blume et al. 1998; Gray et al. 2006)</td>
<td>Markit Group</td>
<td>–</td>
</tr>
<tr>
<td>REG</td>
<td>Region (categorised into three groups: North America-REG1, Europe-REG2 and other-REG3). Each category is dummy coded as 0 or 1 (1 if it’s applicable to the specific region and 0 otherwise).</td>
<td>Markit Group</td>
<td>REG1 = + , REG2 = + as compared to REG3</td>
</tr>
<tr>
<td>LTA</td>
<td>Logarithm of total assets as a proxy for size</td>
<td>DataStream</td>
<td>+</td>
</tr>
<tr>
<td>LTRI</td>
<td>Total Returns Index (calculated as the annual average) – An index that calculates the performance of a group of shares</td>
<td>DataStream</td>
<td>–</td>
</tr>
<tr>
<td>RROA</td>
<td>Rank transformed(^3) ROA of each entity. The ratio of net profit after tax to total assets.</td>
<td>DataStream</td>
<td>–</td>
</tr>
<tr>
<td>RROE</td>
<td>Rank transformed Return of Equity, the ratio of net profit after tax to shareholders equity.</td>
<td>DataStream</td>
<td>–</td>
</tr>
<tr>
<td>SQRETVOL</td>
<td>Square root of returns volatility (calculated as the standard deviation of the monthly total returns index)</td>
<td>DataStream</td>
<td>+</td>
</tr>
<tr>
<td>Y</td>
<td>Year dummies created for years 2001 to 2010 (y1 – y10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Total number of entities in the sample (=319)</td>
<td>Markit Group</td>
<td></td>
</tr>
</tbody>
</table>

\(^{2}\) Right throughout the analysis, the CDS spreads data are used in the number format. Multiplying the CDS price figures by 100 converts to percentage terms and another 100 to basis points.

\(^{3}\) Details of rank transformation are explained in detail in the descriptive statistics in Chapter 5.
5.4.2 Econometric issues dealt within the analysis

5.4.2.1 Non-stationarity

The panel data used in this study is tested for non-stationarity. When dealing with time series data, it is important to ascertain whether the time series is stationary. If the data are non-stationary, then often the data points have means, covariances and variances that change over time (Gujarati 2003). Although non-stationarity is not a big concern for panel data with smaller time periods, tests for non-stationarity are conducted in this study. Maddala and Wu (1999) suggest that the Fisher test is a better test than the other tests for unit roots in panel data. Another advantage is that it does not require a balanced panel, unlike tests such as IPS (Im-Pesaran-Shin test). In this study, the Fisher test is used as a unit root test based on augmented Dicky-Fuller tests.

5.4.2.2 Dynamic panel bias

As mentioned previously, a dynamic panel bias arises when the lagged dependent variable $LCDS_{i,t-1}$ is correlated with the fixed effects in the error term (Nickell 1981). Positive correlation between a regressor and the error violates the assumption of ordinary least squares regression. Thus Roodman (2006) argues that such a situation would inflate the coefficient estimate for the lagged dependent variable by attributing predictive power to it, that belongs to the firm fixed effects. In order to handle a dynamic panel bias as a result of the problem of endogeneity due to independent variables that are not strictly exogenous (i.e. independent variable are correlated with past and possibly current realisations of the error) and a lagged dependent variable, GMM models (Roodman 2006) are used in this study. One and two step system GMM is used in order to identify which model fits to the data well. GMM models of difference and system models are estimators that are designed for dynamic “small T”, large “N” that may contain fixed effects and idiosyncratic errors that are heteroskedastic and correlated within individuals (Roodman 2009). Linear GMM is specifically designed for OLS regression. The difference and system GMM estimators are purely designed for panel data analysis and are particularly based on a set of assumptions about the data generating process (Roodman 2006). The most important assumption is that the process may be dynamic and that the current realisations of the dependent variable may be influenced by the past realisations. Second, there may be arbitrarily distributed fixed individual effects, thus variation over time can be used to identify parameters. Another
important assumption of the system and difference GMM is that the regressors may be endogenous (explained above). The consistency of the GMM estimator depends on the validity of the assumption that idiosyncratic disturbances may have individual specific patterns of heteroskedasticity and serial correlation. However, idiosyncratic disturbances should be uncorrelated across individuals (Roodman 2009, 2006).

In addition, the dynamic panel specification is motivated in this study by Blanco et al. (2005) and (Inci and Podpiera 2010) that use the specification with a lagged dependent variable. The model parameters are estimated using Arellano Bover/Blundell Bond GMM estimator (Arellano and Bover 1995; Blundell and Bond 1998). The reason for the choice of this method is to allow more instruments that improve efficiency. Arellano Bover/Blundell Bond estimator augments the Arellano Bond estimator by making an additional assumption that first differences of instrument variables are uncorrelated with fixed effects. This introduces more instruments and thus can dramatically improve efficiency (Roodman 2006). Another reason is that system GMM can include time invariant variables that would disappear in difference GMM. Hence, the difference GMM is not used in this study. Standard deviation of returns and credit ratings are assumed to be endogenous (as causality could run both ways) to CDS spreads (Inci and Podpiera 2010).

In addition, bank specific time invariant credit risk factors may be correlated with other independent variables, which are accounted for by taking the first differenced equation as well as the level equation in the system GMM. The presence of the lagged dependent variable introduces autocorrelation with the residuals; therefore it is instrumented with the lagged value. Furthermore, GMM estimators are designed for large N and small T panels it is an appropriate estimator for the panel data set in this study where \( T=10 \) and \( N = 319 \), hence a shorter time dimension relative to the number of financial institutions.

Arellano Bover/Blundell Bond GMM estimator thus considers the following level equation (1) and the first difference of equation 1 (equation 2)

\[
LAVGCDS_{t,t} = \beta_1 LAVGCDS_{t,t-1} + \sum_{i=1}^{n} \beta_2 X_{i,t} + U_{i,t}
\]

(1)
\[ \Delta \text{LAVGCDS}_{i,t} = \beta_1 \Delta \text{LAVGCDS}_{i,t-1} + \sum_{i=1}^{n} \beta_2 \Delta X_{i,t} + \Delta e_{i,t} \]

(2)

In equation 2 the fixed effects are removed.

where \( \Delta \) is the first difference operator. In equation 2, the lagged dependent variable, \( \Delta \text{LCDS}_{i,t-1} \), is by construction correlated with the error term \( \Delta e_{i,t} \). This in turn imposes a bias in the estimation of the model. Nevertheless, \( \text{LCDS}_{i,t-2} \), which is expected to be correlated with \( \Delta \text{LCDS}_{i,t-1} \) and not correlated with \( \Delta e_{i,t} \) for \( t = 3, \ldots, T \) can be used as an instrument in estimating equation 2, provided that \( e_{i,t} \) are not serially correlated. This means that lags of order to or more of the dependent variable, \( \text{LCDS}_{i,t} \), satisfies the following moment condition:

\[ E \left[ \text{LAVGCDS}_{i,t-s} \Delta e_{i,t} \right] = 0 \text{ for } t = 3, \ldots, T \text{ and } S \geq 2 \]

(3)

Another source of bias stems from the possible endogeneity of the explanatory variables and the resulting correlation with the error term. In the case of this study, credit ratings and returns volatility are considered to be endogenous variables, due to causality running both ways. In the case of strict exogeneity, the past and future values of such variables are uncorrelated with the error term, which implies the following moment condition:

\[ E \left[ X_{i,t-s} \Delta e_{i,t} \right] = 0 \text{ for } t = 3, \ldots, T \text{ for all } S \]

(4)

\( X \) represents the explanatory variables that hold the assumption of strict exogeneity. However, with the presence of reverse causality as mentioned above, the past and the future values of the explanatory variables are correlated with the error term, i.e. \( \text{COR}[X_{i,t} e_{i,t}] \neq 0 \) for \( t < s \). For such endogenous explanatory variables, only current and lagged values of \( X_{i,t} \) are valid instruments and therefore the following moment condition can be used:

\[ E \left[ X_{i,t-s} \Delta e_{i,t} \right] = 0 \text{ for } t = 3; \ldots; T \text{ and for } s \geq 2 \]

(5)
The orthogonality conditions explained above in equations 3 to 5 provide the underpinnings of the one step GMM estimation used in this study. Thus, this one-step GMM model provides consistent estimates, given the assumption of homoskedasticity and independence in residuals. The two-step GMM estimator, on the other hand, utilises the estimated residuals in order to construct a consistent variance-covariance matrix of the moment conditions (see Arellano and Bond 1991; Blundell and Bond 1998; Louzis et al. 2011; Stapleton 2011).

In this study, both one and two step system GMM is used. The difference between the two is that in the one step estimator, error terms are assumed to be independent and homoskedastic across entities and over time. In the second step, the residuals used in the first step are used to construct the variance-covariance matrix which is consistent. Therefore, it relaxes the assumption of independence and homoskedasticity. The two step estimator is therefore considered to be more efficient than the one step estimator (Beck and Levine 2004). Thus the two step system GMM was also considered in this study.

5.4.2.3 Robustness of results

The results are tested for the presence of unobservable time effects and the robustness of the estimates. Robust estimates are reported for both static and dynamic models unless otherwise specified. For the one-step system GMM, pooled OLS, FE and RE estimates, robust results are reported, therefore all estimates are robust to heteroskedastic error. When obtaining results for the one-step system GMM, the number of instruments used is reported where necessary. In addition, due attention is paid in order to avoid the use of too many instruments. In the two-step GMM the significance is lost with robust results; hence the results reported for the two-step system GMM includes default standard errors.

The following section briefly describes all variables used in the subsequent analysis.

5.5 Variables

5.5.1 The dependent variable

Consistent with previous literature, the CDS premium is used as the dependent variable. Particularly 5-year maturities are used as CDSs are most liquid for this maturity. Blanco et
al. (2005) and Zhu (2006) argue that in the short-term CDS spreads tend to respond faster to changes in credit conditions due to the absence of funding and short sale restrictions in the derivatives market. Thus, the CDS market leads the bond market in price discovery.

The natural logarithm of the annual average of CDS spreads (LCDS) is used as the dependent variable. CDS spread is the price of a CDS expressed in a number format (refer footnote 6). This measure is primarily driven by the credit quality of the underlying asset (Batten and Hogan 2002). The higher the spread, the higher would be the credit risk of the underlying asset. As debtholders charge a higher risk premium in those cases where risk is higher (Jensen and Meckling 1976), by analysing the risk premium on debt owed by individual financial entities as measured by banks’ CDS spreads in relation to the explanatory variables determinants of managerial risk taking in financial, entities could be ascertained (Bolton et al. 2010). Therefore CDS spreads are used as a proxy for managerial risk taking.

As the dataset consists of a daily time-series distribution, an annual average of the CDS spreads is calculated. The annual average represents the mean in the dependent variable for a particular year. It should be noted that there was considerable non-normality in the CDS spreads’ data distribution. As a result, log transformation of the average CDS spread is applied in order to reduce the level of non-normality and the logarithm of CDS spread is used in the entire multivariate analysis.

5.5.2 Explanatory variables

The explanatory variables (independent variables) use in this study includes variables such as credit ratings, lagged CDS spread, region, total assets, ROA, ROE, equity returns and returns volatility (see Table 4.1). The crucial parameter in CDS pricing is the amount of credit risk associated with the underlying reference entity (Byström 2005). By understanding the association of these determinants of credit risk of the underlying asset, a CDS can be used effectively as both a hedging and a speculative instrument. These determinants are explained in the following section.
5.5.2.1 Lagged CDS spread

One year lag of the dependent variable (LCDS) is used in this study as part of the explanatory variables that constitute the model. Motivated by the findings of Blanco et al. (2005), Bierens et al. (2003) and Inci and Podpiera (2010) among others who subscribe to the notion that the contribution to price discovery in CDS spreads is substantially enhanced by the use of a lagged dependent variable and hence, the economic importance of the lagged dependent variable is immense. Keele and Kelly (2006) argue that when there is autocorrelation in ordinary least squares regression, a lagged dependent variable often eliminates the residual serial correlation. They also state that lagged dependent variables can also capture the dynamics in theory. For instance, dependent variable used in this study, CDS spreads, at time $t$, is a function of the CDS spread at $t-1$, which provides modified new information of the CDS spread at time $t$. This allows predicting the CDS spread in time $t$ based on the knowledge of what has happened in time $t-1$. In this case the lagged dependent variable captures the theory of dynamics with a dynamic specification. The lagged variable is also included to control for serial correlation of this variable. Norden and Wagner (2008) investigates whether there is a link between CDS spreads and loan prices and finds that the explanatory power is considerably higher for the model based on lagged CDS spreads as compared to the model including contemporaneous link between markets. The following equation depicts the CDS spread at time $t$ being a function of the CDS spread at time $t-1$.

$$CDS_{i,t} = f(CDS_{i,t-1}) + e_{i,t}$$

Where:

$CDS_{i,t}$ = CDS spread for company $i$, at time $t$

$CDS_{i,t-1}$ = CDS spread for company $i$, at time $t-1$ (one period lag)

$e_{i,t}$ = error term

5.5.2.2 Credit ratings

Credit ratings are an important if not the most important source of credit risk overall and hence have an explanatory power on CDS spreads (see for eg: Daniels and Jensen 2005; Fabozzi et al. 2007; Hull et al. 2004; Norden and Weber 2004). As mentioned previously, due to both CDSs and credit ratings being driven by the credit quality of the underlying asset (which is an unobservable characteristic), credit ratings published by rating agencies
such as Moody’s, Standard and Poor’s and Fitch are used as a proxy for credit risk of issuers and issues. In this study a Markit average credit rating is used which is calculated as an average of Standard and Poor’s, Moody’s and Fitch credit ratings.

Credit spreads change more or less continuously while credit ratings only change on a discrete basis. Hull et al. (2004) argue that if both are based on the same information, then rating changes will lag credit spread changes. Using the same logic one could argue that as CDSs are a derivative of the underlying bond/asset, that credit rating changes will also lag CDS spread changes. As argued by Cantor and Mann (2003), rating agencies have stability as one of their objectives, so would avoid reversing a rating within a very short period of time. This stability could also result in credit ratings lagging CDS spread changes. Nevertheless, as rating agencies base their rating on non-public information, among other publicly available information, the possibility that credit rating changes lead CDS spread changes cannot be ruled out (Hull et al. 2004).

The CDS dataset provided by Markit Group included two categories of credit ratings. The first is a daily credit rating calculated by Markit. The second is an average credit rating (explained above,. For the purpose of this study, the Markit average rating was used as the daily Markit credit rating could not be taken as an annual average. However, the Markit average rating does not change over the years. Hence this variable is treated as a cross-sectional variable. This can be considered a limitation of the dataset/study, however, the analysis is unaffected by this situation as dynamic panel models such as system GMM allows for the use of cross-sectional variables (that do not vary over time), hence the econometric analysis is not affected.

The structure of credit ratings presents several econometric issues. Gray et al. (2006) argue that due to the natural ordering in credit ratings this makes a multiple discriminant analysis inappropriate. The natural ordering relates to AAA being a higher rating than AA, which is higher than A, which is higher than BBB etc. Secondly, the ratings are not evenly spaced, meaning the difference between AAA/AA and A categories may be more or less than the difference between A and BBB categories. This creates a problem in regression analysis, therefore the standard least squares techniques are inappropriate. Following Blume et al.(1998) and Gray et al. (2006) this study uses the following classification.
In this study, credit rating is used as an independent variable $R_i$ of company $i$ in time $t$, thus $R_i$ can take one of nineteen values. The numerical rating conversion is given in Table 5.2:

**Table 5.2 Rating conversion**

<table>
<thead>
<tr>
<th>Credit Rating</th>
<th>Numerical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>19</td>
</tr>
<tr>
<td>AA+</td>
<td>18</td>
</tr>
<tr>
<td>AA</td>
<td>17</td>
</tr>
<tr>
<td>AA-</td>
<td>16</td>
</tr>
<tr>
<td>A+</td>
<td>15</td>
</tr>
<tr>
<td>A</td>
<td>14</td>
</tr>
<tr>
<td>A-</td>
<td>13</td>
</tr>
<tr>
<td>BBB+</td>
<td>12</td>
</tr>
<tr>
<td>BBB</td>
<td>11</td>
</tr>
<tr>
<td>BBB-</td>
<td>10</td>
</tr>
<tr>
<td>BB+</td>
<td>9</td>
</tr>
<tr>
<td>BB</td>
<td>8</td>
</tr>
<tr>
<td>BB-</td>
<td>7</td>
</tr>
<tr>
<td>B+</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
</tr>
<tr>
<td>B-</td>
<td>4</td>
</tr>
<tr>
<td>CCC+</td>
<td>3</td>
</tr>
<tr>
<td>CCC</td>
<td>2</td>
</tr>
<tr>
<td>CCC-</td>
<td>1</td>
</tr>
</tbody>
</table>

Abid and Naifar (2006) argue that using a numerical scale as shown in Table 5.2 can introduce a bias due to the implicit assumption that the rating changes from different rating classes have the same influence on the CDS spread. This is addressed by using a dummy variable for the credit rating which is equal or lower than a particular rating class (in this case A₂) and an interacting term to test the impact of lower credit ratings on CDS prices. A similar approach has been taken by Aunon-Nerin et al. (2002) who create a dummy variable.

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74 The lowest credit rating in the numerical scale is assumed as CCC-, as the dataset does not have any issuers below CCC.
that accommodates a different sensitivity of CDS spreads in relation to the rating for higher and lower ratings of the underlying asset.

Consistent with the above approaches, this study attempts to use a dichotomous dummy variable credit rating of the financial institution. Two rating classes are distinguished: a notation for ratings that are equal or higher than BBB and a notation for ratings lower than BBB. The choice of BBB is purely taken in order to balance the sample size for all subgroups, as the BBB rating is approximately the mid-point between the highest rating of AAA and the lowest rating applicable to this study, of CCC. The cut-off point for the dichotomous classification is BBB, thus the dummy variable takes the value of “0” if the rating is less than “BBB” and “1” if the rating is greater than “BBB”. Therefore the following regression equation was considered:

\[
LAVGCDS = \alpha + \beta_0 \cdot D1 + \beta_1 \cdot R_{it} + \beta_2 \cdot D1 \cdot R_{it}
\]

\(LAVGCDS\) = Natural Logarithm of the annual average of the CDS spreads for each entity over time.
\(D1\) = Dummy variable for credit rating. The value takes 1 if the rating is above BBB and 0 if the rating is BBB and below.
\(R_{it}\) = Credit rating for company \(i\) at time \(t\)
\(D1 \cdot R_{it}\) = dummy variable multiplied by the credit rating

Although this interaction was considered in this study, there was no change in the results, hence is not considered in the analysis.

