CAPITAL REGULATIONS AND FINANCIAL STABILITY
A Cross-Country Perspective

by

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A thesis presented to the University of Western Sydney in fulfilment of the thesis requirement for the degree of Doctor of Philosophy in Finance

School of Economics and Finance
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DEDICATION

To my wife, Sidra, and our daughter, Kashmala.
ACKNOWLEDGEMENTS

A study that has taken so long in the making owes its debt to many people. Among those who helped is my supervisor, Associate Professor Dr. Kevin Daly, who has taken very keen interest in my run towards this milestone, even at times when I would waver in my research efforts. He has not only been my supervisor, he has been a very good friend and colleague, ready to help in all aspects of research, and in my personal life. Kevin’s efforts are especially worth mentioning as he helped me integrate into the academic life, after I had been away from it for over ten years working in the banking industry.

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someone who has sacrificed the most during my time as a research student is my wife, Sidra, who deserves my accolades for holding the post, and for her love and fortitude.
STATEMENT OF AUTHENTICATION

This thesis is my original work and has not been submitted, in whole or in part, for a degree at this or any other university. Nor does it contain, to the best of my knowledge and belief, any material published or written by another person, except as acknowledged in the text.

Asghar Ali
University of Western Sydney
December 2011
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<th>Definition</th>
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<tr>
<td>AAA</td>
<td>ranking grade</td>
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<tr>
<td>ABS</td>
<td>asset backed securities</td>
</tr>
<tr>
<td>AFI</td>
<td>all financial institutions</td>
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<td>AIG</td>
<td>American International Group, Inc.</td>
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<td>APRA</td>
<td>Australian Prudential Regulation Authority</td>
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<td>ASIC</td>
<td>Australian Securities and Investments Commission</td>
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<tr>
<td>BB</td>
<td>ranking grade</td>
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<tr>
<td>BBA</td>
<td>British Banks Association</td>
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<td>BCBS</td>
<td>Basel Committee on Banking Supervision</td>
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<td>BD</td>
<td>borrower defaults</td>
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<td>BG</td>
<td>Breusch–Godfrey test</td>
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<td>BIS</td>
<td>Bank for International Settlements</td>
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<td>BOE</td>
<td>Bank of England</td>
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<td>CAR</td>
<td>capital adequacy ratio</td>
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<td>CCA</td>
<td>contingency claims analysis</td>
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<td>CDO</td>
<td>collateralised debt obligation</td>
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<td>CEPR</td>
<td>Centre for Economic Policy Research</td>
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<tr>
<td>CPI</td>
<td>consumer price index</td>
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<td>DF</td>
<td>default rate</td>
</tr>
<tr>
<td>DNB</td>
<td>De Nederlandsche Bank</td>
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<td>DSGE</td>
<td>dynamic stochastic general equilibrium</td>
</tr>
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<td>DW</td>
<td>Durbin-Watson test</td>
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<td>EAD</td>
<td>exposure at default</td>
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<td>ECB</td>
<td>European Central Bank</td>
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<td>EDF</td>
<td>expected default frequency</td>
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<td>EL</td>
<td>expected loss</td>
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<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>FDIC</td>
<td>Federal Deposit Insurance Corporation</td>
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<td>FMA</td>
<td>Financial Management Association</td>
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<tr>
<td>FOMC</td>
<td>Federal Open Market Committee</td>
</tr>
<tr>
<td>FS</td>
<td>financial stability</td>
</tr>
<tr>
<td>FSA</td>
<td>Financial Services Authority</td>
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<td>FSAP</td>
<td>Financial Sector Assessment Programme</td>
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<td>FSB</td>
<td>Financial Stability Board</td>
</tr>
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<td>FSR</td>
<td>financial stability reports</td>
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<tr>
<td>G-20</td>
<td>group of twenty advanced economies</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>GFC</td>
<td>global financial crisis</td>
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<td>GSE</td>
<td>government sponsored entities</td>
</tr>
<tr>
<td>GVAR</td>
<td>generalised vector autoregressive model</td>
</tr>
<tr>
<td>IAS-39</td>
<td>international accounting standards</td>
</tr>
<tr>
<td>IKB</td>
<td>Industriekreditbank (German Investment bank)</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>INDPROD</td>
<td>industrial production</td>
</tr>
<tr>
<td>IR</td>
<td>interest rate</td>
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<tr>
<td>IRB</td>
<td>internal ratings-based approach</td>
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<td>IRF</td>
<td>impulse response function</td>
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<tr>
<td>KMV</td>
<td>Kealhofer, McQuown and Vasicek (Moody's Corporation)</td>
</tr>
<tr>
<td>LGD</td>
<td>loss given default</td>
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<td>LLP</td>
<td>loan loss provisions</td>
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<tr>
<td>LSE</td>
<td>London School of Economics</td>
</tr>
<tr>
<td>M&amp;A</td>
<td>mergers and acquisitions</td>
</tr>
<tr>
<td>MBS</td>
<td>mortgage backed securities</td>
</tr>
<tr>
<td>NBER</td>
<td>National Bureau of Economic Research</td>
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<tr>
<td>NPL</td>
<td>non-performing loans</td>
</tr>
<tr>
<td>OAEM</td>
<td>other assets especially mentioned</td>
</tr>
<tr>
<td>OeNB</td>
<td>Oesterreichische Nationalbank (Austrian Central Bank)</td>
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<td>OIS</td>
<td>overnight indexed swap</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<td>OLS</td>
<td>ordinary least squares estimation</td>
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<td>OMO</td>
<td>open market operation</td>
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<td>OTC</td>
<td>over-the-counter</td>
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<tr>
<td>PD</td>
<td>probability of default</td>
</tr>
<tr>
<td>PIIGS</td>
<td>group of countries comprising of Portugal, Ireland, Italy, Greece, and Spain</td>
</tr>
<tr>
<td>PIT</td>
<td>point in time</td>
</tr>
<tr>
<td>Q1</td>
<td>first quarter of the year</td>
</tr>
<tr>
<td>QE</td>
<td>quantitative easing</td>
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<tr>
<td>R2</td>
<td>R-squared</td>
</tr>
<tr>
<td>RBA</td>
<td>Reserve Bank of Australia</td>
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<td>RMBS</td>
<td>residential mortgage-backed securities</td>
</tr>
<tr>
<td>RTGS</td>
<td>real time gross settlement</td>
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<td>S&amp;P</td>
<td>Standard and Poor's</td>
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<tr>
<td>SD</td>
<td>serial default</td>
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<td>SDRs</td>
<td>special drawing rights</td>
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<td>SEC</td>
<td>Securities and Exchange Commission</td>
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<td>SPV</td>
<td>special purpose vehicle</td>
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<td>STATA</td>
<td>stataCorp. LP</td>
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<td>TAF</td>
<td>term auction facility</td>
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<td>TARP</td>
<td>troubled asset relief program</td>
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<tr>
<td>TTC</td>
<td>through the cycle</td>
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<tr>
<td>U.K.</td>
<td>United Kingdom</td>
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<tr>
<td>UL</td>
<td>unexpected loss</td>
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<tr>
<td>U.S.</td>
<td>United States</td>
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<td>VaR</td>
<td>value-at-risk</td>
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<tr>
<td>VAR</td>
<td>vector autoregressive model</td>
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<tr>
<td>VECM</td>
<td>vector error correction models</td>
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<tr>
<td>WLS</td>
<td>weighted least squares</td>
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</table>
PREFACE

The scholarship in this thesis is about the role of regulatory capital in financial stability, explained through a case-study approach of Australia and the U.S. This thesis is my original work and does not contain any material published or written by another person, except as acknowledged in the text. Some of the research in this thesis has been previously published or presented at international conferences. I duly acknowledge referees and conference participants' comments and suggestions which have greatly helped this thesis.

Some of the preliminary findings based on research in Chapter 3 have been presented as:


Research in Chapter 2 investigating credit risk modelling of Australia and the U.S. was presented as:


This paper has also been previously published as:

Some of the research findings in Chapter 5 investigating business-cycle effects of Basel-regulatory capital were presented as:

ABSTRACT

Financial stability is without conjecture the primary policy objective of central banks today, in addition accounting for regulatory capital requirements as a solution to the problem, have preoccupied bank regulators since at least the onset of the Global Financial Crisis in 2007/08. Notwithstanding, systemic-risk channel of financial stability is still evolving and our understanding of it is very limited. Designing efficient regulatory capital framework that is not procyclical can be a desirable policy pursuit, as well as possible solution to the too-big-to-fail problem, which involves government indemnifying big corporations at public expense while at the same time be indifferent to smaller, struggling firms. This forms the key objective of this study. This thesis is the first coherent framework of credit risk for Australia and the U.S., conducting macro-stress-test analysis, providing a useful metric for systemic-risk evaluation. It outlines the overarching theme of this research by providing a historical overview of financial stability developments, often through the premise of banking-crises explanation. The study also reviewed theoretical and empirical literature to explore the niche for the current scholarship on financial stability.