5.5.2.3 Size

An extensive number of empirical studies show that the size of the financial institution is crucial (see Ashraf et al. 2007; Minton et al. 2005; Pennacchi 1988). Minton et al. (2005) in particular provide evidence of a positive relation between bank size and the probability that financial institutions will use credit derivatives for hedging purposes. Consistent with Minton et al. (2005), this study uses the natural logarithm of total assets as a proxy for size and thus controls the effect of size differences, although the “size effect” problem is particularly addressed by using ratio indicators, i.e. the use of a numerator and denominator. Further, Ashraf et al. (2007) formulate an empirical model that incorporates
the decision to participate in credit derivative markets by banks and the decision concerning the volume of business transacted. The size was positive and significant in both equations, reflecting the tendency of large banks with substantial human capital and financial resources to have a higher proportion of credit derivative business. In this study, total assets of each entity are used as a proxy for size.

As the size data in this study is obtained via DataStream which consists of companies that are publicly listed, this variable is available only for the listed companies of the CDS spreads dataset.

5.5.2.4 Volatility of equity returns

A critical parameter in CDS pricing is the amount of credit risk linked with the underlying asset. Byström (2005) argues that three different approaches could be followed in order to quantify the amount of credit risk in a CDS that is associated with the underlying asset: to rely on credit ratings, to rely on traditional scoring models that use accounting information and to obtain information on credit risk from the market. In relation to obtaining credit risk information from the market, Byström (2005) argues that if credit risk is acknowledged by the market, then credit risk information would be contained in market prices. One of the most important determinants of the CDS price is the probability of a credit event occurring, and the stock market based credit risk model developed by Merton (1974) suggests that this probability should be related to the stock returns volatility of the reference entity. Ericsson et al. (2009) extend the structural models developed by Merton (1974), Longstaff and Schwartz (1995) and Duffie and Lando (2001) among others and uses them together to suggest that equity volatility is a main determinant of CDS premia.

Volatility of equity returns is also considered to be a main driver of credit risk in structural models as the default event depends on the movement of firm value (see for eg: Hsu et al. 2004; Leland and Toft 1996). The authors use volatility of assets as the main determinant of credit risk. Abid and Naifar (2006) argue that equity returns volatility of the underlying asset may be used as a proxy for credit risk. In this study, volatility of equity returns is used, and calculated as the standard deviation of the monthly equity returns (total returns index) as a proxy for the equity volatility. Hassan et al. (2011) assert that the volatility of the
underlying asset indicates the uncertainty of the security’s value, thus higher equity volatility translates into higher default risk.

5.5.2.5 Region

In this research, the entities in the CDS dataset are divided into three groups based on the region. US and Canadian companies are categorised into the group “North America”, all entities in the European continent are categorised under “Europe” and rest of the entities are categorised under “other”.

A dummy variable is created for each region where the value “1” is given if an entity relates to a specific region and “0” if otherwise. Regions are symbolised as REG1, REG2 and REG3 representing regions 1, 2 and 3 respectively. The countries included in each region are given in Table 5.3.

Table 5.3 provides the classification of financial institutions into regions. Most entities in this sample are from the North American region. While 70 companies are from Europe, only 54 companies of 319 constitute the rest of the world.

<table>
<thead>
<tr>
<th>Region</th>
<th>Countries</th>
<th>Number of Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>United States, Canada and Bermuda</td>
<td>195</td>
</tr>
<tr>
<td>Europe</td>
<td>Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Russia, Spain, Sweden, Switzerland, Kazakhstan and United Kingdom</td>
<td>70</td>
</tr>
<tr>
<td>Other</td>
<td>Australia, Brazil, Cayman Islands, Chile, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Saudi Arabia, Singapore, Taiwan, Thailand and United Arab Emirates</td>
<td>54</td>
</tr>
</tbody>
</table>

Fabozzi et al. (2007) in particular use two regions, America and Europe, in exploring the components of credit risk in CDSs and finds that on average CDS spreads for American entities are higher than for European ones. The main reason for using trichotomous region dummy variables in this study is to investigate whether North American CDS spreads are on average higher than their European counterparts and the rest of the world. By

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75 The “other” category mainly comprises South American, Asian and Middle Eastern companies. Due to the relatively low number of entities in each region, all have been combined together under “other”.

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ascertaining and if North American CDS spreads are (or are not) on average higher than the other regions, it would suggest that for North American entities, managerial risk taking is on average higher.

5.5.2.6 ROE/ROA and TRI

Minton et al. (2005) investigate the impact of profitability on the use of credit derivatives and find that net buyers of protection have a higher ROE, which means that they are highly levered and hence more vulnerable to shocks. Das and Hanouna (2006) show that firms with higher performance as measured by ROE and ROA have CDS securities with lower spreads. Zhang et al. (2009) use a novel approach to explain the determinants of CDSs that predicts the effects of structural factors on credit spreads and finds that ROE has a negative effect. Thus the probability of default is lower when the firm’s profitability improves. In this study, ROA is calculated as the ratio of Net Profit after Tax to Average assets and ROE is calculated as the ratio of Net Profit after Tax to Average Shareholder’s Equity. The issues of linearity and normality are discussed later in this chapter.

\[
\text{ROA} = \frac{\text{NPAT}}{\text{Average Assets}}
\]

\[
\text{ROE} = \frac{\text{NPAT}}{\text{Average Shareholder’s Equity}}
\]

Total returns index is used as a measure of equity returns in this study. TRI calculates the performance of a group of stocks. It includes both capital gains of the group of shares over time and assumes that the cash distributions (dividends) are reinvested in the index. TRI is calculated as the previous index value times the ratio of the current price return index value plus, cash distributions to the previous day’s closing price returns index value (Nasdaq 2011).

\[
\text{TRI} = I_p \times \frac{(I_t + D)}{I_{t-1}}
\]

Where:

\( I_p \) = Previous index value

\( I_t \) = Current price index value

\( D \) = Dividends (cash distributions)

\( I_{t-1} \) = Previous day’s closing price returns index value
As equity returns provide an indication of expected returns, it is reasonable to expect that higher expected returns would provide a lower CDS spread, indicating lower risk (Chiu and Wagner 2010). This negative relationship is also supported by Han and Zhou (2010). Both higher current and expected profitability can indicate better prospects for growth and also resilience to market shocks and therefore can be associated with lower credit risk.

5.6 The sample and time period

Although the above data are obtained from different countries around the world that may differ in prudential standards, they do not limit the econometric analysis that is carried out in this study as panel data techniques used allow these differences to be treated as unobserved time invariant features. The specific measurement error generated for a variable will not cause a bias in the regression coefficients, although it can reduce the overall efficiency in the estimates. The dataset in this study ranges from 2001 to 2010; however, not all entities have CDS spreads data for all companies as it depends on when they started trading with enough liquidity. In addition, as CDSs were introduced in 1997, by 2001 not many companies were using them for hedging or trading purposes. Moreover, the explanatory variables used in this study are available only for publicly listed companies (due to the availability in DataStream). Hence there are many missing observations for companies that are not publicly listed. Thus due to restrictions in data availability, the panel used in this study is an unbalanced panel. Despite the missing data, due to the time dimension of the dataset 2001-10 and the sample size (up to 319) it provides enough observations for consistent estimators, taking into account the asymptotic properties.

The sample size also varies across different specifications used in this study. Due to the use of a lagged dependent variable, the observations are reduced to 665 in the pooled OLS, FE and RE estimates. The observations are further excluded in the dynamic panel models of GMM1 (one-step GMM) and GMM2 (two-step GMM) due to first differencing as well as the use of up to three lag periods in the dependent variable.

5.7 Data collection and screening

This section looks at the data collection and screening procedures of this study that ensures reliability and consistency of the data and preparing and cleaning the data in order to suit the econometric analysis.
5.7.1 Reliability and consistency

The research procedures used in this study incorporate various controls in order to ensure accuracy of the data, including the use of databases from Markit and DataStream. Due to the relevant rigorous data cleaning procedures undertaken by these databases, reliability and consistency were not considered to be serious threats in this study.

Subsequent to the initial data recording procedures, specific data from the Markit database was transferred to Excel files, i.e. 5-year daily CDS spreads and credit rating information; the data were then transferred into STATA files for the analysis. STATA is a complete, integrated statistical package that provides advanced techniques of data analysis and specifically suited to handle panel data, especially dynamic panel models. Further screening was undertaken to check for irregularities in the data recording process. In addition, data obtained from DataStream were transferred to Excel spreadsheets, i.e. ROE, ROA, equity returns, returns volatility and total assets, and then to STATA files.

5.7.2 Outliers

Tabachnick and Fidell (2007) state that an extreme value of one variable (i.e. a univariate outlier) or a strange combination of two or more variables (i.e. a multivariate outlier) can significantly distort statistics. Tests were done to identify the univariate and multivariate outliers. Box plots and scatter plots were used to identify significant outliers. For CDS spreads data, the scatter plot revealed an extreme value (which was assumed to be a financial entity that had more extreme values than a normal distribution). Bivariate and multivariate regressions were used check for significant outliers.

Given the significant outliers in average CDS spreads (for example, in one case the average spread was 0.7961 in number format76 (7961 in basis points) given the mean of the spreads was .01909 (i.e. 190.9 in basis points)), first the data were checked for incorrect data entry, second whether it was a failure to specify missing values and third whether the outlier is not a member of the population. None of the above was identified as the cause of the outliers.

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76 Markit provides CDS spreads data in number format; these need to be multiplied by 100 to convert into percentage terms and multiplied by yet another 100 to convert to basis points.
outlier. Thus the data revealed that the outliers in the average CDS spreads were more of extreme values than a normal distribution. In this case the extreme outliers were deleted and multivariate regressions were conducted without the extreme outliers. There was no significant difference in the results with and without the outliers; hence it was decided to retain them.

The same procedure was adopted for other variables; no cases of extreme outliers were detected. For these variables, outliers (i.e. extreme values that could have a negative value on the estimators) were also checked using regression plots. These plots regress each transformed independent variable against the transformed dependent variable. All data points were more or less in range, hence no extreme outliers were observed.

5.7.3 Missing variables

In particular with CDS spreads, there were many cases of missing data. This was mainly due to a particular selection of CDS spreads of entities being used. For instance, only financial entities with 5-year CDS spreads, denominated in USD for senior unsecured debt and a “no restructuring” clause were considered as part of the dataset. In addition over the ten year sample period from 2001-10, not many financial entities started trading earlier on with enough liquidity (see Section 5.6). This meant that there were many missing variables in the CDS spreads data set. In addition there were missing variables in credit rating data, mainly due to some companies not being rated during a particular year(s). In this case the data were non-existent. Nevertheless, data for other independent variables were only available for public listed companies, resulting in missing values for all non-public companies. In this case the data were missing, not because it was non-existent but because it was unknown. STATA records missing values (identified as empty cells) with the sign “.” instead of a “0” value. These missing values were not taken into consideration when computing the results. The requirements of central limit theorem for minimal sample size were not violated with 319 financial entities used in this study.

As there are missing data, this is an unbalanced panel. Due to the CDS dataset comprising non-publicly listed companies as well, the accounting and market data (such as equity returns) are not available for non-public companies. When using the statistical software
STATA, as the default option in dealing with missing values cases, the missing values are deleted listwise. Only cases with valid values for all variables are used in the analysis. Mean substitution method (Royston 2005) of replacing mean value with the variable mean was not used as the majority of the data that are missing is because values are unknown rather than non-existent.

5.7.4 Normality, linearity and heteroskedasticity

Tabachnick and Fidell (2007) state that in the assumption of multivariate normality all linear combinations of the variables are normally distributed. When this assumption is held, the residuals of the analysis are normally distributed and independent. Skewness and Kurtosis of the variables calculated in this study suggests that the variables are not normally distributed (i.e. skewness and kurtosis are not zero).

STATA searches a subset of the ladder of powers for a transform that converts each variable into a normally distributed variable (see Appendix 1, panels A, B, C and D). The best transformation for each variable of the given transformations is used. For example, for AVGCDS, TA and TRI log transformations were used, while for RETVOL a square root transformation was used. ROE and ROA are transformed using a procedure known as rank transformation, which is explained in detail below. This was mainly carried out due to the existence of negative values, highly skewed distributions and outlier effects. In all cases normality was achieved through the transformation procedures used in Table 5.5.

Table 5.4: Statistical transformations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Name (Prior to transformation)</th>
<th>Variable Name (After transformation)</th>
<th>Transformation Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDS spreads</td>
<td>CDS</td>
<td>LCDS</td>
<td>Log transformation</td>
</tr>
<tr>
<td>Total Assets</td>
<td>TA</td>
<td>LTA</td>
<td>Log transformation</td>
</tr>
<tr>
<td>Return on Assets</td>
<td>ROA</td>
<td>RROA</td>
<td>Rank transformation</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>ROE</td>
<td>RROE</td>
<td>Rank transformation</td>
</tr>
<tr>
<td>Total Return Index (Equity Returns)</td>
<td>TRI</td>
<td>LTRI</td>
<td>Log transformation</td>
</tr>
<tr>
<td>Returns Volatility</td>
<td>RETVOL</td>
<td>SQRETVOL</td>
<td>Square root transformation</td>
</tr>
<tr>
<td>Credit Ratings</td>
<td>CR</td>
<td>-</td>
<td>Not transformed</td>
</tr>
</tbody>
</table>
Thus, in general, the data seems to be highly skewed, containing outliers and negative values. As negative values preclude logarithm and square root transformation, in order to achieve normality of data a procedure known as rank transformation is considered for the treatment of outliers and negative values. Kane and Meade (1998) assert that its use would, among other things, limit the problems of negative values, highly skewed distributions and outlier effects. Rank transformation is achieved by replacing each observation with its respective rank in the sample (Kane and Meade 1998; Zou et al. 2003). These ranks are then used to estimate the given regressions. In using rank transformation, for the vector \([X_{t,1}, X_{t,2}, \ldots, X_{t,n}]\) of each variable, each value of \(X_t\) is replaced with its corresponding rank, in ascending sequence, divided by \(n+1\) (see Table 5.5, panels A and B for a detailed explanation).
Table 5.5 Rank transformation

Panel A: Rank transformation – part 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Financial Institution Number (ID)</th>
<th>Untransformed data (ROE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32</td>
<td>3.45</td>
</tr>
<tr>
<td>2</td>
<td>34</td>
<td>8.72</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>11.99</td>
</tr>
<tr>
<td>4</td>
<td>39</td>
<td>0.13</td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>2.16</td>
</tr>
<tr>
<td>6</td>
<td>44</td>
<td>11.05</td>
</tr>
<tr>
<td>7</td>
<td>46</td>
<td>15.26</td>
</tr>
<tr>
<td>8</td>
<td>47</td>
<td>14.14</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>17.81</td>
</tr>
<tr>
<td>10</td>
<td>52</td>
<td>17.81</td>
</tr>
<tr>
<td>11</td>
<td>55</td>
<td>13.96</td>
</tr>
<tr>
<td>12</td>
<td>57</td>
<td>-11.52</td>
</tr>
<tr>
<td>13</td>
<td>58</td>
<td>25.15</td>
</tr>
<tr>
<td>14</td>
<td>59</td>
<td>1.41</td>
</tr>
<tr>
<td>15</td>
<td>61</td>
<td>9.67</td>
</tr>
<tr>
<td>16</td>
<td>62</td>
<td>17.49</td>
</tr>
<tr>
<td>17</td>
<td>63</td>
<td>17.15</td>
</tr>
<tr>
<td>18</td>
<td>64</td>
<td>21.54</td>
</tr>
<tr>
<td>19</td>
<td>66</td>
<td>24.3</td>
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<tr>
<td>20</td>
<td>67</td>
<td>6.38</td>
</tr>
<tr>
<td>21</td>
<td>69</td>
<td>10.62</td>
</tr>
<tr>
<td>22</td>
<td>70</td>
<td>1.33</td>
</tr>
<tr>
<td>23</td>
<td>72</td>
<td>2.78</td>
</tr>
<tr>
<td>24</td>
<td>73</td>
<td>11.84</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>19.44</td>
</tr>
<tr>
<td>26</td>
<td>77</td>
<td>4.41</td>
</tr>
<tr>
<td>27</td>
<td>80</td>
<td>13.97</td>
</tr>
<tr>
<td>28</td>
<td>81</td>
<td>1.7</td>
</tr>
<tr>
<td>29</td>
<td>82</td>
<td>13.58</td>
</tr>
<tr>
<td>30</td>
<td>83</td>
<td>8.39</td>
</tr>
<tr>
<td>31</td>
<td>85</td>
<td>16.72</td>
</tr>
<tr>
<td>32</td>
<td>89</td>
<td>9.12</td>
</tr>
<tr>
<td>33</td>
<td>92</td>
<td>16.39</td>
</tr>
<tr>
<td>34</td>
<td>94</td>
<td>0.84</td>
</tr>
<tr>
<td>35</td>
<td>95</td>
<td>-19.23</td>
</tr>
</tbody>
</table>

Notes: Following Kane and Meade (1998) and Zou et al. (2003), due to the existence of negative values in the profitability measure such as ROE and ROA, square root or log transformations were not possible. Therefore rank transformation of ROE and ROA is taken and replaced with the rank equivalents of the analysis. The process is illustrated below using an example.

For the vector \([X_{t1}, X_{t2}, X_{t3}, \ldots, X_{tn}]\) for the variable \(X\) in year \(t\), each value of \(X\) is replaced with its corresponding rank (ranging from 1 to \(n\) in ascending sequence) divided by \(n + 1\). For the purpose of illustration, variable ROE for year 2001 is used for 319 financial institutions in the sample. Note, all companies do not have accounting information. The data is limited to public listed companies. Further, all companies do not have data for all years; it depends on when the company has started trading. Hence, the Financial Institution identity no. does not sequentially rank from 1 to 319. Due to the high number of entities (and inadequate space), only the first 32 companies are used in this example.
Panel B: Rank transformation – part 2

<table>
<thead>
<tr>
<th>Financial Institution Number (ID)</th>
<th>Untransformed data (ROE)</th>
<th>Rank (in ascending order)</th>
<th>Transformed Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>-19.23</td>
<td>1</td>
<td>0.003125</td>
</tr>
<tr>
<td>57</td>
<td>-11.52</td>
<td>2</td>
<td>0.00625</td>
</tr>
<tr>
<td>39</td>
<td>0.13</td>
<td>3</td>
<td>0.009375</td>
</tr>
<tr>
<td>94</td>
<td>0.84</td>
<td>4</td>
<td>0.0125</td>
</tr>
<tr>
<td>70</td>
<td>1.33</td>
<td>5</td>
<td>0.015625</td>
</tr>
<tr>
<td>59</td>
<td>1.41</td>
<td>6</td>
<td>0.01875</td>
</tr>
<tr>
<td>81</td>
<td>1.7</td>
<td>7</td>
<td>0.021875</td>
</tr>
<tr>
<td>41</td>
<td>2.16</td>
<td>8</td>
<td>0.025</td>
</tr>
<tr>
<td>72</td>
<td>2.78</td>
<td>9</td>
<td>0.028125</td>
</tr>
<tr>
<td>32</td>
<td>3.45</td>
<td>10</td>
<td>0.03125</td>
</tr>
<tr>
<td>77</td>
<td>4.41</td>
<td>11</td>
<td>0.034375</td>
</tr>
<tr>
<td>67</td>
<td>6.38</td>
<td>12</td>
<td>0.0375</td>
</tr>
<tr>
<td>83</td>
<td>8.39</td>
<td>13</td>
<td>0.040625</td>
</tr>
<tr>
<td>34</td>
<td>8.72</td>
<td>14</td>
<td>0.04375</td>
</tr>
<tr>
<td>89</td>
<td>9.12</td>
<td>15</td>
<td>0.046875</td>
</tr>
<tr>
<td>61</td>
<td>9.67</td>
<td>16</td>
<td>0.05</td>
</tr>
<tr>
<td>69</td>
<td>10.62</td>
<td>17</td>
<td>0.053125</td>
</tr>
<tr>
<td>44</td>
<td>11.05</td>
<td>18</td>
<td>0.05625</td>
</tr>
<tr>
<td>73</td>
<td>11.84</td>
<td>19</td>
<td>0.059375</td>
</tr>
<tr>
<td>35</td>
<td>11.99</td>
<td>20</td>
<td>0.0625</td>
</tr>
<tr>
<td>82</td>
<td>13.58</td>
<td>21</td>
<td>0.065625</td>
</tr>
<tr>
<td>55</td>
<td>13.96</td>
<td>22</td>
<td>0.06875</td>
</tr>
<tr>
<td>80</td>
<td>13.97</td>
<td>23</td>
<td>0.071875</td>
</tr>
<tr>
<td>47</td>
<td>14.14</td>
<td>24</td>
<td>0.075</td>
</tr>
<tr>
<td>46</td>
<td>15.26</td>
<td>25</td>
<td>0.078125</td>
</tr>
<tr>
<td>92</td>
<td>16.39</td>
<td>26</td>
<td>0.08125</td>
</tr>
<tr>
<td>85</td>
<td>16.72</td>
<td>27</td>
<td>0.084375</td>
</tr>
<tr>
<td>63</td>
<td>17.15</td>
<td>28</td>
<td>0.0875</td>
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<td>62</td>
<td>17.49</td>
<td>29</td>
<td>0.090625</td>
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<tr>
<td>50</td>
<td>17.81</td>
<td>30</td>
<td>0.09375</td>
</tr>
<tr>
<td>52</td>
<td>17.81</td>
<td>31</td>
<td>0.096875</td>
</tr>
<tr>
<td>75</td>
<td>19.44</td>
<td>32</td>
<td>0.1</td>
</tr>
<tr>
<td>64</td>
<td>21.54</td>
<td>33</td>
<td>0.103125</td>
</tr>
<tr>
<td>66</td>
<td>24.3</td>
<td>34</td>
<td>0.10625</td>
</tr>
<tr>
<td>58</td>
<td>25.15</td>
<td>35</td>
<td>0.109375</td>
</tr>
</tbody>
</table>

Notes: Financial entity no. 95, which is ranked 1, has a corresponding untransformed ROE of -19.23. The transformed ROE is arrived at by dividing the rank 1 by 320 (=1+319). This procedure is repeated for all 319 entities in the sample of 2001 as well as years 2002-10. The same procedure is applied to ROA.

Bivariate scatterplots were used between two variables in order to check whether both variables were normally distributed and hence linear. The scatterplots revealed that almost all bivariate relationships were not non-linear, hence non-normal. After the transformation of these variables, the bivariate scatter plots revealed more normal and linear relationships.

Homoskedasticity is relation to the assumption of normality, as when the assumption of multivariate normality is met relationships between variables are homoskedastic (Tabachnick and Fidell 2007 pg. 85). The data also violates the assumption of homoskedasticity, hence the error term do not have constant variance, thus
heteroskedastic. Figure 5.2 Panel A displays the residuals vs. fitted values plot which clearly indicates heteroskedasticity in the data. Failure of homoskedasticity is related to non-normality of one or more variables and thus indicates non-normality of this dataset. Panel B on the contrary displays homoskedastic behaviour upon transformation of variables.

**Figure 5.2 Panel A: Residuals vs. fitted values plot (before transforming data)**

![Residuals vs. fitted values plot (before transforming data)](image)

**Panel B: Residuals vs. fitted values plot (after transforming data)**

![Residuals vs. fitted values plot (after transforming data)](image)

After testing for groupwise heteroskedasticity and autocorrelation in the panel data, both null hypotheses are rejected, suggesting the presence of heteroskedasticity and first-order autocorrelation in the error term (see Table 5.6).
Table 5.6: Groupwise heteroskedasticity and autocorrelation

<table>
<thead>
<tr>
<th>Modifed Wald test for groupwise heteroskedasticity</th>
<th>Wooldridge test for autocorrelation in panel data</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$ (146) = 491.24</td>
<td>$F(1, 119) = 758.689$</td>
</tr>
<tr>
<td>Prob &gt; $\chi^2 = 0.0000$</td>
<td>Prob &gt; $F = 0.0000$</td>
</tr>
</tbody>
</table>

5.8 Conclusion

This chapter has described the research design which also incorporates the methodology adopted. With respect to the sample selection (dataset obtained from Markit Group), over 300 entities of global financial firms were selected. This includes all banks in the Markit CDS universe and the remainder are shadow banking institutes for which required parameters (USD currency, XR market convention and senior unsecured debt) were matched.

A panel data methodology was adopted due to the need to control for unobserved heterogeneity and the panel data regression involved a dynamic specification. The rationale for the selection was explained in detail. Although the dataset available is not relatively large, a dynamic panel data analysis with the detailed data diagnostics would enable a robust analysis. Additionally, the chosen model includes year specific dummies to account for the heterogeneity across time.

Various procedures of collection, screening and analysis of data were provided, including a detailed description of the statistical procedures used in this research. The following chapter will explain the descriptive statistics in detail before embarking on the analysis explained in Chapter 7.
CHAPTER 6
DESCRIPTIVE STATISTICS

6.1 Introduction

This chapter provides a detailed description of the data and the descriptive statistics, including the results of the basic univariate analysis. In screening the data prior to the detailed analysis, a number of methods were applied consistent with the recommendation of Tabachnick and Fidell (2007). For example, when obtaining the summary statistics of the CDS data set and other variables, a checklist for data screening was used, such as inspecting the univariate descriptive statistics for accuracy of input, then evaluating the shape of the distribution of data, the incidence of missing data and dealing with these problems, checking pairwise plots for non-linearity and heteroskedasticity, identifying and dealing with non-normal variables and univariate outliers (such as skewness, kurtosis, transforming variables and checking the results of the transformation), identifying multivariate outliers and dealing with the problem, and finally evaluating variables for multicollinearity and singularity.

This chapter primarily describes and explains the data in relation to the selected 319 global financial institutions. It is structured as follows: Section 6.2 explains the datasets, while Section 6.3 provides a detailed analysis and description of the variables used, including a descriptive and univariate analysis and tests for multicollinearity. Finally, Section 6.4 presents a conclusion.

6.2 The data

This study performs a secondary data analysis of CDS spreads obtained from a comprehensive database from Markit Group. As this study particularly concentrates on the financial sector, the quotes are collected from 319 entities of the global banking and shadow banking industries (i.e. non-bank financial institutions). A second dataset is obtained from DataStream\(^{77}\) which includes size, ROA, ROE, total returns and equity volatility (returns volatility). However, this data is only available for a section of the entities in the actual dataset as the accounting and market data are restricted to publicly listed

\(^{77}\) Courtesy of School of Finance, Applied Statistics and Actuarial Studies, Australian National University
companies. Therefore a panel data analysis is carried out for regressions based on such data. In what follows, the comprehensive CDS dataset is explained in detail.

6.2.1 CDS dataset

A CDS is the simplest form of credit derivative. As explained in Chapters 1 and 2, the buyer makes periodic payments over the life of the CDS contract in exchange for protection against default. The seller agrees to compensate the buyer for the difference between the par value and the market value of the underlying asset which is known as a cash settlement. The rapid growth of this market led to increased liquidity and large trading volume which created meaningful prices for CDSs. CDS spreads are the premium payments made by the buyer to the seller.

The dataset includes end of day quotes on CDS spreads. The date range of the data set extends from January 2001 to October 2010. However, not all entities have data since January 2001, the availability of data depends on when the entities started trading with enough liquidity. The total observations in the dataset are 374,835. The country groups include Asia, Europe, North America, Oceania and offshore banking centres. Quotes are collected from a large sample of banks and non-bank financial institutions by Markit and aggregated into a composite end of day quote. This ensures more or less continuous and accurate price quotations. The Markit Group collects price contributions from dealer books of records on a daily basis and these submissions undergo a number of data cleaning tests in order to check for implausible results. The clean contributions are then used to calculate the end of day composite prices for different entities. In the composite calculation, the standard curves include three or more original contributions of which at least two pass the data cleaning tests. Further, Markit uses broker-adjusted composite spreads. The end of day composite is calculated on a combination of contributed prices from market makers (dealers) and broker prices where available. The broker prices are weighted based on price type (dealer or broker indicative), time of day executed and the number of brokers supplying a price (Markit 2010).

This study has only used the 5-year spreads as these contracts are the most liquid. In order to maintain uniformity in contracts, only CDS quotations for senior unsecured debt (coded
as SNRFOR) with a “no restructuring” clause (XR)78 denominated in US dollars were used (Markit 2009). The original dataset consisted of 337 entities, with the final sample reduced to 319, as twelve entities were repeated and six had insufficient data on 5-year CDS spreads (see Chapter 5 for more details).

Summary of the CDS data set used in this study:

- SNRFOR = senior unsecured debt (corporate/financial)
- Doc clause (indicates credit events included in the CDS) = XR: No Restructuring
  The protection buyer is only protected from failure to pay, bankruptcy or moratorium on an entity’s debt. Restructurings do not trigger a credit event. This is market standard for North American entities.
- US Dollar = all CDS spreads are denominated in USD
- 5-Year spreads = CDS spreads for CDS contracts with a 5-year maturity

In addition to CDS spreads data, credit rating data were also obtained from the Markit database. Credit ratings are particularly obtained for the 5-year CDS spreads. These are typically issuer credit ratings. The credit ratings of the financial institutions in this sample range from AAA to CCC, and are converted based on a numerical scale of 1 to 19 (see Chapter 5 for a detailed explanation). Region classification is also based on the country information provided in the CDS dataset.

### 6.2.2 Accounting and market variable dataset

The accounting and market variables are obtained from DataStream (courtesy of the School of Applied Statistics and Actuarial Studies, Australian National University). They include ROE, ROA, equity returns (measured by the total returns index – TRI), returns volatility (RETVOL) and total asset (TA). Returns volatility is calculated as the annualised standard deviation based on the monthly total returns index figures. ROE and ROA are based on ratios hence a “times” measure, while TRI is an index return (see Chapter 5 for

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78 XR is the standard market convention for North American entities post “CDS big bang” as with the growth of the CDS market, hedgers of bank loan portfolios have become a smaller percentage of the overall CDS market, hence leading to the exclusion of restructuring as a North American convention (Markit 2009).
the detailed calculation). Total assets are in $ terms. These variables were collected for each country separately and then collated into a master database.

**Table 6.1 Sample construction**

<table>
<thead>
<tr>
<th>Panel A</th>
<th>Firms in Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>337</td>
<td>Total number of entities for which CDS quotes are provided by Markit*</td>
</tr>
<tr>
<td>- 12</td>
<td>Entities that were repeated</td>
</tr>
<tr>
<td>- 6</td>
<td>Entities with insufficient or no data on 5-year CDS quotes</td>
</tr>
<tr>
<td>319</td>
<td>Total number of entities in the final sample</td>
</tr>
</tbody>
</table>

* The total number of entities was limited to 337 due to the qualifying criteria, i.e. the use of only financial institutions with the previously mentioned criteria.

### 6.3 Descriptive analysis

#### 6.3.1 Distribution of variables

Table 6.2 represents the distribution of variables used in this study across a 10-year period. The first variable column, CDS spreads, shows that in the early years the number of observations is lower as compared to the later years. For instance, in 2001 only 23 observations have contributed to the CDS spreads data set, while 2008 has contributed as many as 268 observations. This can be attributed to the lack of financial institutions that traded in CDS markets with enough liquidity during this period, particularly due to it being the early stages of the development of the CDS market. Although the other variables, i.e. total assets, ROE, ROA, TRI and returns volatility, are more or less consistent in the spread of observations across years, it can be noted that the total number of observations for each period is lower than CDS spreads except for the total return index. This is mainly due to the reduced number of financial entities in the market and accounting variables as a result of the unavailability of data for non-public companies. However, there are consistent observations for credit ratings (312 per year), although not for the entire sample as seven entities are unrated. This gives a total number of observations of 13116 in the total data set.
**Table 6.2 Distribution of variables over the 10-year observation period***

<table>
<thead>
<tr>
<th>Year</th>
<th>CDS spreads</th>
<th>Total assets</th>
<th>ROE</th>
<th>ROA</th>
<th>TRI</th>
<th>Returns volatility</th>
<th>Credit rating</th>
<th>Total observations**</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>23</td>
<td>180</td>
<td>175</td>
<td>166</td>
<td>172</td>
<td>168</td>
<td>312</td>
<td>1196</td>
</tr>
<tr>
<td>2002</td>
<td>67</td>
<td>179</td>
<td>175</td>
<td>169</td>
<td>174</td>
<td>170</td>
<td>312</td>
<td>1246</td>
</tr>
<tr>
<td>2003</td>
<td>126</td>
<td>178</td>
<td>172</td>
<td>169</td>
<td>174</td>
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<td>312</td>
<td>1301</td>
</tr>
<tr>
<td>2004</td>
<td>130</td>
<td>174</td>
<td>170</td>
<td>165</td>
<td>175</td>
<td>171</td>
<td>312</td>
<td>1297</td>
</tr>
<tr>
<td>2005</td>
<td>142</td>
<td>175</td>
<td>169</td>
<td>164</td>
<td>176</td>
<td>170</td>
<td>312</td>
<td>1308</td>
</tr>
<tr>
<td>2006</td>
<td>197</td>
<td>170</td>
<td>166</td>
<td>165</td>
<td>178</td>
<td>171</td>
<td>312</td>
<td>1359</td>
</tr>
<tr>
<td>2007</td>
<td>250</td>
<td>159</td>
<td>159</td>
<td>156</td>
<td>179</td>
<td>172</td>
<td>312</td>
<td>1387</td>
</tr>
<tr>
<td>2008</td>
<td>268</td>
<td>159</td>
<td>154</td>
<td>155</td>
<td>179</td>
<td>170</td>
<td>312</td>
<td>1397</td>
</tr>
<tr>
<td>2009</td>
<td>256</td>
<td>155</td>
<td>151</td>
<td>150</td>
<td>180</td>
<td>171</td>
<td>312</td>
<td>1375</td>
</tr>
<tr>
<td>2010</td>
<td>262</td>
<td>120</td>
<td>111</td>
<td>92</td>
<td>181</td>
<td>172</td>
<td>312</td>
<td>1250</td>
</tr>
<tr>
<td>Total</td>
<td>1721</td>
<td>1649</td>
<td>1602</td>
<td>1551</td>
<td>1768</td>
<td>1705</td>
<td>3120</td>
<td>13116</td>
</tr>
<tr>
<td>Average per year</td>
<td>172.1</td>
<td>164.9</td>
<td>160.2</td>
<td>155.1</td>
<td>176.8</td>
<td>170.5</td>
<td>312</td>
<td>1311.6</td>
</tr>
</tbody>
</table>

*Note: This table provides the total number of observations per year, per variable.

**The total observations column calculates the addition of the total observations for each variable, providing the total number of observations for all variables.

167
6.3.2 Composition and region classification of financial institutions

First, Table 6.3 provides a breakdown of bank vs. non-bank financial institutions. As can be seen, 71 firms are banking institutions while 248 firms are non-bank financial institutions. Thus almost 78% of the total sample comprises non-bank financial institutions such as investment banks, finance companies (including mortgage originators and real estate trusts), hedge funds and insurance companies. Although more banking institutions would have been preferred in this study, these 71 banks were the only available banking firms retained in the Markit database. For the purpose of this classification, banks are categorised as financial intermediaries that undertake commercial banking activities and as a result are subject to Basel international banking regulations.79

Table 6.3 Distribution of financial institutions between bank and non-bank financial institutions

<table>
<thead>
<tr>
<th></th>
<th>Number of firms</th>
<th>As a proportion of total firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking institutions*</td>
<td>71</td>
<td>22.26%</td>
</tr>
<tr>
<td>Non-bank financial institutions**</td>
<td>248</td>
<td>77.74%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>319</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Banking institutions include banks that engage in commercial banking activities.
** All other firms are classified as non-bank financial institutions, which include investment banks, finance companies, hedge funds and insurance companies.

Table 6.4 provides a distribution of bank and non-bank financial institutions among different countries. In this sample, the US has the largest number of banks and non-bank financial institutions (11 and 168 respectively). This can be attributed to the highly developed financial markets and the sheer size of the market. Other countries with a high number of financial institutions are the United Kingdom, Japan, Germany and Australia (with a total number of 16, 15, 10 and 10 respectively).