This study utilises a combination of theoretical and empirical frameworks for laying out the research plan. As part of the empirical exercise, credit risk and macro stress-test utilise weighted least squares and quantiles analysis, respectively. The cyclical nature of existing capital regulations in Australia has been examined using moving average (MA) regression, as well as unsmothered measure of minimum-capital requirement for extreme losses. Similarly, systemic-risk determination of financial stability is investigated through an empirical measure, taking the behaviour of counterparty risk premium during the Global Financial Crisis of 2007–2008 as a test case. Lastly, the effective-communication channel of financial stability, which is being recently adopted by many central banks, has been analysed, using the financial stability reports published by the Reserve Bank of Australia.
It has been argued that short-term interest-rate expectation and debt levels play an important role in insolvency rates, which are at the heart of any credit-risk framework. It is not surprising that tail-risks can potentially exacerbate business cycles, i.e., it might feedback into pro-cyclicality, which supports our hypothesis that the current Basel regulatory requirements tend to decrease in the upswing of business cycles, and increase in downturns.

Future attempts to make the current regulatory regime more robust, should include some measure of liquidity risk, for example, the Libor-OIS spread, in credit-risk modelling frameworks.
Chapter 1

INTRODUCTION

1.1 SETTING THE CONTEXT: THE CORE QUESTIONS

The scholarship in this thesis is about the role of regulatory capital in financial stability explained through a case-study approach of Australia and the U.S. The financial crisis of 2007–2008 and its negative effects on the global economy, and various key implications are the primary drivers behind the idea of promoting “financial stability” in line with its other counterparts, such as monetary and fiscal policy.

There is the perception among the various stakeholders around the world including academics and professional economists, etc., that our fixation with financial stability is perhaps a novel pursuit, prompted by the recent adverse events in the world economies. However, although the focus on the stability of the financial system has not been in proportion to what was needed at any time in the past, except the current crisis, there still was some form of appreciation of the idea that governments and national regulators should work towards achieving stability in the banking, payment and financial system, as the social and financial costs associated with past crises have been colossal.

In this regard, some of the earlier attempts include the establishment of the Federal Reserve System in 1913 in the U.S., in response to the numerous crises that occurred in the history of the new nation1. The Federal Reserve Act, 1913, aimed at restoring confidence in the currency it issued, and generally in the financial system by having:

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1 Major crisis in the U.S. occurred during: 1792, 1837–39, 1873, 1893–95, 1907, 1929–33 (Black Tuesday, when severe stock declines occurred), 1989-90 (“Black Monday” symbolising collapse of the U.S. stock market). Main causes of these crises were war financing, inadequate banking system, which was usually state-based and enjoyed little support from other colonies of the nation.
(1) one-central-banking system for all the states (12 in total, Federal Reserve banks\textsuperscript{2}) and (2) backing the note issue by gold\textsuperscript{3}.

\subsection*{1.2 KEYNESIAN VIEW OF THE CRISES}

Much of the Keynesian revolution and the fall out of the \textit{laissez-faire} ideology in the late-1930s was focused mainly on the use of fiscal policy to increase demand, without any significant breakthroughs in monetary policy and financial stability\textsuperscript{4}, somewhat because several statutory constraints of the Act of 1913 prevented the Federal Reserve from taking revolutionary steps in the pursuit of stabilising markets. In any case, monetary policy in the 1930s was nothing more than the use of discount window for providing liquidity to failing banks.

It was not until the early 1960s that we saw significant breakthroughs in monetary policy. For example, the idea of monetary policy transmission mechanism, now known as “bank lending” or “credit channel” was articulated in the work of Tobin (1969b, 1970d). Similarly, Milton Friedman made a significant contribution, albeit criticising Keynes’ interventionist policies, in the development of monetary policy, such as inflation targeting and stable money supply, theorizing an alternative macroeconomic policy: “Monetarism” which was opposed to any long-term increase of money supply to stimulate output (Friedman 1962; Friedman & Schwartz 1971).

The stagflation era of the 1970s brought about the collapse of the fixed exchange rate mechanism that had been set out under the Bretton Woods system in 1945, leading to rethinking of Depression Economics\textsuperscript{5}, and underscored the role for monetary policy and, to a lesser extent, financial stability. The “Monetarist” rejection of the idea to

\textsuperscript{2} The 12 Federal-Reserve banks are established in these districts: Boston, New York, Philadelphia, Cleveland, Richmond, Atlanta, Chicago, St. Louis, Minneapolis, Kansas City, Dallas, San Francisco

\textsuperscript{3} The note-issue and bank deposits at the Federal Reserve banks were required, pursuant to the 1913 Act, to be backed by 35\% and 40\% gold, respectively.

\textsuperscript{4} Keynes presented in his landmark book \textit{The General Theory of Employment, Interest and Money} (1936) “Liquidity Preference” theory to explain the Great Depression of 1930s: liquidity preference theory assumes that savers prefer to maintain their savings in short-term assets, such as cash or demand deposits, rather than less liquid assets, such as stocks, bonds, commodities, etc.

\textsuperscript{5} Depression Economics refers to the state of affairs in a severe recession or depression characterised by non-conventional economic policies such as Quantitative Easing (QE) and deficit spending by governments. Governments’ policies during the financial crisis of 2007–2008 are usually termed “Depression Economics”.

2
induce demand through increasing money supply spurred the debate about the role of central banks such as the Federal Reserve in the economy. The tumultuous years following the collapse of the fixed exchange rate system, and high inflation, induced market participants as well as academics to think about theorising risks created as markets shifted to a more flexible, volatile exchange rate mechanism. This increased uncertainty spurred a paradigm shift in the way business risk was perceived and managed. As a result, markets for derivatives (instruments) witnessed tremendous increase in demand for these products, as well as significant improvements in their pricing techniques.

The aforesaid events combined with the 1970s oil crisis, saw governments’ response in the form of deregulation and central-bank independence. However, these policy responses from several governments in the developed world, spearheaded by the U.S. and the U.K., were in large part, focused on price stability, not financial stability, primarily because government in these countries had earlier failed in their attempts to tame stagflation. For example, the Bank of England has inflation targeting as its main objective since it gained operational independence in 1997. Similarly, price stability and maximum employment are the core objectives of monetary policy promoted by the Federal Reserve and numerous other central banks, especially those in the developed world.

Although the idea of stabilising the financial system against the threat of bank runs was considered soon after the 1973–74 banking crisis in the U.K., and other bank failures in Europe and the U.S., it is not until the late 1980s that we see significant achievements in the other important area of central banking — financial stability was more formally suggested in the first Basel-Committee standard on regulatory capital requirements, commonly known as Basel I.

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7 For example, significant improvements in option pricing were made by (Black & Scholes 1973) (Merton 1973a).
8 The idea of having a coordinated effort to promote financial stability is said to have originated in the mid-1970s during sideline meetings between the Bank of England Governor, and the Bank for International Settlements (BIS), Basel, Switzerland, which ultimately led to the establishment of Basel Committee on Banking Supervision (BCBS) in 1974. The Committee’s first publication called International convergence of capital measurement and capital standards, famously Basel I was introduced in July 1988 followed by an amendment for market risk in 1996. Its revised version called International
1.2.1 **FINANCIAL STABILITY AS A NOVEL PURSUIT**

Financial stability at this point (early 1970s) began to be perceived as important as any other government policy, including monetary policy, as it provides for efficient allocation of economic resources, pricing information for rational decision-making, and thus, providing an enabling environment for investment and savings, much to the needs of modern-day economies. On the contrary, in an untoward case of instability, severe disruption of financial intermediation may ensue, resulting in misallocation of resources and possible freeze of long-term lending (inter-temporal contracts). In a worst case scenario, we may witness complete or near-complete collapse of the financial system, with financial losses spilling over into the real sectors of the economy. For example, the Great Depression of 1930s had started initially with a few banks failures, but later spread to other asset markets — Black Monday stock market crash — and finally precipitating a severe recession. There were other developments over the following 80 years that contributed to our interest in financial stability. It is, therefore, not surprising to see financial stability gaining significant importance during the recent years.

Financial stability (FS) discussions are usually crises related, as the understanding of leading indicators provides important information for preventing or mitigating the adverse effects of these episodes. The vast body of literature on FS can be categorised as: (1) related to excesses or equilibrium approach; and (2) financial intermediation approach. These are described below.