79 Not all banks used in this study may conform to Basel regulations, due to some not operating at an international level.
Table 6.4 Country distribution of bank and non-bank financial institutions

<table>
<thead>
<tr>
<th>Country</th>
<th>Banks</th>
<th>Non-bank financial institutions</th>
<th>Total number of financial institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Bermuda</td>
<td>-</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Canada</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>-</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Channel Islands</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chile</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Denmark</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>France</td>
<td>2</td>
<td>7</td>
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</tr>
<tr>
<td>Germany</td>
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<td>8</td>
<td>10</td>
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<tr>
<td>Hong Kong</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>India</td>
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<td>1</td>
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</tr>
<tr>
<td>Indonesia</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Ireland</td>
<td>3</td>
<td>-</td>
<td>3</td>
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<tr>
<td>Italy</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Japan</td>
<td>4</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>4</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Korea (Republic of)</td>
<td>5</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Malaysia</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
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<td>2</td>
<td>4</td>
</tr>
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<td>Portugal</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Singapore</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Spain</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Switzerland</td>
<td>-</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Taiwan</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Thailand</td>
<td>1</td>
<td>-</td>
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</tr>
<tr>
<td>United Arab Emirates</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>United States</td>
<td>11</td>
<td>168</td>
<td>179</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>71</strong></td>
<td><strong>248</strong></td>
<td><strong>319</strong></td>
</tr>
</tbody>
</table>

In Table 6.5, these countries are classified into regions: North America, Europe and Other. North America has the highest number of financial institutions (195), while Europe has the second highest number (70). From the description of the sample so far, it is clear that North American financial entities are more active in the CDS markets than their European or rest of the world counterparts. The “Other” region includes the Asia Pacific region, South America, parts of the Middle East and South Asia, comprising 54 entities.
Table 6.5 Classification of the number of financial institutions based on region

<table>
<thead>
<tr>
<th>Region</th>
<th>Countries</th>
<th>Number of Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>United States, Canada and Bermuda</td>
<td>195</td>
</tr>
<tr>
<td>Europe</td>
<td>Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Russia, Spain, Sweden, Switzerland, Kazakhstan, Channel Islands and United Kingdom</td>
<td>70</td>
</tr>
<tr>
<td>Other</td>
<td>Australia, Brazil, Cayman Islands, Chile, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Saudi Arabia, Singapore, Taiwan, Thailand and United Arab Emirates</td>
<td>54</td>
</tr>
</tbody>
</table>

6.3.3 Firm credit ratings

The credit ratings used in this sample are typically issuer credit ratings. Markit collects ratings from Standard and Poor’s, Moody’s and Fitch which are then averaged into a Markit average rating. Table 6.6 provides the distribution of financial institutions based on the rating grade. Based on the sample, financial entities are classified into seven rating categories (i.e. AAA, AA, A, BBB, BB, B and CCC). The highest number are in the A category (105), while the AAA category has the lowest number of firms in this sample. A larger number of firms fall under the broader A category (that includes AAA, AA and A - 177), while the second highest broad category is B (which includes BBB, BB and B – 124). The smallest number of firms are in the broad C category (i.e. CCC - 11). This table provides a clear indication that CDS markets are the most active for higher credit ratings rather than lower credit ratings. Not all entities in this sample have credit ratings. Seven financial institutions are not rated, hence are not represented in the sample.

Table 6.6 Distribution of firms based on credit rating

<table>
<thead>
<tr>
<th>Credit rating*</th>
<th>Number of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>5</td>
</tr>
<tr>
<td>AA</td>
<td>67</td>
</tr>
<tr>
<td>A</td>
<td>105</td>
</tr>
<tr>
<td>BBB</td>
<td>85</td>
</tr>
<tr>
<td>BB</td>
<td>31</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
</tr>
<tr>
<td>CCC</td>
<td>11</td>
</tr>
<tr>
<td>NR**</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>319</td>
</tr>
</tbody>
</table>

* Credit rating used in this study is a Markit average credit rating.
** NR refers to Not Rated.
Table 6.7 provides a breakdown of the financial entities between investment grade and non-investment grade credit ratings. It shows that almost 84% of the total sample of firms has investment grade credit ratings, while only 16% has non-investment grade credit ratings. This further supports the above view that majority of the institutions that trade in CDS markets are investment grade entities, thus resulting in the most liquid market for CDSs.

Table 6.7 Distribution of firms based on investment grade credit ratings vs. non-investment grade credit ratings

<table>
<thead>
<tr>
<th>Credit rating</th>
<th>Number of firms</th>
<th>As a proportion of total rated firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Grade (BBB and above)</td>
<td>262</td>
<td>83.97%</td>
</tr>
<tr>
<td>Non-Investment Grade (below BBB)</td>
<td>50</td>
<td>16.03%</td>
</tr>
<tr>
<td>Total rated firms</td>
<td>312</td>
<td>100%</td>
</tr>
</tbody>
</table>

6.3.4 CDS spread volatility

The following graphs show the volatility of CDS spreads across different regions. CDS spread volatility for each financial institution is calculated as the standard deviation of the daily CDS spreads across 10 years. The numbers on the horizontal axis represent the number of the financial institution; each is sorted on ascending order based on the Red Code (market standard unique identifier of reference entities, providing critical reference data used to document and confirm credit derivative transactions) and ranked from 1 to 319 based on this order. The CDS spreads on the horizontal axis are represented in number format, provided by Markit. The spreads data in the number format should be multiplied by 100 to convert to percentage terms and multiplied by another 100 in order to convert into basis points. As can be seen in panels A, B and C, North American entities exhibit the highest level of volatility. Panel B show that the European entity CDS spreads display a higher volatility as compared to the rest of the world, or the “other” region. At its peak North American institutions exhibit a 0.27 maximum (assumed to peak during the GFC) while European entities peaked at 0.15 in this sample. The rest of the world has only peaked at 0.09, further indicating the relatively less volatile nature of CDS spreads in the

---

80 The entire analysis conducted in this study includes CDS spreads based on the number format.
European and other regions. Panel D shows the combined volatility of CDS spreads among all regions.

Figure 6.1 CDS spread volatility among regions

Panel A: Volatility of CDS spreads in North American financial institutions

Panel B: Volatility of CDS spreads in European financial institutions
Panel C: Volatility of CDS spreads in financial institutions categorised under “Other”

Panel D: Volatility of CDS spreads in financial institutions in all regions

6.3.5 Profitability

Figure 6.2 provides average profitability of all financial institutions of the sample across a 10 year period. Panel A represents the average ROE of all firms per year. As seen in the trend line, there is a sharp decrease during 2007-08, declining to almost 2 times in 2008. It is quite evident that during the GFC (which originated during the second half of 2007) due to the financial difficulties that firms faced there is a sharp decline in profitability, hence
ROE. This is also the case for ROA (Panel B). The two period moving average trend line shows a sharp decline during the GFC, confirming decline in profitability. The sharp decline in both ROE and ROA is an indicator financial institutions (including some of the largest players in CDS markets) were significantly affected with the onset of the GFC.

Panel C represents the average equity returns of all financial entities in the sample across the 10 years. Equity returns are measured in terms of the total returns index in this study. The total return index also shows a sharp decline during the GFC, indicating lower expected profitability.

**Figure 6.2 Average profitability of all financial entities over a 10-year observation period**

**Panel A: Average ROE**

Note: ROE is measured as the net profit after tax divided by the total shareholders equity. Hence the vertical axis represents ROE as a “times” measure. A two period moving average is added to indicate the trend line.
Panel B: Average ROA

Note: ROA is measured as the net profit after tax divided by the total assets of a firm. Again similar to ROE, the vertical axis of ROA represents a “times” measure. A two period moving average is added to indicate the trend line.

Panel C: Average equity returns as measured by the total returns index

6.3.6 Total assets

Figure 6.3 shows the average total assets of all financial institutions across the sample period, with a clear decline up until 2005. Among other reasons, this could indicate that, with the development of CRT techniques such as CDSs and securitisation, financial institutions may hold less assets in their balance sheets. Firstly, in the case of banks, they
need to hold less capital as the credit risk is transferred off-balance sheet. Secondly, with larger number of financial institutions using securitisation to transfer credit risk, assets are transferred off-balance sheet. This could be more significant among American and European entities as compared to the rest of the world. Since 2005 there has been an increase in the average total assets of firms. Again among other reasons, this could mean that the growth in the real estate market in the US and in particular the increased lending to subprime customers could increase the asset base of financial institutions on average. It should also be noted that since most financial institutions in this sample are from the US, the trend will most likely reflect that of the US companies. Since 2009, there is a sharp increase in the total asset base of firms. This could be due to financial institutions recovering from the effects of the GFC. As a result, there could be an increase in the risk appetite of financial institutions that lead to an increase in the total assets held by firms.

**Figure 6.3 Average total assets of all entities across a 10-year observation period**

![Average Total Assets](image)

6.3.7 CDS spreads and returns volatility

The growth in average CDS spreads of all entities and returns volatility are shown in Figure 6.4 (Panels A and B) which consists of yearly averages of summary statistics for CDS spreads and returns volatility for all 319 entities. While CDS spreads did not indicate signs of a crisis until 2008, market indicators such as returns volatility were indicative of an
upcoming crisis. In 2009, average CDS spreads in basis points increased to 800-900, indicating extreme risk and risk aversion (see panel A). As seen in Figure 6.4, as compared to the beginning of 2007 CDS spreads increased almost 10 times during the crisis. This shows that the CDS market was relatively liquid until the latter stages of 2007 although the cash market and the commercial paper market dried up. However, at the height of the GFC in late 2008, CDS spreads jumped up to 900 basis points due to the heavy financial difficulties of contagion and systemic concerns. The increasing returns volatility since late 2006 and early 2007 indicates the concern of stock market participants that also prompted much speculation and discussion of the likely real economic consequences of the US subprime crisis and resultant credit crisis.
Figure 6.4 Time series variation of CDS spreads and returns volatility

Panel A: Time series variation of CDS spreads in the sample of all 319 financial institutions

Panel B: Average returns volatility for all 319 entities as measured by the standard deviation of the total returns index
Table 6.5 provides descriptive statistics for the raw variables. Panel A represents the firm level characteristics. In general, the data presents a problem of highly skewed data distribution and extreme values (outliers). Except for the variable REG, all other variables display positively skewed data distributions. More specifically, TA, TRI and RETVOL display high positive skewness (8.85, 10.63 and 24.59 respectively). CR displays a slight negative skewness (of -.84611). Kurtosis of the predictor and explanatory variables shows that all variables except CR exhibit heavy tailed distributions. ROE and ROA display very heavy tailed distributions. Thus the non-normality of data is found in all explanatory variables.

The mean of CDS is .0190926 (190.926 in basis points). At first sight this may seem that the average CDS spread is not too high as compared to the maximum 7961 basis points, probably indicating more liquid contracts with investment grade credit ratings and somewhat stable market/economic conditions. However, the minimum and maximum values indicate that there is extreme volatility in CDS spreads, probably due to the onset of the GFC. The median of average CDS is .0072085 (72.08 basis points), which means that CDS spreads of most entities are less than the average CDS spread. The descriptive statistics also indicate that negative values exist in ROA and ROE, indicating negative profitability during the GFC. In general, the data seems to be highly skewed, containing outliers and negative values. As negative values preclude logarithm and square root transformation in order to achieve normality of data, a procedure known as “rank transformation” is adopted for the treatment of outliers and negative values. Therefore, ROE and ROA are transformed based on rank transformation (see Chapter 5). Credit ratings of financial institutions span from investment grade to non-investment grade. In this sample, the minimum credit rating is “2” indicating CCC, and the highest is “19” indicating AAA.

Panel B represents the descriptive statistics for CDS spreads on a yearly basis. The average CDS spread was highest in 2009 (.0462418 or 462 basis points) due to many firms facing severe financial difficulties at the height of the GFC. In 2010 average spreads declined to 271 basis points (.02717), though still not to pre-GFC levels. CDS spreads displayed
positive skewness in most of the years, with 2010 reflecting a very high positive skewness (10.539). The high kurtosis values in most of the years, with the highest in 2008 (58.10), indicate the distribution in each year is too peaked with short, thick tails. The descriptive statistics suggest that CDS spreads highlight the problem of heightened risk and risk aversion.
Table 6.5 Descriptive statistics of the untransformed dependent and explanatory variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Firm characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>CDS</td>
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<td>8.177867</td>
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<tr>
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<tr>
<td><strong>Panel B: Summary statistics for CDS spreads (in number format)</strong></td>
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<td></td>
<td></td>
<td></td>
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<td>Year</td>
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<td>250</td>
<td>.0072031</td>
<td>.0032431</td>
<td>.0002354</td>
<td>.0753104</td>
<td>.0104843</td>
<td>3.450296</td>
<td>16.86666</td>
</tr>
<tr>
<td>2008</td>
<td>268</td>
<td>.0305985</td>
<td>.0132497</td>
<td>.0012548</td>
<td>.5919058</td>
<td>.0512149</td>
<td>6.051681</td>
<td>58.10153</td>
</tr>
<tr>
<td>2009</td>
<td>256</td>
<td>.0462418</td>
<td>.0245486</td>
<td>.0020466</td>
<td>.4034995</td>
<td>.0621561</td>
<td>2.968038</td>
<td>13.13194</td>
</tr>
<tr>
<td>Total</td>
<td>1721</td>
<td>.0190926</td>
<td>.0072085</td>
<td>.0002354</td>
<td>.7961487</td>
<td>.0562649</td>
<td>10.53943</td>
<td>137.6532</td>
</tr>
</tbody>
</table>

Note: The table presents summary statistics of the untransformed variables included in this study. Panel A presents the descriptive statistics for the firm-level variables: the 5-year CDS spreads (in number format), total assets, equity returns, volatility, ROE, ROA and credit ratings. Returns volatility as the annualised standard deviation based on monthly returns, ROE and ROA are measured as a ratio net profit after tax to total shareholder equity and total assets respectively. Equity returns are measured by the total returns index. Credit rating is based on an equivalent numerical scale from AAA to CCC. Region is categorised as a dummy variable (i.e. North America, Europe and Other). Panel B presents the descriptive statistics of CDS spreads by year.
6.3.9 Relationship between CDS spreads and explanatory variables

The plots in Figure 6.5 shows the variation of CDS spreads among the explanatory variables. The first graph that represents the relationship between the log of the CDS spread and the log of total assets (indicating firm size). It can be noticed that the concentration of the points are between -0.7 and -0.2. However, from this graph it cannot be concluded whether the CDS spreads increase or decrease with the size of the firm. Although it cannot be visually captured in the graph, it could be captured in the panel data model. It should be noted that with all variables, the degrees of freedom are reduced in the dynamic panel model, although it is still an adequate sample econometric analysis. The second graph represents the relationship between the total returns index (indicating equity returns) and CDS spreads, showing a clear negative relationship. The third graph plots the CDS spreads against square root of returns volatility. It does not suggest any expected relationship; however, Figure 6.5 shows a positive relationship as indicated in the literature. ROE and ROA graphs do not indicate a strong negative or positive relationship. Higher profitability could reduce the CDS spreads due to the lower riskiness in the entity. Therefore, a negative relationship is predicted. Although this is not evident from the graphs it could be captured in the panel data analysis which allows for unit specific coefficients. The final graph shows the relationship between credit ratings and CDS spreads. Although it does not indicate any relation, this is largely expected, since a numerical scale is used for credit ratings which ranges from 1 to 19, where 1 refers to “CCC-” and 19 refers to “AAA”. Theory and evidence suggest that there should be a negative relationship as the higher the creditworthiness, the lower would be the default risk, hence riskiness of the firm.

81 Dummy variables (regions and years) are not considered here.
Figure 6.5 CDS spreads vs. explanatory variables (lta, ltri, sqretvol, Rroe, Rroa, CR respectively) (2001-10)

6.3.10 Multicollinearity and singularity

Multicollinearity and singularity are issues associated with the correlation matrix that occur when the independent variables are too highly correlated (Tabachnick and Fidell 2007). Multicollinearity relates to the situation when variables are too highly correlated (above
0.9), while in singularity the variables are almost redundant, meaning the variable is a combination of two or more other variables. Table 6.6 presents the correlation matrix and the variance inflation factors that measures multicollinearity.
Table 6.6 Tests for multicollinearity
Panel A: All 319 global financial institutions, 2001-10, correlation coefficient matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>LTA</th>
<th>LTRI</th>
<th>SQRETVOL</th>
<th>RROE</th>
<th>RROA</th>
<th>CR</th>
<th>REG1</th>
<th>REG2</th>
<th>REG3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTA</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRI</td>
<td>0.0466</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQRETVOL</td>
<td>0.0893</td>
<td>0.7731</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RROE</td>
<td>0.0515</td>
<td>0.2679</td>
<td>0.1645</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RROA</td>
<td>-0.5229</td>
<td>0.0973</td>
<td>0.0205</td>
<td>0.3950</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.4888</td>
<td>0.3472</td>
<td>0.2420</td>
<td>0.2113</td>
<td>-0.3031</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REG 1</td>
<td>-0.5522</td>
<td>-0.0380</td>
<td>-0.0919</td>
<td>-0.0338</td>
<td>0.3163</td>
<td>-0.3527</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REG 2</td>
<td>0.2595</td>
<td>0.1290</td>
<td>0.1865</td>
<td>-0.0161</td>
<td>-0.3199</td>
<td>0.3457</td>
<td>-0.6217</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>REG 3</td>
<td>0.4404</td>
<td>-0.0776</td>
<td>-0.0657</td>
<td>0.0580</td>
<td>-0.0863</td>
<td>0.1069</td>
<td>-0.6504</td>
<td>-0.1907</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Panel B: Variance inflation factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RETVOL</td>
<td>3.68</td>
<td>0.271860</td>
</tr>
<tr>
<td>TRI</td>
<td>3.67</td>
<td>0.272675</td>
</tr>
<tr>
<td>REG1</td>
<td>1.78</td>
<td>0.560884</td>
</tr>
<tr>
<td>REG2</td>
<td>1.70</td>
<td>0.587278</td>
</tr>
<tr>
<td>CR</td>
<td>1.14</td>
<td>0.874374</td>
</tr>
<tr>
<td>TA</td>
<td>1.12</td>
<td>0.891785</td>
</tr>
<tr>
<td>ROE</td>
<td>1.08</td>
<td>0.929680</td>
</tr>
<tr>
<td>ROA</td>
<td>1.05</td>
<td>0.955078</td>
</tr>
</tbody>
</table>

Mean VIF 1.90
Panel A in Table 6.6 presents the correlation coefficient matrix of the independent variables. None of the variables are highly correlated (correlation is not above 0.9), hence there are no significant issues of multicollinearity. Panel B presents the variance inflation factors (VIF) of each independent variable. The VIFs are less than 4 and the tolerance levels are greater than .10, resulting in the conclusion that multicollinearity is not a severe problem in this study.