1.2.2 **EXCESSES APPROACH TO CRISES**

The cyclical explanation of FS argues that financial crises start building as a result of some combination of an inefficient monetary policy, excessive investments, and leverage (also called mal-investment). The crisis then unfolds when excessive risk-taking and leveraged positions are closed out in the context of sharp declines in asset prices. Minsky (1977) and Kindleberger (1978), for example, emphasize the role of excess in the build-up of financial crises. Although these authors underscore the

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*Convergence of Capital Measurement and Capital Standards: A Revised Framework*, famously Basel II in 2004, incorporating variable risk weights, with the latest version incorporating changes such as high capital ratios, focus on equity capital, etc., is available as *A global regulatory framework for more resilient banks and banking systems* since 2010, after it was endorsed at the G-20 summit in Seoul, Korea.
cyclical nature of investments and leverage, what they overlook is why problems in one sector of the economy cause mass unemployment and significant decline in growth. In somewhat identical fashion, Monetarists such as Freidman perceive crisis as a direct consequence of problems related to money supply. For example, they argue that the Great Depression was caused by inadequate liquidity problems, which could have easily been rectified by increasing money supply by the U.S. Federal Reserve.

### 1.2.3 FINANCIAL INTERMEDIATION VIEW

Other authors have tried to explain crises from the stand-point of intermediation between market participants. This view has gained importance since the seminal, although citing a different example, work of George Akerlof on intermediation problems in the used-car industry. Later, it evolved into the question of why agents act in a manner that may destabilise the financial system, which led to the theory of “asymmetric information.” Earlier attempts in this direction were based on the concept of applying uncertainty to the intermediation of saving-lending process. Interestingly, the “adverse selection” and “moral hazard” problems in the lending markets are termed by some commentators as contributing factors of the Global Financial Crisis.

Before BCBS’s efforts to formalise financial stability as a policy objective in the early 1970s, central banks usually thought of this as a practical issue requiring a pragmatic approach without much input, if any, from academics to formalise the issue of systemic default. Amongst the first efforts, involving equilibrium modelling of default, were Shubik (1973), Shubik & Wilson (1977), and more recently, Dubey, Geanakoplos & Shubik (2000). On the other spectrum of default conceptualisation, is Merton type, atheoretical models usually based on equity, or bond market prices.

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9 It is worth noting that interestingly Akerlof was working on the causes of business cycles, and turned to problems in car sales as a possible explanation for growth variations; at the time fluctuation in new car sales was a major factor in the U.S. business cycles. See also, Akerlof (1970).

10 The concept of asymmetric information and decision making under uncertainty was popularised by, among others (Champ, Smith & Williamson 1996; Greenwald & Stiglitz 1991).

11 Systemic default occurs when institutions whose size and inter-connectedness are large enough to cause disruption in the payments system and financial markets, fail. Serial default occurs when sovereign (government) fails to repay interest, or principal or both, on its debt.

12 See also, among others, On The Pricing Of Corporate Debt: The Risk Structure Of Interest Rates by Merton (1973b).
1.3 RESEARCH OBJECTIVE

The overarching theme of the research in this thesis is to investigate financial stability from a cross-country perspective, considering Australia and the U.S. as a test case for this research. To this end, we have considered one of the main links in the study of financial crises, i.e., banking defaults. According to the schematics of this approach, we estimate a credit risk model for the two countries, and perform simulations to study default-related events for each country. This scholarship takes a holistic view of the research question — can capital regulations serve as an efficient tool for achieving financial stability — by expanding our discussion of credit-risk assessment to include: (1) a-cyclical determination of regulatory capital (Basel capital requirements); (2) financial stability reports (FSR) as new tool of financial stability; and (3) understanding the causes of the recent Global Financial Crisis. Finally, this scholarship explores the paradigm of financial crises, and suggests why systemic risk is a complex issue worthy of further investigation with a view to mitigate or prevent the costly side-effects associated with economic downturns.

1.4 RESEARCH METHODOLOGY

The financial stability investigation conducted in this thesis is achieved through a combination of theoretical and empirical frameworks, with focus on credit-risk aspects of borrower-defaults. In this respect, the critical step is to know how to identify and measure credit risk. This is accomplished by articulating a credit-risk framework based on previous research. In order to develop a comprehensive framework for financial stability, one which also takes into account other sources of fragility, business-cycle-sources of financial stability are also considered in Chapter 4 and 6.

The study of credit risk has employed the “structural default” theory discussed here; however, it has used aggregated measure of default (i.e., default rates) instead of defaults under a binomial-setting. This is because we have employed credit risk estimation from a macro perspective as against a micro one, which is most popular with individual banks. Nonetheless, the alternative method of credit risk should have similar results as the final specification of the model turns out to be the same.

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13 See also, Ali & Daly (2010), Merton (1973a), Black & Scholes (1973), and Wilson (1997a, 1997b)
14 Under a binomial setting, borrower defaults are represented as 1’s and no defaults as 0’s. Because default in this case is a binary number often, a binomial estimation such a “logit” or “probit” is employed to obtain parameters of the model.
However, there are several advantages to using macro stress-tests such as aggregate-level surveillance and contagion risks for the banking sector\textsuperscript{15}.

In a logical next step, the credit risk parameters obtained in this way are utilised in a simulation study of the two countries (i.e., Australia and the U.S.), which provides valuable insight into the credit risk characteristics of each country. In particular, the Basel-recommended adverse or tail-event scenarios are constructed (akin to an impulse response function, IRF)\textsuperscript{16}.

From a methodological point of view, a time-series sample of the two countries’ default data has been used in credit risk estimation. Since a small sample continuous measure of default is considered in this study, a weighted least square (WLS) estimation is used, as it is best suited to estimation-related problems such as non-constant variance. As for the stress testing, the study applies adverse shocks of various magnitudes to estimate macro or systemic risk for each of the two countries. The stability of Basel-determined capital requirements is analysed using moving average (MA) regression. The technique is particularly useful in the case of time-series data, especially when considerable non-stationariness\textsuperscript{17} is present. The next component of this study’s financial stability framework, that is, external communication of central bank’s objectives and conduct of financial sector surveillance, is analysed in the case of the Australian economy. Financial stability reports (FSRs), have been utilised to theorise the effectiveness of “external communication” in achieving financial stability. For the banking-crisis source of financial fragility, the recent Global Financial Crisis (GFC) has been used as an empirical case-study to test how central bank policies operate during adverse macroeconomic conditions.

1.5 FINANCIAL STABILITY AND CAPITAL REGULATIONS: A RUNNING THEME

The forerunner to financial stability is a typical central bank acting as a “lender of the last resort,” providing liquidity to failing financial institutions during a financial crisis, particularly depository banks. Thus, in keeping with this view, monetary policy of the

\textsuperscript{15} See also, Cihak (2005) for an overview of macroprudential stress tests used by most central banks.

\textsuperscript{16} An impulse response function (IRF) is used to track the impact of any factor on other variables considered in a simultaneous-equation system, often used in a structural vector autoregressive (SVAR) model that applies economic theory to time-series policy analysis.

\textsuperscript{17} Non-stationariness means the data has a unit root, when according to model assumptions it should not have one. In other words, the data is not trend-stationary; the violation of this assumption can be addressed by a variety of methods, including “transforming the data,” or taking “first difference.”
1930s and 1940s was much about the central-bank use of discount window to “print money,” flooding bank coffers with the much-needed liquidity. This was, however, a clear advantage over the era when central banking either did not exist, or had little operational control over money supply.

Then there was the “gold standard” that had for quite a long time put fetters upon the imagination of central banks — contrary to the common belief, anchoring monetary policy to specie-based currency, which has a limited supply, has not been less problematic, sometimes causing even more price volatility than under the “fiat” system. Except for the period when the gold standard was gradually scrapped by central banks, such as the U.S. Federal Reserve in the 1930s and then again in early 1970s, the post second-world-war era witnessed no major financial crises. However, the banking crisis in the U.K. in early 1970s, together with the liquidity crisis faced by several international banks, and other factors forced central banks to seriously consider pursuing financial-stability as a policy goal.