Reinforcing the above, Figure 6.6 shows the correlations among explanatory variables in the dataset. It illustrates that correlations are not significant, thus multicollinearity is not a big problem.

**Figure 6.6 Correlations among regressors (2001-10)**
6.4 Conclusion

This chapter provided detailed investigation of the variables used in this study and summary statistics. The descriptive results suggest that there are considerable differences in firm level characteristics. CDS spreads data show considerable variability over the years across financial institutions. The sample includes a greater proportion of non-bank financial institutions as compared to banking institutions. The descriptive statistics in general show high level of skewness and kurtosis, indicating non-normality across all variables. The analysis of multicollinearity has indicated that multi-collinearity is not a severe concern. The variables of TA, ROE, ROA, TRI, RETVOL, CR and REG will be tested empirically on the dependent variable CDS spreads in Chapter 7 which also provides a detailed econometric analysis and a description of the results of this study.
CHAPTER 7
DATA ANALYSIS AND RESULTS

7.1 Introduction

The primary objective of this chapter is to provide a detailed analysis of the data and the results of testing the various hypotheses. The results show significant evidence that an institution’s credit ratings, returns volatility and profitability measures can predict CDS spreads and hence managerial risk taking. The chapter discusses the results of the analysis which show that CDS spreads are positively related to returns volatility and negatively related to credit ratings and profitability measures. The results for pooled OLS, static and dynamic panel models with year dummies are presented for comparison purposes.

7.2 Econometric analysis

In order to gain insight into the possible managerial risk taking behaviour of global financial institutions, a dynamic model specification is used. In this model, CDS spreads of financial entity \(i\) in year \(t\) is used as a dependent variable. Although the model is the same, five different regressions are performed in order to identify the most suited regression. Hence, the following hypotheses (developed in Chapter 4) are tested in this chapter.

\(H_1:\) Higher credit risk as indicated by a lower credit rating is associated with higher managerial risk taking of firms

\(H_2:\) Firm size\(^{82}\) is positively related to CDS spreads and thus managerial risk taking.

\(H_3:\) ROA is negatively related to CDS spreads and thus managerial risk taking.

\(H_4:\) ROE is negatively related to CDS spreads and thus managerial risk taking.

\(H_5:\) Equity returns\(^{83}\) are negatively related to CDS spreads and thus managerial risk taking.

\(H_6:\) Returns volatility is positively related to CDS spreads and thus managerial risk taking.

The following section describes the econometric issues dealt within the analysis, especially non-stationarity. Heteroskedasticity and autocorrelation test results are presented later in the chapter which were also highlighted in Chapter 5.

\(^{82}\) As proxied by total assets.

\(^{83}\) Measured by the total returns index.
7.2.1 Non-stationarity

The panel data used in this study is tested for non-stationarity. In this study the Fisher test is used as a unit root test based on augmented Dicky-Fuller tests, which result in the null hypothesis of non-stationarity being rejected for all variables. The results are presented in Table 7.1.

Table 7.1 Test of non-stationarity in panel data

<table>
<thead>
<tr>
<th>Fisher Test for panel unit root based on augmented Dicky-Fuller test (1 lag)</th>
<th>H0: All panels contain unit roots (are non-stationary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAVGCDS</td>
<td>LTA</td>
</tr>
<tr>
<td>( \chi^2 ) (434) = 673.56</td>
<td>( \chi^2 ) (354) = 659.44</td>
</tr>
<tr>
<td>p-value = 0.0000</td>
<td>p-value = 0.0000</td>
</tr>
</tbody>
</table>

7.3 Empirical results

The existence of managerial risk taking in financial institutions is observed in this study using CDS spreads (i.e. premium paid on a CDS contract) of a financial institution using an international dataset and a dynamic specification.

Table 7.2 presents the results of the OLS, static and dynamic panel data models. The first three columns present the results from the pooled OLS, FE and RE estimates. Although these estimates are not reliable due to the presence of a lagged dependent variable, which in turn causes an endogeneity bias, they are still reported due to the reflection of important information. For instance, pooled OLS provides the upper bound of the estimated coefficient of the lagged dependent variable, while the FE estimator provides the lower bound. FE and RE estimates tests the heterogeneity across panel units.

For the pooled OLS regression by adding a dummy for each year, the pure effect of the independent variables is estimated, thus controlling for unobserved heterogeneity. In addition, tests for heteroskedasticity and autocorrelation are carried out. These results show that the panel is heteroskedastic with serial correlation. A modified Wald test and the Wooldridge (2002) test were conducted to test for heteroskedasticity and autocorrelation.
respectively (see Chapter 5) whose presence is likely to have influenced the results of the pooled OLS. Furthermore, the panel data regression is controlled for the size effect by obtaining the log of total assets.

An F-test is also carried out to identify the appropriateness of fixed effects vs. the pooled OLS. The F-test indicates that the fixed effects specification outweighs the pooled OLS. When comparing the F statistic of the FE estimate with the OLS estimates, although the F-value in OLS is statistically significant, it is smaller compared to the FE estimate, suggesting that FE better fits the underlying data. As the FE model assumes that the unobserved effect is correlated with one or more of the regressors, pooling the cross-sections and estimating a pooled OLS regression, results in a biased and inconsistent estimator of the coefficient (Stapleton 2011). This suggests the results of the pooled OLS may be biased and that financial institution specific factors are significant in the study. Although the RE estimate has a higher chi-squared, both FE and RE estimates suffer from the endogeneity bias due to the lagged dependent variable being correlated with the error term, thus the strict exogeneity assumption is unlikely to hold. Therefore FE and RE estimates are inconsistent. These limitations of the pooled OLS and static panel models justify the use of a dynamic panel model such as GMM estimators.

As a result of the problem of endogeneity due to the presence of a lagged dependent variable dynamic models are considered to be preferred. For this reason, Hausman test results are not provided and the regressions for pooled OLS and static panel models are conducted in order to obtain a suggestion of the coefficients of the parameters. Therefore, based on the characteristics of the data used in this study, the best specification is the system GMM specification. As a result of the use of a lagged dependent variable, the sample size has been reduced to 644 observations in the pooled OLS, FE and RE estimates. The observations have been further reduced due to 388 under the GMM specifications due to the use of deeper lags for the purpose of instrumenting. The following discussions are based on all the specifications used in this analysis. However,

---

84 Although the Hausman test suggests that the FE estimates are preferred, RE estimates are provided in order to highlight the difference in RE estimates to that of fixed effects. The results of the Hausman test are not provided due to the inapplicability of static panel models for the data used in this study.
more emphasis is placed on the best specification for the given model (i.e. one-step system GMM specification).

As discussed in Chapter 5 and presented in Table 7.2, the heteroskedasticity and autocorrelation tests indicate that such problems exist. Hence, robust standard errors are used to handle these issues. In order to account for entity heterogeneity across time, year specific dummies are used. Table 7.2 provides a summary of the results from all models employed, while the detailed results of each method are provided in subsequent tables.

In Table 7.2 all variables display the expected relationship in all models, but with varying degrees of significance.

It is noted that all tables and sub-tables of 7.2 are presented in the output format as shown in STATA software.
Table 7.2 Estimated coefficients for pooled OLS, fixed effects, random effects, and system GMM1 (2001-10)

Notes: legend: * p<0.05; ** p<0.01; *** p<0.001 (represents 95, 99 and 99.9 percent level of confidence)
Panel A presents the results of the variables used in this study. Panel B presents the results for the year dummies and relevant statistical tests used.
Robust results are provided for fixed and random effects models.
y1 - y10 refers to years 2001 to 2010
1 One step system GMM where all available lags of the dependent variable are used from the third lag on robust results are displayed here.
2 In this model, two step results are not robust. Significance is lost with robust results, hence they are not reported.
It is noted that this table is presented in the output format as shown in STATA software.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pooled OLS</th>
<th>FE</th>
<th>RE</th>
<th>System GMM1</th>
<th>System GMM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lavgcds</td>
<td>.6554837***</td>
<td>.2989229***</td>
<td>.6554837***</td>
<td>.41064751***</td>
<td>.40424805***</td>
</tr>
<tr>
<td>L2.</td>
<td>.00822064</td>
<td>.20192978</td>
<td>.00822064</td>
<td>.1425897*</td>
<td>-.9624532**</td>
</tr>
<tr>
<td>L3.</td>
<td>-.02207231</td>
<td>-.9144231***</td>
<td>-.02207231</td>
<td>-.1824437***</td>
<td>-.17719655***</td>
</tr>
<tr>
<td>ltri</td>
<td>.00293234*</td>
<td>.0079964**</td>
<td>.00293234*</td>
<td>.00874592***</td>
<td>.00871056***</td>
</tr>
<tr>
<td>sqretvol</td>
<td>-.41176173**</td>
<td>-.49307893**</td>
<td>-.41176173**</td>
<td>-.21763585</td>
<td>-.2230927***</td>
</tr>
<tr>
<td>Rroe</td>
<td>-.17682446*</td>
<td>-.21794133</td>
<td>-.17682446</td>
<td>-.41402191*</td>
<td>-.4252943***</td>
</tr>
<tr>
<td>Rroa</td>
<td>-.04648206***</td>
<td>(dropped)</td>
<td>-.04648206***</td>
<td>-.07838935**</td>
<td>-.08150249***</td>
</tr>
<tr>
<td>cr</td>
<td>.14684851**</td>
<td>(dropped)</td>
<td>.14684851**</td>
<td>.20415237</td>
<td>.16529102*</td>
</tr>
<tr>
<td>reg1</td>
<td>-.10923076</td>
<td>(dropped)</td>
<td>-.10923076</td>
<td>-.41897402</td>
<td>-.43397591**</td>
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<tr>
<td>reg2</td>
<td></td>
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### Panel B:

<table>
<thead>
<tr>
<th></th>
<th>Pooled OLS</th>
<th>FE</th>
<th>RE</th>
<th>System GMM1</th>
<th>System GMM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>y1</td>
<td>(dropped)</td>
<td>(dropped)</td>
<td>(dropped)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>y2</td>
<td>.14003146</td>
<td>.39470307***</td>
<td>.14003146*</td>
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<tr>
<td>y3</td>
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<td>-.1190931</td>
<td>-.4824839***</td>
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<td>y4</td>
<td>-.6413022***</td>
<td>-.44051952***</td>
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<tr>
<td>y5</td>
<td>-.53766973***</td>
<td>-.42590933***</td>
<td>-.53766973***</td>
<td>-.19300561**</td>
<td>-.19143581***</td>
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<tr>
<td>y6</td>
<td>-.68906523***</td>
<td>-.58562635***</td>
<td>-.68906523***</td>
<td>-.40115122***</td>
<td>-.39709063***</td>
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<tr>
<td>y7</td>
<td></td>
<td></td>
<td></td>
<td>.35709871***</td>
<td>.34962659***</td>
</tr>
<tr>
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<td>1.1517707***</td>
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<td>1.628711***</td>
<td>1.6420769***</td>
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<td>y9</td>
<td>.5978364***</td>
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<td>.5978364***</td>
<td>1.4299942***</td>
<td>1.4633716***</td>
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<td>y10</td>
<td>-.29152075**</td>
<td>-.34228609*</td>
<td>-.29152075**</td>
<td>.92634098***</td>
<td>.94348333***</td>
</tr>
<tr>
<td>_cons</td>
<td>-.95936656***</td>
<td>-.43085153*</td>
<td>-.95936656***</td>
<td>-.25143777**</td>
<td>-.21100536***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>664</th>
<th>664</th>
<th>664</th>
<th>388</th>
<th>388</th>
</tr>
</thead>
</table>

**Modified Wald test for heteroskedasticity:** 491.24****

<table>
<thead>
<tr>
<th>Wooldridge test for autocorrelation</th>
<th>758.689****</th>
</tr>
</thead>
</table>

| r2       | .87834507 | .86753022 |
| r2_a     | .87514362 | .86647263 |
| r2_o     | .46730829 | .87834507 |
| r2_w     | .86753022 | .84508833 |
| r2_b     | .13783525 | .89246659 |
| F        | 274.35889 | 294.78183 |

| Wald chi2 | 10763.982 | 4715.6231 | 21239668 |
Results for pooled OLS, fixed effects, random effects, system GMM1, system GMM2 and system GMM1 robust (Note: y1-y10 refers to years 2001-10)

Table 7.2.1 OLS regression estimates – Dependent variable: CDS spreads (lavgcds)

| Variable | Coef. | Robust Std. Err. | t | P>|t| | [95% Conf. Interval] |
|----------|-------|------------------|---|------|------------------|
| lavgcds  |       |                  |   |      |                  |
| L1.      | .6554834 | .0415447          | 15.78 | 0.000 | .5739045 .7370623 |
| lta      | .0082206 | .0115346          | 0.71 | 0.476 | -.0144291 .0308704 |
| ltri     | -.0220723 | .0172964          | -1.28 | 0.202 | -.0560363 .0118917 |
| sqretvol | .0029323 | .0012162          | 2.41 | 0.016 | .0005441 .0053205 |
| Rroe     | -.4117617 | .1252196          | -3.29 | 0.001 | -.6576484 -.165875 |
| Rroa     | -.1768245 | .0815032          | -2.17 | 0.030 | -.3368676 -.0167813 |
| cr       | -.0464821 | .0089199          | -5.21 | 0.000 | -.0639976 -.0289665 |
| reg1     | .1468485 | .0560539          | 2.62 | 0.009 | .0367786 .2569184 |
| reg2     | -.1092308 | .0790858          | -1.38 | 0.168 | -.2645269 .0460654 |
| y1       | 0      | (dropped)         |   |      |                  |
| y2       | .1400315 | .0761226          | 1.84 | 0.066 | -.0094461 .289509 |
| y3       | -.4824839 | .0839534          | -5.75 | 0.000 | -.6473384 -.3176294 |
| y4       | -.6413022 | .0566428          | -11.32 | 0.000 | -.7525283 -.5300761 |
| y5       | -.5376697 | .0489896          | -10.98 | 0.000 | -.6338678 -.4414716 |
| y6       | -.6890652 | .0545708          | -12.63 | 0.000 | -.7962228 -.5819076 |
| y7       | 0      | (dropped)         |   |      |                  |
| y8       | 1.078125 | .0852139          | 12.65 | 0.000 | .9107953 1.245455 |
| y9       | -.5978364 | .1107965          | 5.40 | 0.000 | -.3802717 .8154011 |
| y10      | -.2915208 | .1085754          | -2.68 | 0.007 | -.5047241 -.0783174 |
| _cons   | -.9593666 | .2628676          | -3.65 | 0.000 | -.1475545 -.4431884 |

Note: The pooled ordinary least squares regression results include robust standard errors
Table 7.2.2 FE Estimates – Dependent variable: CDS spreads (lavgcds)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Robust Std. Err.</th>
<th>t</th>
<th>P &gt; t</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>lavgcds</td>
<td>.2989229</td>
<td>.0551507</td>
<td>5.42</td>
<td>0.000</td>
<td>.1899198 - .407926</td>
</tr>
<tr>
<td>lta</td>
<td>.2019298</td>
<td>.1068845</td>
<td>1.89</td>
<td>0.061</td>
<td>- .0093231 - .4131826</td>
</tr>
<tr>
<td>ltr</td>
<td>-.3914423</td>
<td>.0879251</td>
<td>-4.45</td>
<td>0.000</td>
<td>-.5652227 - -.217662</td>
</tr>
<tr>
<td>sqrtvol</td>
<td>.0079964</td>
<td>.0028742</td>
<td>2.78</td>
<td>0.006</td>
<td>.0023157 - .0136771</td>
</tr>
<tr>
<td>Rroe</td>
<td>-.4930789</td>
<td>.1603631</td>
<td>-3.07</td>
<td>0.003</td>
<td>-.8100301 - -.1761278</td>
</tr>
<tr>
<td>Rroa</td>
<td>-.2179413</td>
<td>.1441049</td>
<td>-1.51</td>
<td>0.133</td>
<td>-.5027588 - .0668761</td>
</tr>
<tr>
<td>cr</td>
<td>0 (dropped)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reg1</td>
<td>0 (dropped)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reg2</td>
<td>0 (dropped)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>y2</td>
<td>.3947031</td>
<td>.1103498</td>
<td>3.58</td>
<td>0.000</td>
<td>.1766011 - .612805</td>
</tr>
<tr>
<td>y3</td>
<td>-.1190931</td>
<td>.1071647</td>
<td>-1.11</td>
<td>0.268</td>
<td>-.330897 - .092135</td>
</tr>
<tr>
<td>y4</td>
<td>-.4405195</td>
<td>.0961134</td>
<td>-6.37</td>
<td>0.000</td>
<td>-.5771194 - -.3039196</td>
</tr>
<tr>
<td>y5</td>
<td>-.4259093</td>
<td>.0491368</td>
<td>-8.67</td>
<td>0.000</td>
<td>-.5230263 - -.3287924</td>
</tr>
<tr>
<td>y6</td>
<td>-.5856264</td>
<td>.0608592</td>
<td>-9.62</td>
<td>0.000</td>
<td>-.705912 - -.4653407</td>
</tr>
<tr>
<td>y7</td>
<td>0 (dropped)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>y8</td>
<td>1.151771</td>
<td>.083067</td>
<td>13.87</td>
<td>0.000</td>
<td>.9875922 - 1.315949</td>
</tr>
<tr>
<td>y9</td>
<td>.9519646</td>
<td>.1220301</td>
<td>7.80</td>
<td>0.000</td>
<td>.7107771 - 1.193152</td>
</tr>
<tr>
<td>y10</td>
<td>.3422861</td>
<td>.1338366</td>
<td>2.56</td>
<td>0.012</td>
<td>.0777635 - .6068087</td>
</tr>
<tr>
<td>_cons</td>
<td>-4.308515</td>
<td>1.926781</td>
<td>-2.24</td>
<td>0.027</td>
<td>- .8116721 - -.5003101</td>
</tr>
</tbody>
</table>

sigma_u  1.0108819
sigma_e  .38483631
rho     .87341764 (fraction of variance due to u_i)