The ensuing literature on financial stability developed along the lines of banking crises perhaps, because historically this has proved to be one of the most important causes of financial crises, besides other causes, such as currency and sovereign debt problems. Although initial research on financial stability emanated from within central banks themselves as it was largely considered a practical issue needing practical solutions, we did see numerous contributions from academics since the early 1980s. For example, the classical view that crises are caused by “mob psychology,” and not structural changes in the underlying economy was advanced by Kindleberger (1978). Similarly, the external-shock view of financial crises is advanced by Minsky (1977, 1982), who see “excessive leverage” as the culprit behind abrupt reversals of investment positions, leading to large-scale bankruptcies and downturns. Hyman Minsky’s work on “financial instability hypothesis” has been revived from obscurity by the GFC and therefore, the current downturn is often termed as “Minsky’s moment” by many economists. Excessive leverage is one important lesson we can draw from the GFC.

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18 Most central banks today operate under this system, where currency notes are backed up by a government guarantee, as opposed to a “gold standard,” where gold is used to anchor the issue. Paper money provides enhanced flexibility to central banks in their conduct of monetary policy, as they could change money supply without many constraints.

19 The liquidity crisis in Europe in mid-1970s was touched off by the failure of German Bankhaus Herstatt and its U.S. counterpart, Franklin National Bank of New York.
(Chapter 2, Chapter 6). However, the widely-accepted view of crises was proposed by “equilibrium” theorists such as Diamond & Dybvig (1983), who see state-switching in equilibria as a possible cause of banking crises: if everybody thinks that there is an impending run on the bank, then they want to be the first in queue to withdraw their money; on the other hand, if only genuine withdrawals, those meant for liquidity purposes, are made by bank customers then it is optimal to leave one’s savings with the banks, leading to a “good” equilibrium where there is no run on the bank.

None of the above developments, however, specifically considered the financial sector in their explanation of crises. The Financial-intermediation view of crises was propagated by Bernanke, Gertler & Gilchrist (1998) and Gertler (1988). Funding and market liquidity play a very important role in exacerbating financial fragility, as has been the case during the GFC. In a typical freezing up of financial intermediation, the initial decline of security prices leads to funding problems for shadow banks, which ultimately affect their ability to access wholesale funding market, and a vicious funding-market-price decline spiral ensues. This has been nicely illustrated by considering the collapse of U.S. investment firm Bear Stearns, which collapsed in early 2008 even though it was holding sufficient cash days before the collapse (Chapter 6).

Classical Macro-monetary models consider a financial system in which only a central bank can issue currency, in addition to setting interest rate on default-free IOU, typically issued by government; their theoretical model has no role for risk, default, and commercial banks. Although such macro models do provide a good overview of a hypothetical financial system, their lack of risk intermediation is what makes them somewhat less practical.

If all risk can be insured, then there would be no need for financial intermediation. Besides, if every risk is guaranteed without any conditions by an IOU-issuing sovereign entity like the International Monetary Fund (IMF), then it could create problems of “information asymmetry”: for example, some of the big investment banks in the U.S. were taking too much risk knowing they are going to be bailed out by tax-payer money.

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20 Financial fragility is used interchangeably with financial instability, and both imply a lack of stability in financial markets and payment systems, usually marked by rising yields and high risk premiums on otherwise good performing investments.

21 Shadow banks are non-depository institutions, typically investments banks that raise funds through the interbank market.

22 IOU stand for I owe you, suggesting debt owed to someone.
as their interconnectedness to other banks is vital to the survival of the entire U.S.
financial system — in fact, to many other economies of the world as well.
This makes “default” central to any analysis involving financial stability. Considering
the policy-implication aspect of default, we have set it as the overarching theme of this
thesis.
Some of the early research on borrower-defaults developed along the lines of
“Structural model” developed by Merton (1973a), which consider “default” as the
equivalent of an “put option”23 — with borrower defaulting when total assets’ value
falls behind the value of total liabilities (i.e., when there is zero or negative net-worth
in the business, making this as the threshold point, beyond which it is not optimum
for the borrower to continue with the business).

1.6 MAJOR CONTRIBUTIONS OF THE THESIS
This thesis is the proponent of research on financial stability from a perspective of
cross-country investigation of credit risk. Some of the major contributions of the thesis
are outlined below.
First, we conduct a cross-country analysis of credit risk, which provides a
comprehensive way to measure risk. This is in contrast to most studies that deal with a
single-country investigation, without much consideration of the fact that the world has
witnessed significant globalisation of markets in the last decade or so, making systemic
risk much more susceptible to adverse macroeconomic events, not just in nation
states, but across the world as well.
Second, we have not only focused on credit risk, which underpins many past
financial crises including the GFC, but have also taken a rather comprehensive view of
several other factors that are important for the study of financial stability. For
example, we have considered “procyclicality” and the Global Financial Crisis of 2007–
08, for our investigation, and have drawn important lessons from these
complementary aspects of credit risk.

23 A put option is a derivative product and is used for hedging or speculation against an expected fall in
the prices of an asset such as stocks, bonds, etc. The option writers as they are called charge commission
for the service, and take the opposite position of the buyer. The option contract is like buying an
insurance policy and, accordingly does not necessarily have to be exercised by the buyer, hence the term
“option.”
Lastly, this is the first study that analyses the effectiveness of Australia’s monetary policy by using financial stability reports (FSR), which the Reserve Bank commenced publishing in 2004. These reports provided critical insight into how the Reserve Bank (RBA) handled financial stability issues, and most importantly they provided ex-ante analysis of potential weakness in the financial markets.

1.7 OVERVIEW OF THE THESIS

CHAPTER 1 discusses a brief introduction of the thesis, research problem and, most importantly, the methodology employed in conducting the research. Given the distinct nature of Chapters 2, 3, 4, 5, and 6 discussed in this thesis, the survey of previous findings has been provided for each of these chapters separately instead of collating it into one chapter. The rest of the thesis is organised as follows:

CHAPTER 2 serves a bi-cameral purpose, as it has surveyed recent developments in the financial-stability analysis, and also conducts a modelling of credit risk for Australia and the U.S. The exercise is based on a reduced-form methodology derived from the seminal work of Merton and Black-Scholes option pricing models. This empirical investigation of credit risk is based on time series quarterly data for ten years, 1995–2009, for both Australia and the U.S. This chapter provides a useful introduction to the overarching theme of the thesis, i.e., modelling of financial stability. Moreover, it has also provided a framework that is later used in Chapter 3 in discussing the design of a possible stress-test exercise for Australia and the U.S.

CHAPTER 3 serves as a framework for tail-shock response analysis through the use of “macro stress-test” of the two countries, preceded by a succinct overview of recent literature in this area of research. The contribution of this chapter is that it provides an empirical framework useful for quantifying credit risk obtained from a stress-test estimation of a hypothetical shock to the economy. The quantification of risks is probably the most difficult aspect of any financial stability framework, and this chapter has tried to achieve this through a simple methodology: the research has employed the

24 More precisely, the RBA has been publishing FSRs since 2004, after they were first introduced in 1997 by Riskbank and Bank of England, central banks of Sweden and the U.K., respectively.

25 See also, (Black & Scholes 1973; Merton 1973b). Merton’s work “On the Pricing of Corporate Debt: The Risk Structure of Interest Rates” is based on threshold models of market equity prices; where it is optimum for a borrower to default (usually denoted by state 1) when value of assets falls behind liabilities, and not to default (denoted by, say, state: zero) when there is positive equity in the firm, i.e., asset value exceeds total liabilities.
credit-risk parameters (as estimated in Chapter 2 on “credit risk”) to test two adverse scenarios, namely moderate stress (MS) and severe stress (SS) corresponding to a change of 10% and 20%, respectively, in the adverse direction of the parameters considered. As a general rule, the stress values should represent the largest past movement in the relevant macroeconomic factors over a prescribed time horizon, i.e., encompassing the deviation from the trend\textsuperscript{26}. This exercise could be very useful in estimating likely credit losses in the event of extreme but plausible negative events such as recessions.

**Chapter 5** discusses Financial Stability Reviews (FSRs)\textsuperscript{27} published by the Reserve Bank of Australia (RBA)\textsuperscript{28}, as well as by many other central banks\textsuperscript{29}. This chapter has analysed the Reserve Bank of Australia’s FSRs as a new tool to measure financial stability (FS), drawing on the experience of IMF, among others, which publishes these reports for the purpose of analysis of financial-stability-related issues in major economies. The credit risk models and the subsequent macro stress-test methodology developed in Chapter 2 and 3 respectively, can be seen as the conventional tools for financial stability. Since financial crises can propagate to the financial system through a variety of transmission channels, their identification is vital to the orderly management of such adverse events. It is this “identification of channel” approach that is the thrust for this chapter, as it analyses the validity of Reserve Bank’s Reviews in the context of GFC.