Note: FE estimates include robust standard errors
Table 7.2.3 RE estimates – Dependent variable: CDS spreads (lavgcds)

Random-effects GLS regression
Number of obs = 664
Group variable: company
Number of groups = 146
R-sq: within = 0.8451
Obs per group:
  between = 0.8925
  avg = 4.5
  max = 9
  overall = 0.8783
Wald chi2(17) = 10763.98
corr(u_i, X) = 0 (assumed)
Prob > chi2 = 0.0000

| Variable  | Coef.    | Robust Std. Err. | z      | P>|z|  | [95% Conf. Interval] |
|-----------|----------|------------------|--------|------|----------------------|
| lavgcds   | .6554834 | .0388802         | 16.86  | 0.000 | .5792796  | .7316872 |
| lta       | .0082206 | .0116491         | 0.71   | 0.480 | -.0146111 | .0310524 |
| ltri      | -.0220723| .014803          | -1.52  | 0.127 | -.0504531 | .0063085 |
| sqretvol  | .0029323 | .0008991         | 3.26   | 0.001 | .0011701  | .0046946 |
| Rroe      | -.1776825| .0933006         | -1.90  | 0.058 | -.3596903 | .0060413 |
| Rroa      | -.0464821| .0079913         | -5.82  | 0.000 | -.0621447 | -.0308194 |
| cr        | .1468485 | .0564521         | 2.60   | 0.009 | .0362045  | .2574925 |
| reg1      | -.1092308| .0811201         | -1.35  | 0.178 | -.2682233 | .0497617 |
| reg2      | .1400315 | .0712377         | 1.97   | 0.049 | .0004082  | .2796547 |
| y1        | -.4824839| .0773578         | -6.24  | 0.000 | -.6341023 | -.3308655 |
| y2        | -.6413022| .0558332         | -11.49 | 0.000 | -.7507332 | -.5318712 |
| y3        | -.5376697| .0654522         | -11.55 | 0.000 | -.6288966 | -.4464429 |
| y4        | -.6890652| .0636356         | -10.83 | 0.000 | -.8137887 | -.5643418 |
| y5        | 1.078125 | .0803078         | 13.42  | 0.000 | .9207248  | 1.235525 |
| y6        | .5978364 | .1106592         | 5.40   | 0.000 | .3809484  | .8147244 |
| y7        | -.2915208| .1015545         | -2.87  | 0.004 | -.4905639 | -.0924776 |
| y8        | -.5953666| .2795041         | -3.43  | 0.001 | -.1507184 | -.4115486 |
| y9        | .38483631| 0                | (dropped) |
| y10       | 0        | 0                | (dropped) |
| _cons     | -.9593666| .2795041         | -3.43  | 0.001 | -.1507184 | -.4115486 |
| sigma_u   | 0        | 0                | (fraction of variance due to u_i) |
| sigma_e   | .38483631| 0                | 0.000  | 1.235525 |
| rho       | 0        | 0                | (fraction of variance due to u_i) |

Note: RE estimates include robust standard errors
Table 7.2.4 System GMM1 – Dependent variable: CDS spreads (lavgcds)

Dynamic panel data estimation, one-step system GMM

<table>
<thead>
<tr>
<th>System dynamic panel data estimation</th>
<th>Number of obs = 388</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group variable: company</td>
<td>Number of groups = 108</td>
</tr>
<tr>
<td>Time variable: year</td>
<td>Obs per group: min = 1</td>
</tr>
<tr>
<td></td>
<td>avg = 3.592593</td>
</tr>
<tr>
<td></td>
<td>max = 7</td>
</tr>
<tr>
<td>Number of instruments = 263</td>
<td>Wald chi2(17) = 4715.62</td>
</tr>
<tr>
<td></td>
<td>Prob &gt; chi2 = 0.0000</td>
</tr>
</tbody>
</table>

One-step results

| Variable  | Coef.  | Robust Std. Err. | z    | P>|z|   | [95% Conf. Interval] |
|-----------|--------|------------------|------|-------|---------------------|
| lavgcds   | .4106475 | .0703817 | 5.83 | 0.000 | .2727019 | .5485931 |
| L1.       | -.1962453 | .0626028 | -3.13 | 0.002 | -.3189446 | -.073546 |
| L2.       | .142586 | .0571845 | 2.49 | 0.013 | .0305065 | .2546655 |
| L3.       | .0447966 | .0413052 | 1.08 | 0.278 | -.0361602 | .1257534 |
| lta       | -.1824437 | .0625028 | -3.13 | 0.002 | -.3189446 | -.073546 |
| ltri      | .0447966 | .0413052 | 1.08 | 0.278 | -.0361602 | .1257534 |
| Rroa      | -.4140219 | .0552884 | -2.49 | 0.013 | -.3189446 | -.073546 |
| er         | -.078394 | .0256229 | -3.06 | 0.002 | -.1286094 | -.0281693 |
| sqretvol  | .0087459 | .002178 | 4.02 | 0.000 | .0044771 | .0130147 |
| Rroa      | -.2176358 | .2580239 | -0.84 | 0.399 | -.7233534 | .288017 |
| reg1      | .2041524 | .3274253 | 0.62 | 0.533 | -.4375895 | .8458943 |
| reg2      | -.418974 | .4094333 | -1.04 | 0.296 | -.1204809 | .3668065 |
| y5        | -.1930056 | .0700799 | -2.75 | 0.006 | -.3303597 | -.0556515 |
| y6        | -.4011512 | .0748799 | -5.36 | 0.000 | -.5479131 | -.2543894 |
| y7        | .3570987 | .0865093 | 4.13 | 0.000 | .1875436 | .5266539 |
| y8        | 1.628711 | .1220545 | 13.34 | 0.000 | 1.389488 | 1.867934 |
| y9        | 1.429994 | .1555854 | 9.19 | 0.000 | 1.125052 | 1.734936 |
| y10       | .926341 | .1580497 | 5.86 | 0.000 | .6165692 | 1.236113 |
| _cons     | -2.251438 | .8338415 | -2.70 | 0.007 | -.3885737 | -.6171383 |

Note: One step GMM results include robust standard errors
Table 7.2.5 System GMM2 – Dependent variable: CDS spreads (lavgcds)

Dynamic panel data estimation, two-step system GMM

<table>
<thead>
<tr>
<th>System dynamic panel data estimation</th>
<th>Number of obs  = 388</th>
<th>Number of groups = 108</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group variable: company</td>
<td>obs per group:</td>
<td>min = 1</td>
</tr>
<tr>
<td>Time variable: year</td>
<td>avg = 3.592593</td>
<td>max = 7</td>
</tr>
<tr>
<td></td>
<td>Number of instruments = 263</td>
<td>Wald chi2(17) = 4.58e+06</td>
</tr>
<tr>
<td></td>
<td>Probs &gt; chi2 = 0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Two-step results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>z</th>
<th>P&gt;z</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>lavgcds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1.</td>
<td>.4042481</td>
<td>.0180168</td>
<td>22.44</td>
<td>0.000</td>
<td>.3689359 -.4395603</td>
</tr>
<tr>
<td>L2.</td>
<td>-.2005856</td>
<td>.0069776</td>
<td>-28.75</td>
<td>0.000</td>
<td>-.2142615 -.1869097</td>
</tr>
<tr>
<td>L3.</td>
<td>.1477278</td>
<td>.0177528</td>
<td>8.32</td>
<td>0.000</td>
<td>.1129329 .1825227</td>
</tr>
<tr>
<td>lta</td>
<td>.0370444</td>
<td>.008962</td>
<td>4.13</td>
<td>0.000</td>
<td>.0194792 .0546096</td>
</tr>
<tr>
<td>ltri</td>
<td>-.1771966</td>
<td>.013081</td>
<td>-9.68</td>
<td>0.000</td>
<td>-.2103797 -.1413134</td>
</tr>
<tr>
<td>lroa</td>
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<td>.0429067</td>
<td>-9.91</td>
<td>0.000</td>
<td>-.5093949 -.3412039</td>
</tr>
<tr>
<td>cr</td>
<td>-.0815025</td>
<td>.008962</td>
<td>-9.91</td>
<td>0.000</td>
<td>-.1513797 -.0116271</td>
</tr>
<tr>
<td>sqretvol</td>
<td>.0087106</td>
<td>.005958</td>
<td>14.62</td>
<td>0.000</td>
<td>.0075427 .0098784</td>
</tr>
<tr>
<td>lroe</td>
<td>-.2230953</td>
<td>.0444308</td>
<td>-5.02</td>
<td>0.000</td>
<td>-.3101781 -.1360125</td>
</tr>
<tr>
<td>reg1</td>
<td>.165291</td>
<td>.0735517</td>
<td>2.25</td>
<td>0.025</td>
<td>.0211324 .3094496</td>
</tr>
<tr>
<td>reg2</td>
<td>-.4339759</td>
<td>.1346428</td>
<td>-3.22</td>
<td>0.001</td>
<td>-.6978709 -.1700809</td>
</tr>
<tr>
<td>y5</td>
<td>-.1914358</td>
<td>.0066825</td>
<td>-28.65</td>
<td>0.000</td>
<td>-.2045333 -.1783383</td>
</tr>
<tr>
<td>y6</td>
<td>-.3970906</td>
<td>.0490691</td>
<td>-41.32</td>
<td>0.000</td>
<td>-.4159241 -.3782571</td>
</tr>
<tr>
<td>y7</td>
<td>.3496266</td>
<td>.0183409</td>
<td>19.06</td>
<td>0.000</td>
<td>.3136791 .385574</td>
</tr>
<tr>
<td>y8</td>
<td>1.642077</td>
<td>.0312238</td>
<td>52.59</td>
<td>0.000</td>
<td>1.580879  1.703274</td>
</tr>
<tr>
<td>y9</td>
<td>1.463372</td>
<td>.0417142</td>
<td>35.08</td>
<td>0.000</td>
<td>1.381613  1.54513</td>
</tr>
<tr>
<td>y10</td>
<td>.9434833</td>
<td>.045796</td>
<td>20.60</td>
<td>0.000</td>
<td>.8537248  1.033242</td>
</tr>
<tr>
<td>_cons</td>
<td>-.2110054</td>
<td>.1608788</td>
<td>-13.12</td>
<td>0.000</td>
<td>-.242537 -.1794737</td>
</tr>
</tbody>
</table>

Note: Two step system GMM results include default standard errors, hence are not robust for heteroskedastic error. Arellano-Bond test for zero autocorrelation in first-differenced errors

<table>
<thead>
<tr>
<th>Order</th>
<th>z</th>
<th>Prob&gt;z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4.0578</td>
<td>0.0000</td>
</tr>
<tr>
<td>2</td>
<td>-1.0516</td>
<td>0.2930</td>
</tr>
</tbody>
</table>

H0: no autocorrelation
7.3.1 Results of all models

7.3.1.1 Credit ratings

A strong negative relationship is found between CDS spreads and credit ratings in all models, with the exception of the fixed effects model, while having significant coefficient estimates, consistent with Hypothesis 1. CR has been removed in the FE model due to being a pure cross-sectional variable. The significance levels for the relationship between CDS spreads and credit ratings in the OLS, RE, GMM1 and GMM2 models are $p < 0.001$, $p < 0.001$, $p < 0.1$ and $p < 0.001$ respectively. This significant negative relationship confirms previous research findings that credit risk has a strong positive influence on CDS spreads (Abid and Naifar 2006; Daniels and Jensen 2005; Norden and Weber 2004).

7.3.1.2 Returns volatility

A positive relationship between CDS spreads and returns volatility (standard deviation of returns) is found in this study, consistent with Hypothesis 6. Returns volatility is also significant in all specifications with $p < .05$, $p < .01$, $p < .01$, $p < .01$, and $p < .001$ respectively in the OLS, FE, RE, GMM1 and GMM2 models respectively. This implies that entities that have a higher volatility in equity returns have increased CDS spreads, indicating higher default risk and risk taking by financial institutions. These results are consistent with previous research (Byström 2005; Ericsson et al. 2009; Hassan et al. 2011).

7.3.1.3 Profitability measures

Hypothesis 5 (Total returns index) indicates a negative relationship and as strongly significant at the $p < 0.001$ level in the FE, GMM1 and GMM2 models, but not significant in OLS and RE models ($p > .1$ in both models). This concludes that entities with better future prospects will be less risky, resulting in lower CDS spreads. Prior research has shown that accounting based measures of profitability and CDS spreads are negatively correlated (Hypotheses 3 and 4). The hypothesis was supported for ROA (Hypothesis 3) only in the pooled OLS, system GMM1 and GMM2 ($p < .05$, $p < .05$ and $p < .001$ respectively), while the coefficients were not significant in the FE and RE models ($p > .1$ and $p > .05$ respectively). However, for ROE except the GMM1 estimates, all other models

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Please see Tables 7.5.1 through 7.5.5 for details of p-values in the different estimators.
(i.e. OLS, FE, RE and GMM2) support Hypothesis 4 (\( p < .01, p < .01, p < .001 \) and \( p < .001 \) respectively). Although the relationship between CDS spreads and ROE is consistent in these models, since the GMM1 model does not yield the same result, it is concluded that ROE does not have a significant influence on CDS spreads. However, even in the GMM1 model a negative relationship is portrayed, indicating that entities that have a higher ROE would have a lower risk. Nevertheless, as the results are not significant, ROE is not considered as a variable that influences managerial risk taking in this study. On the contrary ROA is considered to have a negative influence on CDS spreads as profitable institutions have a lower probability of default. On the other hand, lower profitability would mean higher volatility in future cash flows, thus higher credit risk. These results confirm previous findings (Casu and Girardone 2005; Chiu and Wagner 2010; Inci and Podpiera 2010).

7.3.1.4 Total assets

Total assets and CDS spreads indicate a positive relationship in all models (which is also noted in the literature, see Nguyen and Faff (2002)), but the coefficients are not significant for OLS, FE, RE and GMM1 estimates (i.e. \( p > .1, p > .05, p > .1, \) and \( p > .1 \) respectively). However, in the system GMM2 model total assets are significant at 99.9% level (\( p < .001 \)). This result is not consistent with the findings of Minton et al. (2009) and Ashraf et al. (2007) who indicate that larger banks are more inclined to use credit derivatives for hedging credit risk and have substantial human capital and financial resources in order to deal in credit derivatives markets. Although the variable total assets are significant in the GMM2 model as they do not represent robust results, it is considered that total assets are not significant in this model and hence is not a predictor of managerial risk taking. Total assets that are an indicator of the size of the financial institution have a positive coefficient. This means that larger financial institutions are more likely to engage in riskier activities. This positive relationship between total assets and CDS spreads is significant in both one and two step system GMM, but the significance is lost when estimating the robust one step system GMM model.

7.3.1.5 Region and year dummies

When considering the region dummy variables, REG1 has a positive coefficient with REG3, meaning when average CDS spreads in North America (NA) are higher, the average spreads of the “other” group also increase, while the average spreads in the
European region (REG2) is lower than in North America, which is contrary to expectations. A possible explanation for this could be that the “other” region comprises countries in South America for which CDS spreads are largely driven by US markets. The year dummies reflect the expected results. The coefficients are negative and significant for years 2003-07; while from 2008 and 2009 represent a positive significant coefficient, indicating the significant increase in CDS spreads with the onset of the GFC.

As the data set characteristics violate OLS, FE and RE model assumptions, the diagnostic tests are not conducted in order to evaluate which model is superior. As a result, none of these models are suited for this dataset. Therefore, more emphasis is placed on system GMM1 and system GMM2 estimates. In Table 7.2, the last two columns present GMM estimators. It also presents the three lag one and two step system GMM coefficient estimators for the given model. The coefficient of the lagged dependent variable for the second lag is negative and statistically significant in both one and two step estimators. This means that CDS spreads are likely to decrease if they have increased in the previous period.

7.3.2 Results of the one-step system GMM model

One-step system GMM results indicate that profitability indicators such as ROA and the total return index have a negative relationship with CDS spreads. Although ROA is significant ($p < .05$), ROE is not significant in this model ($p > .1$ – see Table 7.2.4). This reflects that the higher the profitability in terms of ROA and TRI of an entity (past and expected profitability), the lower would be the riskiness of the respective entity, indicating a lower CDS spread. One-step system GMM results are robust for heteroskedastic error; however, ROE is not significant when taking robust results ($p > .1$). Credit ratings have a strong negative relationship ($p < .01$) as expected, indicating entities that have lower credit worthiness are more risky and vice versa. Returns volatility displays a strong positive relationship with CDS spreads ($p < .001$) which is consistent with the literature which emphasises the importance of returns volatility in the prediction of default probabilities as expected default frequencies result in higher stock return volatilities (Berndt et al. 2004; Byström 2005). As expected, although total assets (used as a proxy for size) display a positive relationship which is consistent with the notion that larger firms use credit derivatives to a greater extent, this also could mean that as larger companies are more

---

[^86]: i.e. Hausman test and Breusch-Pagan Lagrange multiplier (LM)
systemically important, they are more vulnerable to systemic risks (Acharya and Pedersen 2010). Higher risk taking by larger financial institutions, with a higher use of CDSs, could increase CDS spreads of such institutions as opposed to smaller institutions. However, one-step system GMM results are not significant ($p > 0.1$) when using the robust standard errors although significant in the FE and system GMM2 models. The year dummies from 2005 to 2010 are all significant, displaying the expected relationship in the one-step results. For example, the crisis years from 2007 to 2009 represent strong positive significant relationships, indicating heightened risk and risk aversion in markets.