**Chapter 4** discusses Basel II’s major issue of “pro-cyclicality, which has been actively debated by the major central banks of the world, especially so in the aftermath of the Global Financial Crisis. So far, in Chapter 2, and 3, we have discussed how to model and quantify credit risk, and later in Chapter 5, we considered an unconventional measure of financial stability — i.e., FSRs. However, although the main driver behind the revised framework of Basel II was to align risk with regulatory capital, i.e., minimum-

\textsuperscript{26} For general description of how to select these stress scenarios, see also, Marco Sorge (2004).

\textsuperscript{27} In some other central bank jurisdictions, these are called Financial Stability Report (FSR) instead of Financial Stability Review, but as they serve the same purpose, the names are used interchangeably in this thesis.

\textsuperscript{28} RBA has been publishing financial stability Reports on a 6-monthly basis since 2004, as noted in Chapter 5.

\textsuperscript{29} It is worth noting that the U.S. Federal Reserve currently does not publish a report equivalent to Financial Stability Report (FSR), and consideration for its publication in the future is part of our recommendations, as noted in the Chapter on FSR.
capital requirements should be determined broadly in line with the riskiness of assets held by firms, the risk-capital linkage also posed problems of potential procyclicality. It is argued that the current Basel II regulatory standard can potentially exacerbate economic crisis: it tends to lower capital requirements in economic booms and increase minimum-capital requirement during downturns, primarily because of risk rating migrations, i.e., under Basel II, the denominator (risk-weighted assets) of the required capital ratio decreases, as asset ratings improve during economic expansion and vice versa. The main contribution of this chapter is that the empirical study conducted in Chapter 4 confirms previous finding of the presence of procyclicality in the minimum-capital requirements. Due to default-data availability limitations, a hypothetical portfolio of borrowers has been constructed, using aggregated data from the Australian Bureau of Statistics and the Reserve Bank of Australia. Using moving-average regression, it is argued that the estimation results support the presence of procyclicality in the case of Basel II capital regulations in Australia\(^\text{30}\).

CHAPTER 6 discusses the recent Global Financial Crisis (GFC) as an afterthought to our discussion of financial stability, taking our cue from the 2007–2008 financial crisis. The main contribution of this chapter is that it tests the “asymmetric information” and “financial intermediation” theories to explain the GFC with profound implications for the conduct of monetary policy. In the pre-crisis U.S., we notice a period that is characterised by tremendous growth in “securitization” and “off-balance sheet” investment products, coupled with accommodating monetary policy and widening fiscal deficits. These factors then gave rise to unsustainable debt levels in the U.S., with the markets participants deleveraging soon after problems started to surface in the sub-prime housing market, which had attracted much of the capital inflows from surplus countries in East Asia and the Middle East. Initially, the problems in credit markets were deemed to be limited to the U.S. housing market, with only dim prospects for a potential spillover into other sectors of the U.S. economy, or in the extreme case, affect the rest of the world.

CHAPTER 7 provides an overview of main findings and implications of the thesis. Some of these findings include the important effect of interest rates and leverage on

\(^{30}\) It is worth noting that at the time of writing this thesis, the existing capital regulations in Australia and many other countries are based on Basel II, with the latest version called Basel III due for implementation in 2013.
credit risk. Moreover, the “external communication” channel of financial stability is found to be less effective in the case of Australia, judged from an assessment of the adverse effects of GFC on the Australian economy. Finally, the thesis also speculates on the possible future direction of research discussed in this thesis.
Chapter 2

CREDIT RISK ASSESSMENT OF AUSTRALIAN BANKING SECTOR: A COMPARATIVE INVESTIGATION

2.1 INTRODUCTION

The advent of globalisation has given rise to the kind of risk management innovations that are now embraced by academics, practitioners and central bank authorities alike throughout the world. As a result, the perception about risk, both at micro and macro level, changed altogether and since the 1990s we have seen an array of new risk tools being sought after and invented at an ever greater pace. For instance, a key
development that took place in June 2004 was the availability of a new regulatory framework called Basel II\textsuperscript{31}. Although Basel II does not serve as a mandatory standard, it does provide a risk management framework that can identify potential weakness in the financial system, and could potentially help us avoid severe discontinuous-imbalances in the global economy.

This revised framework of Basel II makes the overarching theme of the research in this chapter. Keeping this view, we investigate the macroeconomic determinants of aggregate credit risk and implications for capital requirements by constructing an aggregate credit default model that relies on various macroeconomic variables to explain default rates in the economy. We used quarterly data for 15 years from 1995Q1–2009Q2. Estimation was conducted using WLS regression method. The results suggest that both the coefficients of the models as well as elasticity exhibited similar relationship in finding out default probabilities on an aggregate level. We confirm the findings of the previous studies in the case of the level of economic activity and total indebtedness as meaningful indicators of aggregate default. Other indicators such as the level of industrial activity failed to explain default, contrary to previous studies conducted in this domain. Our investigation also reveals that the U.S. economy is, \textit{ceteris paribus}, more susceptible to adverse macroeconomic shocks than does the Australian economy.

The chapter is organised as follows. Section 2.2 outlines the literature on the topic. Section 2.4 explains the motivation behind research, rationale and contribution of research. Section 2.5 gives detailed information on data, model specification and estimation. Section 2.6 and 2.7 discuss the empirical results and analysis, respectively. In Section 2.8, we provide conclusion.

\textbf{2.2 LITERATURE REVIEW}

The many roots of the GFC, beginning in the U.S., were associated with valuation problems in subprime-mortgage securities that track mortgage loans. Like a domino effect, the crisis spread far and wide, affecting other markets around the world. However, the tipping point was not witnessed, until the fall of Northern Rock in the

U.K. which set in motion severe contraction in financial markets. While the crisis spread to other major financial centres and started to spill over into the real economy, few saw it coming. There are, however, some who claim to have forewarned on the crisis, noted among them is Roubini (2006) who strongly advocated a role for monetary policy to deflate asset bubbles. This assertion was met with criticism from the beginning. Roubini argues that central banks should not preoccupy themselves with asset bubbles, as there is limited evidence on the direct effects of these bubbles and monetary policy (Bernanke & Ilian 1997; Clarida & Gertler 1996; Laubach & Posen 1997; Rich 2003).

It is unclear whether it was a policy indifference or complexity of the issue that inhibited our understanding of the GFC. However, since the crisis, we have seen concerted efforts based on an international consensus that aims to encompass the relatively new dimension of policy, i.e., financial stability on a wider scale and as a result of various post-crisis G-20 summits, Financial Stability Board (FSB) has been constituted. Similarly, in the U.S., various measures such as systemic regulator, market measures and consumer protection and resolution agency, etc., are being discussed. While it is hard to imagine the current focus might not change to other pressing issues, such as growth and unemployment, the crises has underlined systemic risk, which is now getting unprecedented attention from academics, as well as central banks and other regulators.

### 2.3 SOURCES OF SYSTEMIC RISK

Systemic risk can be defined as the sum total of various financial risks at individual institutions, such as depository banks and financial intermediaries. According to Acharya et al. (2010), systemic risk can be thought of as a significant loss of intermediation in the financial markets, as a result of losses experienced by few big banks or many small banks, and which has the potential to spread to the mainstream economy.

In the study of financial stability, it is imperative to identify possible trigger mechanism or the sources of financial risk. However, identification of all possible risk-factors, especially on aggregate level, is a complex task. So far, and helped by some evidence from the GFC, we can identify some of the possible sources of systemic risk:

- Macroeconomic conditions and imbalances;
Macroeconomic conditions relate to the conduct of monetary and fiscal policy and their impact on the stability of financial markets. For example, it is argued that in the GFC, the low interest-rate setting by the U.S. Federal Reserve also contributed to the housing boom.

- Financial sector risk or contagion;
  Historically, there has been a very strong link between financial sector and financial crises. In this regard, many have concluded that financial sector is a special case, highly susceptible to a boom-bust cycle. According to Allen & Gale (2003), a small shock that initially affects only a small portion of the financial markets can spread by contagion to encompass either the entire financial system or, as in a major crisis, to the wider-economy. Contagion can spread through a variety of channels, such as asset-prices and payments system.

- External or foreign exchange imbalances
  Imbalances, both domestic and foreign, can play an important part in the propagation of systemic risk. The GFC is a case in point, where the surplus countries such as China and some Gulf economies’ large capital outflows contributed to a significant rise in real estate boom in the U.S. and several European countries such as Ireland, Spain, etc. According to Bernanke (2010), there is strong link between rising house prices and large capital inflows from surplus countries.

A traditional view of banking crises is based on the 2-equilibria theory: if depositors are confident of the soundness of the banking system, only people who need liquidity will withdraw their savings, and so we have a good equilibrium; if, on the other hand, depositors are concerned about the health of the banking system, then it is optimal to get hold of cash and the bad equilibria is self-fulfilling (Freidman & Schwartz 1963). Liquidity preference or the desire to hold cash as an asset, given the availability of interest-yielding bonds, has been formalised, albeit differently, by Keynes and Tobin. According to Keynes, investors have inelastic expectation about prevailing interest rates. Thus, the decision whether to hold cash or to invest largely depends on investors expectation based on “sticky” bond prices (Keynes cited in Crouch 1971, p. 368).
Tobin (1958b), in contrast, explains “liquidity preference” theory in terms of uncertainty surrounding expected interest rates derived from bonds: assets returns are normally distributed, which are independent of bond yields.

The two-equilibria models of bank crisis involve three factors: demand deposits issued by banks provide better risk-sharing among people, deposit contract has a bad equilibria when people panic and withdraw cash balances from banks and lastly, there are huge economic consequences of bank runs. Diamond & Dybvig (1983) have suggested a “deposit insurance” scheme to address the issue of undesirable equilibria resulting in bank runs. In the wake of the GFC, many commentators have cited the enormous growth in securitization investments, coupled with excessive leverage as the contributing factor to systemic risk. For instance, Reinhart & Rogoff (2009) argue that the failure of regulators overlooking systemic risk prior to the GFC, arises from “this-time-is-different” syndrome, which is the belief that the recent innovation in financial markets has reduced risk, effectively leaving little to no room for active supervision by regulators32.

In the study of financial crisis caused by some “discontinuous” imbalances in the economy, Alexander and Sheedy (2008, p. 102) argue that credit risk modelling takes centre stage. First, in its own right to be used for efficiently allocating capital to the most productive uses according to the regulatory regime of Basel II and second, as a means to forecast the build-up of a potential financial crisis, which can also be analysed by their inherent dynamics. According to Mishkin (2009), financial crises develop as a result of severe contraction in capital markets characterised by financial-institution failures and sharp declines in asset prices. Asymmetric information33 resulting in “adverse selection” and “moral hazard” explain the subsequent freezing of credit markets after a crisis has been set in motion. Starting in mid-2007, defaults in the sub-prime mortgage market sent a “bad news” signal to the financial markets, ultimately ending up in the worst financial crises since the Great Depression of the 1930s. Allan Greenspan, former Chairman of the U.S. Federal Reserve, called it a

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32 Interestingly, “this-time-is-different” syndrome has existed since long, as evidenced from the excerpt taken from the newspaper published in the lead up to the other big crash – The Wall Street Crash of 1929 and the ensuing Great Depression. The excerpt, which draws a comparison between 18th century “Mississippi Bubble” and the ostensibly good times of early 1920s, is depicted on the title page of this chapter.

33 For a good understanding of the associated concept ‘agency problem’ consult Gitman et al. (1998, p. 21)
“once-in-a-century credit tsunami” (Naylor, 2008). Although, past crises have been less-pronounced compared to the global financial crises (GFC), the world did experience quite a number of them in the past. So, what exactly is different about the GFC is a complicated question, one of particular importance that academics and central bank authorities are now trying to answer. With many financial institutions going bust and significant stall in the credit markets, the sub-prime crisis has completely changed the outlook of money and financial markets (Mishkin 2009). As a result, the study of money and banking has completely changed and is in need of a complete overhaul.

Various studies have been conducted in this domain. The study by Jakubik and Schmieder (2008) investigates the issue of credit-risk modelling under a top-down approach. They have realised credit risk analysis by means of conducting a stress test exercise. Their study compares two countries: a transitional economy (Czech Republic) and a developed economy (Germany), and investigates the macro-determinants of defaults in these two countries. Quarterly data is employed and the observations for the Czech Republic are for 8-years (1998–2006) and 12-years for Germany (1994–2006). The time horizon is selected in such as manner that it includes several severe crises (e.g., the 1997 Asian crisis). They complete their research in three stages: First, they construct separate macroeconomic models for corporate and household sectors of both countries by employing different specifications. The unbiasedness of the model was performed through tests for heteroscedasticity (Breusch-Pagan test) and autocorrelation (by Q-Statistics) in the residuals. In the second stage, a stress-test using various scenarios is constructed for each country. Separate credit models are constructed for corporate and household sectors of the Czech Republic and Germany. The results, on average, validate the previous studies. However, more promising is the corporate sector modelling; the household sector model does not exhibit broad explanatory power, which needs obvious improvement.

In the case of a corporate model, a macroeconomic shock of moderate severity (10% change) has greater impact on the Czech economy (more than 100% increase in default rates and 60% increase in capital requirement) than the German economy (40% increase in default rates and only 30% increase in capital requirements).

34 They have used a moderate (10%) change, a severe (20%) change and an expert judgement scenario. Change here refers to one in the unfavourable direction only.
Although the study provides broader implications for credit risk, the selection of scenarios for stress tests performed to capture adverse macroeconomic shocks are based on arbitrary selection rather than being based on sound macroeconomic foundations. Selection of stress scenarios on this basis are devoid of explanatory power. Alexander and Sheedy (2008, p. 7) has termed them “ad hoc methods of stress testing.” This results in many extreme but realistic scenarios being ignored. It is, therefore, necessary to investigate fat-tails distributions of default events.

Ideally, stress tests should posses:

“An IRB\textsuperscript{35} bank must have in place sound stress testing processes for use in the assessment of capital adequacy. Stress testing must involve identifying possible events or future changes in economic conditions that could have unfavourable effects on a bank’s credit exposures and assessment of the bank’s ability to withstand such changes. Examples of scenarios that could be used are (i) economic or industry downturns; (ii) market-risk events; and (iii) liquidity conditions” (Basel Committee on Banking Supervision 2004b, p. 89).

Alfaro and Drehmann (2009) conducted a critical research on the validity of stress tests. They have studied 43 crises in a group of 30 countries, and found out some interesting facts that underlie the importance of not mis-specifying the model-based approaches of stress tests. The GFC has underscored the importance of applying a holistic macro-prudential approach to financial regulation instead of a micro-driven evaluation of risk. Measuring risk of individual financial institutions and then aggregating it to assess system-wide vulnerability in the economy can hardly simulate a real-world scenario. There are various problems with stress testing approaches. The failure of these methodologies is often associated with ignoring intra-feedback and inter-feedback effects of an economy. The majority of macro stress-tests also use domestic indicators of risk, as cross-border effects of contagion pose important implications for credit risk. Scenarios based on historical perspective do not necessarily translate into an ex-ante estimation of system-wide risk. In the research, a model-robustness check, which is imperative for any stress testing scenario, reveals that in the majority of the cases (about 65%), the hypothetical relationship fades away, especially

\textsuperscript{35} IRB stands for internal ratings-based approach used for credit risk under the Basel II regulatory framework
at the onset of a financial crisis. Stress-test design should possess judgment-based scenarios, apart from working out merely a statistical relationship among determinants of default risk.

Apart from the several issues that can arise in the design stage scenario-based stress tests, they hold good promise for the future development in the area of credit risk management. The importance of stress tests has also been underlined in various research papers of the Basel Committee on Banking Supervision (BCBS). They mention it as an important risk assessment and control mechanism used by banks as part of their own risk models, and in their regulatory environment, e.g., Basel II. It has been found to provide an ex-ante assessment of system-wide risk, with the ability to overcome shortcomings of models that rely on primarily replicated data. “While stress tests provide an appropriate level of capital ... a bank alternatively may employ other actions in order to help mitigate increasing levels of risk” (Basel Committee on Banking Supervision, 2009, p. 1).

The current financial turmoil that started in the U.S., initially led by sharp declines in house prices, has been transformed into a severe credit crunch with substantial losses experienced across equity markets and real sectors of the global economy. The stakeholders expected the benign macroeconomic conditions to last for longer than it actually did. Over-reliance on diversification methodologies alone, and overlooking possible correlation among adverse but plausible events was partly to blame for the Global Financial Crisis (GFC). Inconclusive efforts to stave off possible discontinuous imbalances in the system had taken place in the lead up to the GFC, particularly the Basel II framework of 2004 and the in-house development of risk practices.

### 2.4 HISTORICAL OVERVIEW OF CREDIT RISK

For several decades leading up to early 1970s, there was relatively little interest paid to financial stability (FS) (Goodhart, 2005). That all changed as a result of the mid 1970s banking crisis in Europe and the failure of Franklin National Bank in the U.S., when the Basel Committee on Banking Supervision (BCBS) was formed, and it put in place

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36 For a good discussion of replicated models like Monte Carlo simulation, see also, *An introduction to value-at-risk* by (Choudhry, 2006, p. 102)
in 2004 the Basel II\textsuperscript{37} standards relating to financial stability. Basel II is a risk management framework for FS that aligns regulatory capital to economic capital by way of measuring default probabilities and their linkages to the risk management framework of a country.