In relation to the instrumenting with variables in one and two step system GMM, Blundell and Bond (1998) provide an increased efficiency where it differences the instruments in order to make it exogenous to fixed effects. In order to obtain new moment conditions for data in levels and at the same time retaining the Arellano-Bond conditions for the differenced equation Blundell and Bond (1998) have designed a system estimator (the level and the differenced equations) which provides twice the observations, where the undifferenced observations follow the differenced observations (Roodman 2006). Thus, the system GMM provides increased efficiency. Up to three lags of the dependent variable are used (see Tables 7.2, 7.2.4 and 7.2.5) in this study due to the need to find good instruments in order to provide efficient results. In the one and two step system GMM models, all instruments available from the third lag onwards are used. However, using deeper lags reduces the sample size. As a result, the total number of observations reduces to 388. As the number of entities used is large (i.e. 319), three lags and all available instruments from the third lag onwards are used. In keeping with the rule of thumb, the number of instruments is less than the number of observations (see Tables 7.2.4 and 7.2.5). In both one and two step system GMM, the number of instruments used is 263 which is lower than the number of observations in either case which is 388. The use of deeper lags in this study is required by the regression and not warranted by finance theory. In the dynamic component of the CDS spread determinant model, the one-year lagged CDS spread as expected portrays statistically significant positive coefficient in the first lag in both one and two step results. The two step system GMM uses a consistent estimate of the weighting matrix, taking the residuals of the one step results, which makes it asymptotically more

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87 All instruments used are reported where necessary.
efficient (Presbitero 2008). Although almost all variables are significant and display the expected relationship in the two-step system GMM model (see Table 7.2.5), the results are not significant with the robust standard errors. In this study, the instrument set is restricted to the three lags of the dependent variable $CDS_{it}$, as there is no evidence of second-order autocorrelation. According to Arellano and Bond (1991) there could be inconsistency in the estimates if there is second order autocorrelation in the first differenced errors, in which case the lagged dependent variable ($CDS_{it-1}$) needs to be restricted three lags or deeper (Roodman 2006). In order to check for first order serial correlation in levels, the second order correlation in differences is used as this is expected to detect correlation between the level and differenced errors. The null hypothesis of no AR(2) is not rejected in the two step system GMM model (see Table 7.5), implying that the estimates in this model are consistent, hence the model is restricted to three lags of the dependent variable. It should be noted that the one-step system GMM model provides significant robust results for this study and is considered as the best fit for the data used.

These findings suggest that firm specific factors such as credit risk, profitability and equity volatility (as indicated by standard deviation of returns) are driving forces of CDS spreads, as these predictors provide concise information of the health of the enterprise (Chiaramonte and Casu 2010). This result is consistent with Das et al. (2006) and Chiu and Wagner (2010). This in turn suggests that CDS spreads of financial institutions reflect the risk captured by accounting as well as market variables that highlights managerial risk taking (Bolton et al. 2010).

A general remark is that not all variables included in the final model (one step system GMM model) are predictors of CDS spreads, and as a result, they are not predictors of managerial risk taking in this study. Specifically, the estimation results for the one step GMM model indicate that the coefficients of total assets and ROE are not significant in this model. Except for Hypotheses 2 and 4, all other hypotheses are supported in this research. Although the size of the financial institutions, proxied by total assets, displays a positive relationship as expected in the literature due to larger financial institutions being more likely to have the financial capital, expertise and knowledge in the trading of more complex derivative products, the results show that the coefficient for this variable is not significant in the one step GMM results.
These findings suggest that the one step GMM model appears to have a preferable specification, which provides robust results, in describing managerial risk taking behaviour in financial institutions. In addition, there is no second order serial correlation in the first differenced errors. As such, the null hypothesis of zero autocorrelation is accepted in the second order first differenced errors.

7.4 Conclusion

The main conclusion of this chapter is the identification of the predictors of CDS spreads that are used as a proxy of managerial risk taking. The results provide evidence that credit ratings, returns volatility, ROA and equity returns have a significant influence in determining CDS spreads. However, total assets and ROE are not significant in the one-step system GMM results, although they are significant in other models.

Credit risk and equity volatility as measured by standard deviation of returns have a significant influence on CDS spreads and in turn on managerial risk taking. This chapter has focused on some of the key variables that drive CDS spreads and attempted to investigate the potential relation that exits between CDS spreads and firm specific accounting and market variables. With a sample of 319 financial entities drawn from 33 countries around the world, the results contribute to a rather limited existing literature on the determinants of CDS spreads and managerial risk taking.

For the analysis of managerial risk taking, which is proxied by CDS spreads (Bolton et al. 2010), two risk indicators (CR and RETVOL) and three indicators of profitability (ROE, ROA and TRI) are used, in order to investigate the expected relationship to CDS spreads and to what extent these variables explain CDS spreads. The choice of variables is consistent with the literature (Alexander and Kaeck 2008; Chiaramonte and Casu 2010; Das et al. 2009; Jacobs et al. 2010).

The results show that indicators of firm risk such as credit rating and equity volatility are significant drivers of CDS spreads and hence of managerial risk taking. This reflects a recently emerging view in the literature concerning the role of CDS spreads in indicating managerial risk taking. The following chapter summarises the findings and their link to the theoretical framework and also presents a conclusion to this thesis.
CHAPTER 8
FINDINGS AND CONCLUSION

8.1 Introduction

“It was derivative trading (including credit default swaps) and excessive risk taking that led to the financial crisis ... The CDS positions held by the five largest banks posed 'significant risk' to the financial system. Big banks should have extra restrictions placed on them, including a ban on derivative trading, because of the risk that they would need government money if they fail ...”

Joseph Stiglitz
Nobel Prize winning economist
Source: Bloomberg, 12 October 2009

A large body of literature that has emerged since the GFC\textsuperscript{88} suggests that, although CDSs were originally developed for hedging purposes, these derivative instruments in fact create opportunities for risk taking. Managerial risk taking as it applies to banking and other non-bank financial institutions is critically different to non-financial institutions, with a significant portion of the capital structure consisting of equity. The risk taking motives of such capital structures/organisations point to at least three arguments which relate to the complex nature of the agency relationship in banks and other non-bank highly levered financial institutions. Building on the concept of managerial self-interest from an agency theoretic framework and a positive accounting theoretic perspective, this thesis analyses the potential causes for the growth in the CDS market and its eventual collapse during the GFC.

The purpose of this research is to empirically examine and provide possible explanations for the “rise and fall” of the CDS market. The media, analysts and scholars have claimed that bank risk-taking with the use of credit derivatives was a primary contributing factor towards the GFC (e.g. Financial Times 2010; Kero 2010). Against this background, this study particularly focuses on how managerial risk taking as proxied by CDS spreads was a contributing factor to the rise and fall of the CDS market. Drawing on the classical agency theory developed by Jensen and Meckling (1976) and extending its arguments to risk taking

\textsuperscript{88} Despite the growing amount of literature since the GFC that focuses on the risky properties of CDSs, there are some earlier studies that identify the same, for example, Instefjord (2005).
in the banking industry, this study uses the concept of self-interest by managers to help explain the CDS market during the period surrounding the GFC.

The remainder of this chapter is structured as follows: In Section 8.2 the major findings of this research are summarised. Section 8.3 discusses the findings in the light of agency theory and positive accounting theory, and explains how each research question is answered. Section 8.4 discusses the theoretical significance of this study. Section 8.5 discusses potential policy implications and practical significance. Section 8.6 highlights the limitations of this study. Section 8.7 discusses recommendations for future research and concludes.

8.2 Summary of major findings

Chapter 7 of this thesis presented data analysis and results which suggested the following:

i. During the period 2001-10 several market measures were significantly related to CDS spreads and, as a result, to risk taking by financial institutions. In particular, returns volatility and credit ratings are significantly related to risk taking. The higher the credit risk and volatility in equity returns, the higher would be the CDS spreads and thus overall firm risk. This indicates higher risk taking in these institutions. These findings are useful in the analysis of risk taking by global financial institutions.

ii. During the same period there is strong evidence that profitability measures such as ROA and equity returns were significantly related to risk taking in financial institutions. This suggests that financial institutions with a lower profitability are perceived to be more risky due to increased probability of default. Firms that have a higher profitability, on the other hand, can be perceived as less risky due to lower probability of default.

iii. However, the findings do not support the size of the financial institution as being a predictor of firm risk taking. Although significance is lost when taking robust results, firm size (as proxied by total assets) displays a positive relationship, indicating that larger financial institutions are more inclined to take high risks than smaller ones.

iv. Overall, this study highlights the importance of accounting and market related variables in measuring CDS spreads and thus risk taking in financial
institutions. During the period from 2001 to mid-2007, prior to the GFC, the phenomenal growth in the CDS market can be attributed partly to risk taking in highly levered financial institutions. This is due to the use of CDSs, increasing firm risk irrespective of the purpose they are used for. With the onset of the GFC, the collapse of financial institutions that engaged in excessive risk taking and as a result were major participants in CDS markets created systemic risks through their counterparties and thus resulted in the collapse in these markets.

The following section explains in detail the results obtained from the econometric estimator.

8.2.1 Determinants of risk taking of financial institutions

The econometric analysis as depicted in the dynamic one step system GMM panel model reveals that credit ratings, returns volatility (measured by the standard deviation of returns), equity returns (measured by the total returns index), ROA and region all have strong explanatory power and have a strong influence on CDS spreads. The one-step results have found that ROE and total assets are insignificant, hence may not be predictive variables. The main aim is to understand whether CDS spreads are a good proxy for managerial risk taking and to what extent the above mentioned variables influence managerial risk taking. The study considers firm specific variables that estimate the relationship between balance sheet ratios of financial institutions and their respective CDS spreads over 10 years, including the period of the GFC.

i. Credit rating

The models predict that credit rating has a significant negative relationship with CDS spreads, implying that the higher the creditworthiness of the underlying asset, the lower would the overall riskiness of the firm. This could mean that self-interested managers have less incentive to monitor creditors, due to the existence of CRT products or government bail-out schemes, and can increase risk taking. This can in turn increase the uncertainties of future operating cash flows; as a result, a firm’s credit worthiness will deteriorate when

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89 Although total assets and ROE are not significant in the one step results, total assets are significant in the two-step estimator and ROE is significant in the OLS, FE, RE and system GMM two-step estimates.
there is managerial preference towards risk taking, leading to a lower credit rating. Higher credit risk in financial institutions can be attributed to higher risk taking. Credit rating agencies have also acknowledged executive compensation as playing an important part in ascertaining credit risk in institutions (S & P 2008). This is mainly because large compensation packages can induce managers to deliver short-term financial results and to obscure long-term structural problems. Such managers could pursue high risk strategies that have higher payoffs and higher risk (Mann 2005).

Although credit ratings are related to CDS spreads, the variation of a CDS spread is not completely explained by the credit ratings. In addition, as Jacobs et al. (2010) argue, there are significant differences between credit ratings and CDS spreads. The observed discrepancies can be explained in their study, by equity volatility (of the underlying asset), returns and balance sheet ratios, which is also supported in this thesis.

ii. Returns volatility
Returns volatility has displayed a significant positive relationship with CDS spreads. The data suggests that the volatility has significant explanatory power of CDS spreads even in the presence of credit ratings. Historical volatility, defined as the standard deviation of returns, has been considered as a proxy for the volatility risk or the uncertainty of the value of the underlying asset (Campbell and Taksler 2003). The data indicates that this returns volatility is directly related to credit risk and thus to the overall riskiness of the firm. The main reason for this is that equity bears the ultimate form of credit risk as it represents the most subordinate in the capital structure of the firm. CDS spreads changes are strongly linked to equity returns and thus to returns volatility. As the CDS market is considered to be more informationally efficient than the bond market in terms of price discovery, CDS spreads would be more sensitive to increases in equity volatility. As such equity volatility can be an indicator of managerial risk taking. For example, managers who are compensated through stock options are more likely to engage in risk taking as higher volatility in equity returns would translate into higher returns on the stock options.

iii. Profitability measures
ROE and ROA have a negative relationship to CDS spreads, indicating that higher profitability lowers the overall riskiness of the firm. Although ROE is not significant in the model, ROA displays significant negative relationship. Firms that have a higher level of
assets and hence a lower ROA can be perceived as very risky. As a result, CDS spreads would increase. In addition, financial institutions that have higher profitability would have lower financial distress costs. Such firms are less likely to use derivatives for hedging purposes (Bartram et al. 2009). While ROA measures the past profitability of a firm, equity returns indicate its future profitability. Increasing equity returns could be associated with better health of the firm, thus reducing CDS spreads. As a result, financial institutions that have a higher profitability are less likely to engage in the use of derivatives for risk mitigation.

iv. Size
The size of the firm (as measured by total assets) is another important determinant of CDS spreads, identified by the literature. It has a positive relationship with CDS spreads in this study. This implies that, on average, larger financial institutions tend to be more risky. Larger financial institutions are particularly prone to the problem of moral hazard due to the perception of being “too big to fail” and policies such as depositor insurance and “lender of last resort” schemes. Large financial institutions are particularly considered “too big to fail” due to their high systemic importance. As a result, these policies could encourage risk taking in larger financial institutions. This risk taking will be more pronounced in non-commercial bank financial institutions as these are not subject to regulation in terms of capital requirements. This could mean that self-interested managers of larger financial institutions would have a higher incentive to take excessive risk due to consequences of risk taking being externalised. Although in all models the size variable displays a positive relationship, significance is lost in the one-step system GMM results when obtaining robust estimates.

v. Region
The region analysis indicates that on average North American CDS spreads are higher than European CDS spreads, implying that North American financial institutions are higher risk takers than their European counterparts. This result could also be due to the subprime crisis originating in the US, which could mean that North American financial entities were more exposed to the CDS market as compared to their European counterparts.
The following section explains the link between agency theory and the findings of this research.

8.3 Findings and their link to agency theory

The analysis presented in Chapter 7 provides evidence of firm attributes that contribute to the overall risk taking of financial institutions. This section explains the link to agency theory which is based on the fundamental human assumption of self-interest. Section 8.3.2 provides a snapshot of how each research question is answered, using the key findings, presented in this thesis.

Agency theory highlights the typical conflict of interest between the principal and the agent which in essence arises due to the separation of ownership and control (Jensen and Meckling 1976). As a consequence, managers can pursue their own objectives at the expense of the shareholders and debtholders. As classical agency theory argues, managers are primarily risk averse when compared to shareholders because managers cannot diversify their employment, while shareholders can diversify their risk by holding a diversified portfolio (Jensen and Meckling 1976). However, the principal-agent problem as it applies to highly levered financial institutions such as banks and non-bank financial institutions is significantly different to firms with ‘all equity’ capital structures. Demsetz et al. (1997) and Prescott (1999) in particular discuss the moral hazard problem associated with deposit insurance that results in excessive risk taking in the presence of agency problems in banks. This is because, due to the existence of a regulator in the banking industry, depositors and shareholders have a lesser incentive to monitor the activities of the manager, creating opportunities for the manager to take excessive risks. Many studies have attempted to estimate the problem of agency costs in relation to risk taking (for eg: Bryan et al. 2006; John et al. 1994; Leland 1998). As the agency relationship in the banking industry is more complex than an ordinary public firm, there are studies that specifically aim to address the issue of risk taking related to the principal-agent problem in banking firms (eg: Demsetz et al. 1997; Dong et al. 2010; Fortin et al. 2010; Laeven and Levine 2009). Previous research assumes that banks conform to the concept of a “firm” in the context of agency theory (Allen and Cebenoyan 1991; Gorton and Rosen 1995; Saunders et al. 1990). However, the environment within which commercial banks operate is more complex than other firms. Commercial banks operate in regulated markets, and these
dynamics cause the agency problem to be more intricate. In addition, their capital structure is highly geared, which reflects a bank’s role as an intermediary (Ciancanelli and Reyes-Gonzalez 2000). Although this thesis focuses on the entire finance industry that includes banks as well as non-bank financial institutions, emphasis is placed on the agency conflicts in banks due to the significant presence of banks in CDS markets (see OCC 2007).

It can be argued that managers who are self-interested would engage in riskier activities in order to obtain higher returns. The regulatory environment within which banks operate and the highly levered capital structure of banks encourage risk taking further by managers as compared to non-financial companies.

Many studies in bank risk taking discuss agency problems in relation to the structure of executive compensation. Zhang (2006) in particular argues that increasing a manager’s incentive to take risk also increases the agency costs of debt, therefore such incentives would lower the debt capacity due to an increased incentive to engage in asset substitution. Following the work of John and John (1993), Zhang (2006) claims that higher performance incentive structures would increase managerial incentives to shift risk to debtholders as a higher alignment of shareholders’ and managers’ interests would motivate managers to engage in risky activities at the expense of debtholders. Concomitantly, in highly levered firms the shareholder-manager interest alignment will be weakened as debtholders would demand a higher borrowing cost in order to protect against risk shifting activities (Zhang 2006). Incentive structures that align the interests of shareholders and managers would reduce the agency costs of equity while increasing the agency costs of debt. In the current study, compensation variables are not used, due to data availability issues. Managerial risk taking is proxied using CDS spreads. Bolton et al. (2010) argue that excessive risk taking by management can be proxied by CDS spreads as the price of debt.

Banks generally operate in a relatively more opaque market than other businesses because they deal with highly sensitive private client information which is not in the public domain. With large internationally active banks, this opacity is further pronounced. Accounting information may not provide information for an accurate risk assessment and may not

90 Owners seldom provide more than 10% of the funds in banks, with depositors and bondholders providing the rest.
91 The cost of insuring against a firm’s default (premium).
allow timely monitoring. However, market prices are better suited to provide information for an accurate risk assessment (Düllmann and Sosinska 2007). Unlike bond spreads which are subject to interest rate and liquidity risk, CDS spreads mainly relate to credit risk which makes them more suitable measures of credit risk than other market measures of riskiness.

Instruments such as CDSs can be used by financial institutions in order to improve returns on their investment portfolios. Due to the ability of CDSs to be traded on their own, in addition to being a credit risk management instrument, many financial institutions have used them for the purposes of providing trading income (Fitch Ratings 2010). The leverage potential of naked CDSs is far higher when used for trading purposes rather than hedging purposes as when trading it is not necessary to own the underlying asset/reference entity. As innovation of these instruments was mainly concentrated on creating high-margin profits, there were higher incentives for financial institutions to use them.

CDSs allow risks to be spread in the broader economy than otherwise would have been the case. Their use in the process of securitisation, known as synthetic securitisation, has allowed investors to gain synthetic exposure to the underlying asset (Gibson 2004). Even their use purely for hedging purposes by financial institutions would be increased as it was believed that this could reduce the risks of high risk investments. Using CDSs for hedging purposes could also increase incentives for risk taking in financial institutions because, by being able to transfer risk through such products, there is less incentive for lenders to monitor borrowers’ activities. This also can lead to incentives for accepting high risk borrowers as the risk can be transferred to a third party that will in turn be fully exposed to the credit risk of the underlying asset. In addition, bank and non-bank financial institutions earned substantial fees as dealers/intermediaries for CRT products such as CDSs. This further encouraged financial institutions to increase risk taking as this risk could be transferred to a third party. Therefore it can be argued that managerial risk taking driven by self-interest can, to a large extent, explain the growth in the CDS market.

As financial institutions that are buyers and sellers of protection are subject to regulation and supervision, they need to maintain capital accordingly. However, not all financial institutions (i.e. non-bank financial institutions) are subject to regulation and supervision as much as banks/financial intermediaries. To the extent that unregulated entities are major
participants in CDS markets (as in the case of the dataset used in this study\textsuperscript{92}), this lack of regulation could mean that their managers are more likely to engage in trading CDSs to lower costs, in terms of maintaining capital. Even if regulated financial institutions are subject to capital requirements which reduce the exposure to the risks arising through the trading of CDSs, due to the significant amount of non-bank financial entities and non-financial entities trading in CDS markets and some of them being systemically important, the lack of regulation of these institutions may pose a systemic risk. Further, as the CDS market is largely unregulated, managers of financial institutions may be more inclined to trade in CDSs than in other regulated investment products. Risk taking by the managers of both bank and non-bank financial firms would increase. This increases the systemic risk. As a result of this, a failure of one financial institution can lead to counterparties to a transaction not being able to fulfil their obligations, and the resulting contagion effect can lead to a collapse of the CDS market. Therefore it can be argued that the managerial self-interest led to increased risk taking, thereby leading to the phenomenal growth of the CDS market and also may have led to its eventual collapse.

8.3.2 Addressing research questions and the key findings

This section reviews and answers the research questions in relation to the key findings of this study explained in Chapter 7.

Research question no. 1:

1. Why did the CDS market increase in popularity up until the GFC?

This study provides evidence and supports the existing literature on the determinants of CDS spreads. Although these have been explored and tested in prior literature, the relevance of CDS spreads in investigating managerial risk taking is limited in prior research. In addition there is a paucity of literature linking managerial risk taking indicated in CDS spreads of financial entities to the growth in the CDS market. The results show that financial entities that have a higher credit risk as indicated by a lower credit rating would

\textsuperscript{92} Out of the total 319 financial institutions, only 71 are banks.
have a higher influence on CDS spreads (i.e. increasing CDS spreads). They also suggest that higher returns volatility of the financial institution leads to higher CDS spreads. As credit rating and returns volatility indicate the level of risk of the underlying asset, the effect of these variables on CDS spreads and hence on managerial risk taking could indicate that companies with a lower credit rating and higher returns volatility would have a higher level of risk taking. The results also indicate that profitability measures such as ROA and equity returns have a negative influence on CDS spreads, meaning higher profitability would indicate lower risk as indicated by CDS spreads and thus lower risk taking. Drawing on the concept of managerial self-interest suggested by agency theory, it can be argued that self-interested managers increase risk in order to increase returns. The existence of a regulator (especially in banks), “too big to fail” perceptions and use of risk transfer instruments such as credit derivatives would particularly provide incentives for increased risk taking. In particular, the use of credit derivatives for either risk management or speculative purposes can increase firm risk levels, as indicated by higher returns volatility or lower credit ratings. The positive relationship between CDS spreads and returns volatility and negative relationship between CDS spreads and credit ratings confirms the higher risk taking levels of financial institutions. This could mean that the higher risk taking levels can be attributed to the increased use of CDSs, contributing to the phenomenal growth in the CDS market prior to the GFC.

Research question no. 2:

2. Why did the CDS market almost completely collapse during and after the GFC?

Following from the previous arguments in answering research question no. 1 which relates to the higher risk taking levels that have led to the phenomenal growth in the CDS market, the near total collapse of this market also can be attributed to the increased risk taking, that is, the increased risk taking driven by self-interested managers through the use of CDS can result in a substantial decline in their value with the financial difficulties experienced by the underlying borrowers during the subprime crisis. This can be partly attributed to the lack of monitoring and assessing the quality of the underlying asset. Highly leveraged firms such as financial institutions are prone to excessive risk taking due to risk shifting from shareholders to bondholders (Jensen and Meckling 1976). Given the large number of non-
bank financial institutions participating in CDS markets that are not bound by strict capital regulations as compared to commercial banks, there could be a higher tendency in such firms to engage in excessive risk taking and increase the use of products such as CDSs. In addition to the risky properties of CDSs such as counterparty risk, systemic risk and providing the incentive for further acquisition of risk, due to the higher fee income received from intermediaries making it profitable for them to act as a dealer for CDS transactions. The growth in the CDS market further highlights the less attention paid to the riskiness of these instruments. The users of CDSs in addition could transfer risk off-balance sheet which creates a facade of a balance sheet that is risk free. There was no appearance of deficiencies in these instruments which in turn led to a continued growth in the CDS market. Due to the ability of transferring risk to third parties, CDSs increase risk taking by allowing further acquisition of debt. In addition to the excessive risk, the increase in leverage has made these entities more sensitive to bankruptcy during periods of market uncertainty. Eventually when the subprime crisis unfolded, the value of the underlying assets declined, resulting in severe losses to financial institutions. The contagion in the financial services industry, which is far more pronounced than any other industry, and the systemic effects in the CDS market (due to counterparty risk), mean that the failure of one institution can lead to a domino effect on others across the global market. The risk taking behaviour of financial institutions which is indicated by the credit ratings, returns volatility and profitability measures in this study can be used to explain the extent to which managerial risk taking has contributed to the collapse of the CDS market. It can also be argued that such risk taking by financial institutions which is reflected in the excessive growth in the CDS market also led to its collapse.

8.4 Theoretical contributions

There are two main theoretical contributions from this research.

First, this study contributes to the growing literature in managerial risk taking; in particular, the use of CDS spreads in understanding managerial risk taking in financial institutions. This research assesses the applicability of existing theories such as agency theory and positive accounting theory which draws upon on the concept of managerial self-interest, in order to highlight how this managerial risk taking as proxied by CDS spreads can explain the rise and fall of the CDS market. Overall, it appears that the one step generalised
methods of moments model (system GMM1) is relevant in explaining the determinants of CDS spreads in financial institutions that help explain the variables that drive CDS spreads, thus managerial risk taking. This is one of the first studies that provides a link between managerial risk taking as represented by CDS spreads and the phenomenal growth and the eventual collapse of the CDS market.

The dynamic panel model used (system GMM1) appears to be robust and consistent. Given the nature of the data (cross sectional and time series), static panel models and standard pooled Ordinary Least Squares regression methods are superseded by the system GMM model. The strength of this model is that it is dynamic, which captures the dynamic price discovery behaviour of CDS spreads with the use of a lagged dependent variable.

Second, this research uses the concept of managerial self-interest drawing on agency theory (Jensen and Meckling 1976) as applied to the growth and collapse of the CDS market. Jensen and Meckling (1976) assume that individuals act to maximise their own utility, hence it is argued in this thesis that such self-interested managers, in order to further their own interests and with the aim of increasing the returns to shareholders, do take on excessive risk. Given the circumstances and the context within which financial institutions operate (i.e. being highly leveraged), the argument of self-interest of managers, support the increase use of CDSs to enhance returns. As a consequence of the high systemic risk that resulted through the use of these instruments, and the subsequent managerial risk taking (through the use of CDSs) can be argued as a cause that led to the collapse of the CDS market. This research supports the assertion that CDS spreads do in fact indicate managerial risk taking (Bolton et al. 2010) and that this was significant in the rise and fall of the CDS market.

8.5 Potential policy implications

Research in this thesis suggests that understanding the determinants of CDS spreads would be the first step towards better understanding them as a proxy for managerial risk taking. It is believed that the approach followed in this thesis may have considerable potential as a tool in exploring managerial risk taking through CDS spreads. This research examines the linkage between variables that indicate managerial risk taking and its impact on CDS spreads, thus on firms’ credit risk exposure. The results indicate that managerial risk taking in fact does drive CDS spreads. With reference to the growth in the CDS market peaking at
$62 trillion in 2007, far higher than the global GDP, in the lead-up to the GFC with increasing CDS spreads, it can be argued that the growth of the CDS market, which highlights the level of activity in the CDS market, can explain that managerial risk taking has increased significantly. This problem in highly levered entities such as financial institutions, either through deposit protection schemes or implicit guarantee schemes, is fundamentally different to the classic principal agent problem (Holmström and Tirole 1993) that relates to all equity public firms (Bolton et al. 2010). For such highly levered firms, shareholder maximisation would mean excessive risk taking at the expense of depositors (particularly in banks, due to moral hazard), regulators and taxpayers. The problem of managerial risk taking in the context of banks and non-bank financial institutions that extend loans would mean that CDSs are used as part of their risk transfer process, with the risk being transferred off-balance sheet. This could particularly encourage risk taking by managers in financial institutions as this risk could be transferred eventually to others in the market, who are willing to take it on. Therefore, the growth in the CDS market could be attributed to a certain extent to managerial risk taking which also contributed to the eventual collapse of the CDS market.

For practitioners, policy makers and academics, understanding the use of CDSs and their implications for managerial risk taking is important because by understanding the risks that CDSs generate per se and its influence on the risk taking decisions of the management have implications for the market and the broader economy. In addition, the sharp increase of the use of CDSs, particularly by financial institutions, and the eventual collapse of the CDS market has attracted much attention from policy makers. This thesis highlights that managerial risk taking as a potential reason behind the phenomenal increase in the CDS market is also the central feature of its subsequent collapse, highlighting the importance of the nature of the use of credit derivatives by financial institutions (i.e. purpose) and its effect on the total risk of a financial institution. Although CDSs were originally developed to reduce risk, particularly in banks (that are heavily exposed to credit risk), the reason for the increased overall risk of financial institutions certainly deserves more attention by policy makers. One important reason is that much of the increase in the use of CDS was for speculative purposes rather than hedging. The size of the CDS market deserves much attention by policy makers as the purpose these instruments are used for significantly increases risk in financial institutions. Although the size of the CDS market was far lower
than the market for interest rate derivatives, for example, its phenomenal growth within a short span of time affected the stability of the financial system to a large extent. Nevertheless, there is no accurate indication as to the amount of risk transferred with CDSs. Regulators have a challenging task in assessing the overall counterparty risk and concentration of systemic exposures. Notwithstanding that Australian banks are not as heavily exposed to the credit derivatives market as their US and European counterparts, the identification of the concentration and the formation of systemic exposures is an important challenge for the Reserve Bank of Australia (RBA). One important aspect of counterparty risk is that, as CDS positions are marked to market, increasing margin calls on an entity that is already in financial distress (as a result, being downgraded) can lead to increased liquidity risk, weakening the already distressed entity. If such counterparties have a high level of concentration in the CDS market along with high correlation between protection sellers and the underlying asset, there is significant systemic risks. Assessing counterparty risk is a challenge to central banks as the CDS market lacks transparency. Hence, it is difficult to assess counterparty risk at an aggregate level. Understanding the bi-lateral commitments of financial entities as a result is necessary.

Another important implication of this thesis is that CDS spreads have the potential to reflect risk taking of financial institutions. Although they do not completely explain this (i.e. they can increase due to high liquidity risk resulting from adverse market conditions), when CDS spreads are analysed along with their determinants, policy makers can monitor risk taking of financial institutions in an effective manner. If CDS spreads are indicative of managerial risk taking, then policy makers such as the Australian Prudential Regulation Authority (APRA) could monitor risk taking activities of financial institutions along with credit ratings, equity returns and equity volatility as indicated in this thesis. For instance, those that have higher CDS spreads along with lower credit ratings, higher volatility and lower equity returns could indicate higher level of managerial risk taking. The usefulness of CDS spreads in indicating managerial risk taking in large financial institutions can be important to central banks, such as the RBA, as they can be used to assess the counterparty risk concentrations in those considered to be systemically important.

The new proposed Basel III Accord for capital regulation in banks suggests a substantial increase in the capital requirement for OTC activities, providing incentives to use more
standardised products which are exchange-traded. As a result, activity in the CDS market could be less than prior to the GFC. However, what regulators should be concerned with is that higher capital requirements may not necessarily reduce risk taking by financial institutions. Blum (1999) suggests that as future profitability reduces, banks have a higher incentive to increase risk today, in order to compensate for the loss in profits in future. As a result, the increase in capital requirements needs to be treated with caution by regulators such as APRA in a domestic context. As mentioned previously, understanding counterparty risk is also important for APRA, especially in institutions that are considered to be systematically important, as larger financial institutions have more incentives to increase risk. The extent to which non-bank financial institutions are major participants in the CDS market and not subject to regulations such as the banking industry, is a concern. Non-bank financial institutions mainly use credit derivatives in their trading book and, given the complexity of more advanced CDS products (such as CDS indices and synthetic CDO tranches), it is important for regulators to restrict trading of complex products. This is primarily because market participants themselves lack understanding of the complexity in managing these risks. Although managerial risk taking, as highlighted by CDS spreads, is a good indication for regulators/prudential supervisors, the extent of risk taking involved by firms, the differences in the regulatory structure of banks vs. non-bank financial institutions can create supervisory challenges and regulatory arbitrage. A greater consistency in regulation for the participants in the CDS market may be required in order to reduce systemic risk, thus contributing to the overall stability of the financial markets. In this way, excessive risk taking can be identified and brought to the attention of policy makers in advance of a crisis.

8.6 Limitations of this thesis

CDS spreads data have been drawn from 319 global financial institutions. As some of these are not publicly listed, not all balance sheet and market data are available for such institutions. This could be identified as a limitation of this study as it may have had an impact on the results. In addition, as the average credit rating provided by Markit (i.e. Markit Average Rating calculated as an average of credit ratings provided by S&P, Moody’s and Fitch), credit ratings are only available as a cross-sectional variable. However, the econometric analysis is not affected as the system GMM method allows for cross-sectional variables that do not vary over time. The credit ratings used are issuer ratings and the
Markit Average Rating will only change when the ratings provided by the agencies change. On average, the issuer ratings have not changed during the period considered, but nevertheless this is identified as a limitation of this study. Another could be the difference in prudential standards in countries that could affect the analysis. Due to the CDS dataset including global financial institutions that conform to different prudential regulatory frameworks, this can hamper cross-region analysis of the data. However, this would not limit the econometric analysis, and the dynamic specification used controls for individual heterogeneity.

Another limitation of this research is its generalisability. As this sample uses a limited number of variables, due to the restricted access to larger datasets with additional variables, it limits the generalisation of the results. In other words, the variables used in this study do not solely explain CDS spreads. The use of additional variables such as managerial compensation variables may result in a better model that explains CDS spreads or managerial risk taking. Also, the results cannot be generalised into the non-financial sector as the capital structure and the level of leverage differ in financial institutions.

8.7 Recommendations for future research

The use of CDS spreads to understand firm risk taking is increasingly popular among research in risk indicators, therefore there exists a potential for a variety of research projects to be undertaken using a CDS spreads database. This thesis proposes a number of issues for further research. Firstly, although the individual country specific heterogeneities are controlled for in the econometric analysis, one could take into account regulatory differences in the banking sector per se in different countries in order to conduct a country specific analysis in their banking industries. This may highlight the possible differences in risk indications (i.e. through the use of CDS spreads) due to regulatory differences. Secondly, as policy makers are more focused on limiting systemic risk rather than idiosyncratic risk of financial institutions, one could use improved measures of financial institutions’ contribution to systemic risk as highlighted in CDS spreads that could indicate the level of systemic risk based on the interconnectedness in the finance industry in a particular market, thus tailoring regulations/policies accordingly. Moreover, future research could address factors such as the extent to which country specific factors affect risk taking as denoted by CDS spreads in a particular industry. Although this thesis concentrates
specifically on the finance industry, due to the systemic importance given the global interconnectedness in the industry, future research could consider other industries, given that non-financial industries are increasingly popular in CDS markets and non-regulated entities such as special purpose vehicles. In addition, how factors such as size, capital base and liquidity levels affect risk taking in institutions would be more meaningful given post-GFC concerns of undercapitalised and low liquid financial institutions that fell prey to a massive crisis.

The main aim of this thesis was to provide a link between CDS spreads, which are used as a proxy for managerial risk taking (following Bolton et al.(2010)) that explains the rise and fall of the CDS market. Therefore, arguing that managerial risk taking has caused the rise and the eventual collapse of the CDS market. For future research one could also use the net positions bought or sold of CDSs by financial institutions along with profitability and risk variables that could ascertain the levels of risk and profitability of such firms. It should be noted that in this thesis the main objective is not only to test causality, but also to use CDS spreads as indicators of risk taking and thereby linking this to the rise and fall of the CDS markets which is predicted by existing theories and arguments. The main reason for the use of existing theories and predictions was to understand the importance of managerial risk taking on the growth and the demise of the CDSs that were so popular, with the size of the market being far higher than the global GDP. This has important policy implications as the excessive growth of derivative instruments such as CDSs can indicate a higher level of activity in the CDS market and potentially high risk in financial firms. This requires regulatory attention as eventually it could result in systemic consequences. As the Joint Forum of the Basel Committee (2010) has highlighted, although CDSs per se did not contribute to the GFC, poor risk management by certain institutions that were prominent participants in CDS markets certainly exacerbated the systemic risk.

Finally, as CDSs replace credit risk with counterparty risk, it is important for regulators and market participants to understand that central clearing counterparties may not completely eliminate counterparty risk and that sufficient liquidity, capitalisation, strong risk management and responsible behaviour are required to fully address the issue of risk in CDSs.
In conclusion, as long as managers of financial institutions are driven by the hunt for profitability by furthering their self-interest without integrity (morals), financial systems and economies are susceptible to future crises. No amount of financial regulation can assure integrity in the individuals who manage these institutions. After all, one cannot simply regulate responsible behaviour …
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APPENDICES

Appendix 1

Figure I: Transformation of Variables

Panel A: CDS Spreads (CDS)

<table>
<thead>
<tr>
<th>Density</th>
<th>Avg_CDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>cubic</td>
<td></td>
</tr>
<tr>
<td>square</td>
<td></td>
</tr>
<tr>
<td>identity</td>
<td></td>
</tr>
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<td>sqrt</td>
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<tr>
<td>1/sqrt</td>
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<tr>
<td>inverse</td>
<td></td>
</tr>
<tr>
<td>1/square</td>
<td></td>
</tr>
<tr>
<td>1/cubic</td>
<td></td>
</tr>
</tbody>
</table>

Histograms by transformation

Panel B: Total Assets (TA)
Panel C: Total Returns Index (TRI)

Panel D: Returns volatility (RETVOL)
Histograms by transformation
PUBLICATIONS ASSOCIATED WITH THIS THESIS


Dias, R. & Mroczkowski, N. 2011, “Do Banks use Credit Default Swaps to hedge or speculate? – An Agency Theoretic Perspective”, International Conference of Critical Accounting, New York, USA.