It is important that national supervisors (for example, central banks) and academia work in a cohesive manner to explore issues relating to the inter-linkages between portfolio risk and macro risk from the FS point-of-view. It is argued that of the two main objectives of a central bank authority, FS remains a challenge to measure and forecast. While there remains a broader consensus between practitioners and academics on the issue of price stability, the need exists to do a lot more on the FS front. “A stable financial system is a key ingredient for a healthy and successful economy... the Bank’s role is to contribute to maintaining the stability of the U.K. financial system” (Bank of England 2010). The GFC has once again highlighted the complex nature of the latter objective. Goodhart argues strongly for developing a theory of FS instead of taking the industry modelling practices for policy prescription as in the case of Basel II, which he terms as “piggy backing” on the current bank practice on risk management (e.g., value-at-risk, KMV models used by commercial banks) (Goodhart 2005, p.120). There are, however, these problems with Basel II, namely:

1. Portfolio theory interpretation;
2. Asymmetric requirements;
3. Need for a buffer over the required risk premia; and
4. Distinction between expected loss (EL) and unexpected loss (UL).

The issue of cyclicalitiy\textsuperscript{38} arises with Basel II, as risk premia tends to be very unstable: it decreases significantly in benign economic conditions and rises abruptly in times of downturn, disrupting the equilibrium between savers and users of capital and thus, can lead to severe FS issues, if unattended to by the national regulatory authorities.

Aside from the issues that are associated with the Basel II standard, particularly that of cyclicalitiy, it has brought about good risk-management practices in the industry,

\textsuperscript{37} Note that the latest version Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework - Comprehensive Version published in June, 2006 is a compilation of all previous standards including BCBS (2004).

\textsuperscript{38} For a good discussion of pro-cyclicalitiy associated with Basel II (see also, for example (Borio, Furfine & Lowe 2001; Borio & Lowe 2002; Danielsson 2002; Danielsson, Shin & Zigrand 2004)}
especially amongst the less-sophisticated financial institutions. A solution to this problem could be that capital adequacy ratio (CAR) should be linked to asset price changes (CAR should increase as price level rises and vice-versa) instead of risk co-variances, which tend to become difficult to measure, especially as the degree of risk-aggregation (i.e., measuring risk on sectoral or country-wide basis is much more difficult than on a micro or portfolio basis) increases. However, a moral hazard is in order here – linking minimum capital to asset price level can lead to lax lending practices in times of downturns.

2.4.1 RATIONALE FOR THE CROSS-COUNTRY STUDY

The empirical modelling of financial stability (FS), a generalization of which is used in this thesis, relates to mostly Western European countries and North America. For instance, the German central bank (Deutsche Bundesbank) uses a logarithmic model of various macroeconomic variables to forecast future losses of the banking sector. The model employs, for instance, the growth rate as a proxy for capturing the cyclical implications of loan losses (Deutsche Bundesbank 2009). An aggregated approach to FS is also employed by the Bank of England as part of the International Monetary Fund’s (IMF) Financial Sector Assessment Programme for the U.K. (Haldane, Hall & Pezini 2007). Working on a similar concept, Pain (2003) has investigated how the loan loss provision (LLP) parameter behaves around default events, and what are its determinants. LLP can prove to be a good indicator for assessing FS. Under this approach, an aggregate model is constructed using various macroeconomic variables (in this case, real GDP, real interest rates and lagged aggregate lending) to examine LLP of the banking sector of U.K.

While GDP, interest rates and bank lending are all significant factors to explain LLP, banks’ idiosyncratic risk (e.g., concentration in one sector) can also significantly explain LLP.

The relationship of LLP and the macro-economy is realised through a reduced-form lag-distributed model. This is especially useful, if the underlying assumption is that factors entering the model are exogenous, and can address questions relating to the rate of change of indicators and LLP. On the other hand, the structural models are

39 For further details, see also, Jakubik & Schmieder (2008)
good for determining the joint relationship among variables and can potentially answer the questions like why real GDP and LLP move together. It is, therefore, worth comparing Australia, having a sound financial sector structure, with the U.S., which is hard hit by the Global Financial Crisis (GFC). The same can also be realised in the case of developing countries, provided estimation can incorporate the structural differences that may arise.

2.4.2 CONTRIBUTION OF THIS RESEARCH

Research in this chapter provides a basic framework for the stress-testing exercise of the financial system. The importance of this exercise is underlined by Lopez (cited in Alexander & Sheedy 2008) as a means to assess the potential vulnerability of the financial system. In foresight, the journal of Wall Street and Technology (1999) reported Alan Greenspan, the former Chairman of U.S. Federal Reserve, emphasizing the importance of stress tests, one of delegating the responsibility of risk management to the incumbent institutions, and a limited role for the regulatory authorities in the domain of risk management. The stakeholders are to adapt to a new way of thinking about portfolio diversification, and consider adverse events which may not be seemingly correlated, and statistically significant. Scenario analysis can point in the direction of declining asset quality and problems associated with liquidity. According to Alexander and Sheedy (2008), stress tests are used to analyse distribution of losses under a typical value-at-risk (VaR) scenario\(^40\). The contribution of this chapter is that it provides a direct comparison of the U.S. and the Australian economies.

2.5 DATA AND MODEL SPECIFICATION

Quarterly, time-series data for the factors below for the period 1995Q1 to 2009Q2 is used for both countries:

1. Default rate;
2. GDP (growth rate s.a.);
3. Interest rate (6-m Treasury Bill);
4. Industrial production (indexed s.a.); and
5. Debt to GDP ratio.

\(^{40}\) For further details, consult Basel Committee on Banking Supervision (2006)
Two approaches to modelling default risk have been utilised. The first approach is derived from Merton (1974) and Wilson (1997a, 1997b) called a “structural approach.” Wilson (1997a) has tried to explore questions associated with the financial innovations, i.e., how to measure risk on an aggregate level, especially of the derivative instruments. It identifies Expected Loss (EL) and threshold capital as the two most important parameters for capturing credit risk. Pricing of credit risk of derivative products is much more complex than conventional instruments. The underlying assumptions are:

- Actual loss distribution instead of normal distribution is assumed. The shape of the distribution (in this case, skewed and multinomial) is important consideration, as it tends to be dynamic and a function of the degree of portfolio concentration and changes to the portfolio mix;
- Initially, loss(gain) are measured on a discounted basis, and marked-to-market for credit exposures that are illiquid; and
- The loss distribution takes account of the current state of the economy rather than relying only on the ex-post averages. This might under or over estimate the actual extent of risk. Under this approach, the average default rate is related to the state of economy being proxied on GDP and unemployment rate, i.e., default is a function of economic activity: \( df = GDP + u \) where \( df \) represents probability of default, and \( u \) is the unemployment rate. The results show that default rate is well explained by these variables, although sectoral differences might be present. As a probabilistic model is considered in this thesis, a logit is the preferred functional form over a linear or an exponential form: 

\[
p_{jt} = \frac{1}{1 + \exp(y_{jt})},
\]

where \( p_{jt} \) denotes the probability of default of a counter-party in segment \( j \) and time \( t \), \( y_{jt} \) is segment specific index of the macro economy.

The intuition behind the logit model is that it provides a better fit of the model, and for any given value of the index \( y \), it yields a value of the interval \( [0,1] \) necessary for a probabilistic model\(^{41}\). While this research solves the estimation problems of

\(^{41}\) A model that assigns probabilities to likely events which, in our case, is the occurrence (or non-occurrence) of a default event.
heteroscedasticity by running a weighted routine of Ordinary Least Squares (OLS), Wilson (1997b) focuses on how best to use it to explore the loss distribution of a hypothetical portfolio of risk exposures. The following assumptions are in order:

- The economy can take one of the three forms: expansionary (where growth of +1% or more is considered), average (growth of 0%); and recession (growth of minus1%);
- Probability of default for each segment is represented by, say, a beta measure of systemic risk, which, however, in this case is assumed to represent economic cycles instead of equity prices; and
- Estimation of the actual loss distribution for the portfolio.

The assumption of a constant volume of recovery in the event of default is somewhat unrealistic, as it will primarily depend upon the individual security (agent). A solution to this is the simultaneous simulation of defaults and recovery rate by using, for example, credit ratings.

The reverse side of this is that a random selection of the recovery distribution is used to achieve a reliable estimate of loss in the case of default. It is argued that in the case of some assets types (e.g., mortgages), recovery rate is highly negatively correlated with the probability of default (PD). The argument used here is that residential homeowners rarely default on their mortgages when there is significant equity at stake. Interestingly, this coincides with Merton’s (1974) idea, which considers default as a put option. It is exercised if the value of a particular asset goes down an assumed threshold, otherwise the option buyers do not exercise their right and let the default event occur.

The second strand of models called “reduced form” involves pricing of credit derivatives from the term-structure of interest rates. In the reduced-form model, the relationship among indicators tends to significantly weaken as evidenced from both theory and practice (Alfaro & Drehmann 2009). This is because these models are based on the assumption that, actually, abrupt change in investor behaviour, whether as a result of change in the macro fundamentals or speculative bubbles, causes financial crises.

42 See also, Jarrow & Turnbull (2000)
Let us assume that asset returns are normally distributed, i.e., \( R_{it} \sim N(\mu, \sigma^2) \) where \( \mu \) and \( \sigma^2 \) are mean and variance, respectively; then
\[
R_{it} = \sqrt{\rho F_t} + \sqrt{1-\rho} U_{it}
\]
Equation 2-1
where \( R_{it} \) denotes asset return of a homogenous firm \( i \) in the economy and \( F_t \) represents aggregate return of an economy. \( U_{it} \) denotes firm-specific return and is assumed to be random and standard normally distributed. Market risk is modelled by \( \rho \), which is correlation between returns of the firm and aggregate economy.

According to Cihak (2007b), the most popular credit risk model is that of Merton (1974), which considers default as an option, exercisable if the asset return falls below a certain threshold, \( T \).
\[
P(Y_{it} = 1) = P(R_{it} < T)
\]
Equation 2-2
where \( Y_{it} \) denotes a binary variable with two possible states: borrower defaults (1), and no default (0), respectively. \( R_{it} \) denotes asset return while \( T \) is the default threshold.

Credit risk is arguably the most important aspect in the study of financial stability (FS). This is underlined by Lange et al. (2007, p.556) who state “credit risk is still more likely to cause a financial institution to fail than either interest rate risk or foreign exchange (FX) risk.” While other risks types are important, the focus of research in this chapter will be credit risk. In this regard, while Merton (1974) uses market prices as a proxy for default, Wilson (1997a, 1997b) explain default as a logit function of a vector of various macroeconomic factors. The same methodology is adopted in this chapter. However, since aggregated default rates are used in this research, continuous variable estimation methodology is preferred for the purpose.

The generalisation of the Jakubik and Schmeider (2008) model for estimation of default is derived from Eq.(1) and Eq.(2) above:
\[
P_{(\cdot \cdot)} = P( \sqrt{\rho F_t} + \sqrt{1-\rho} U_{it} < \alpha_0 + \sum_{j=1}^{k} \alpha_j X_{jt} )
\]
Equation 2-3
Eq. (3) is re-arranged as:
\[
df_t = f(C + \sum \alpha_j X_j)
\]
Equation 2-4
where $df_t$ denotes the response variable of the model and is defined as the ratio:

$$df = \frac{\text{non-performing loans}}{\text{total loans}}$$

The default rate is based on non-performing loans (NPL), $\alpha$ is the coefficient vector, $X_i$ is the vector of the macroeconomic variables, and $C$ is a constant. Previous studies have found various macroeconomic variables to be useful determinants of credit risk (Virolainen 2004). However, relatively very few macroeconomic factors can explain credit risk in a rational manner, including in times of financial downturns.

We find GDP, the interest rate, industrial production, and the level of debt as macroeconomic factors useful in the context of financial stability. These factors are discussed in detail in section 2.6 on empirical results. The choice between the aforesaid models would, however, should be based on an interactive stress-testing process involving both the banking sector and the regulatory regimes, with less dependence on the complexity involved in the models (Haldane, Hall & Peziini 2007). Generally, the model can take numerous macroeconomic factors as useful determinants of credit risk. For instance, for a developing economy with capital controls in place, the exchange rate is a very useful factor for such methodology. So the choice of any particular factor for this methodology is broadly consistent with the structure of the economies considered in this thesis. A corollary from this is that interest rate would be more important in an economic setting aligned to inflation-targeting central banks. Similarly, because Australia has floated its dollar since the early 1980s, the research would not focus on exchange rate in the model specification.

The empirical model for the developed economy is described as follows:

$$df_t = C + \alpha_1 IR_{t-1} + \alpha_2 GDP_{t} + \alpha_3 INDPROD_{t-3} + \alpha_4 DEBT_{t-4} + \epsilon$$

Equation 2.5

**2.5.1 ESTIMATION OF MODEL**

The approach used here defines default as having only two possible states: 1, denoting *default* and 0, denotes *no default*. Binary choice estimation\(^{43}\) offers the best fit for the model depending on whether macro or micro determination of credit risk is required.

According to Cihak (2007b), generalization of this approach is adopted by the finance

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\(^{43}\) A good survey on binomial models is given in (Hock & Elliot 2006)
industry in the form of Credit Metrics and KMV. A derivative of the same approach can be estimated using a logit function with various macroeconomic factors. Based on aggregated approach to credit risk, grouped binary estimation is used in this research.

2.5.2 TESTING PARAMETERS OF MODEL

The time series data used in the estimation was assumed to be stationary. The Augmented Dickey-Fuller test also indicates the same result. The Breusch-Pagan test indicates no heteroscedasticity. Moreover, autocorrelation was present in the residuals, as indicated by Breusch-Godfrey (BG). This violation was overcome by running a weighted routine instead of equal weighting for each observation44.

2.6 EMPIRICAL RESULTS OF THE AUSTRALIAN MODEL

Table 2.1 below describes the variables used in the model along with their time lags, coefficients, significance levels, and the standard errors (further details about the choice and behaviour of the variables are provided in Section 3.5 of Chapter 3, and in Appendix 2-3 and 2-4 at the end of the thesis). The growth variable is highly significant, having negative correlation with the default rate. The short-term interest rate (real) has a negative coefficient, but is insignificant along with industrial production as a cyclical indicator. The level of debt in the Australian economy, as indicated by the debt-to-GDP ratio is positively correlated with the default rate, \(df\) and is highly significant. Overall, the fit of the model as indicated by adjusted \(R^2\) is significant in explaining the default rate.

44 Baum (2006) provides a good resource on Weighted Least Squares (WLS) estimation methods.
TABLE 2-I  
Credit Risk Estimation for Australia

(Dev. Variable: default rate)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Notation</th>
<th>Lag</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>GDPG</td>
<td>0</td>
<td>-0.00006***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.00000752)</td>
</tr>
<tr>
<td>Interest rate</td>
<td>IR</td>
<td>1</td>
<td>-0.0528876</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0.0368063)</td>
</tr>
<tr>
<td>Industrial Production</td>
<td>INDPROD</td>
<td>3</td>
<td>0.0406253*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0153443)</td>
</tr>
<tr>
<td>Debt-to-GDP</td>
<td>DEBT</td>
<td>4</td>
<td>1.118836***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.1721657)</td>
</tr>
</tbody>
</table>

Obs. 53  
Prob > F 0.0000  
Adj R2 0.8327

Note: Standard errors are in parentheses. ***, **, * indicate 1%, 5%, 10% levels of significance, respectively; estimation has a constant term and a dummy for structural change.

2.6.1 DEFAULT RATE: AUSTRALIA

Figure 2.1 below shows the performance of our model for Australia’s default rates covering the period 1995Q1–2009Q2. The graph indicates that non-performing loans (NPL) initially fall rapidly until the beginning of the new millennium, then decline slowly until early 2005 after which default rate begins to accelerate in their rate of decline until the end of 2007, finally increases rapidly in the mid-2009. The onset of the rapid expansion in the availability of household credit over the latter period of our study has clear implications. For example, an increasing debt-repayment burden of households which, if coupled with liberal lending practices, can lead to large-scale bankruptcies, as indicated by an increase in default rates from 0.2% (mid-2007) to 0.7% at the peak of the Global Financial Crisis in mid-2009. The late 1990s clearly
indicate a rapid decrease in default rates, as suggested by a decline from 1.5% in
beginning of (1995Q1) to a low level of 0.2% (2007Q2), primarily because the
economy was starting to recover from the recession of the mid-1990s
2.6.2 **EMPIRICAL RESULTS FOR THE U.S. MODEL**

Table 2.2 below indicates the relevant variables used in the estimation of the model for the U.S. economy over 1995Q1–2009Q2 along with their coefficients, lags, significance levels, and standard errors. As expected, the GDPG variable has a negative effect on default, and is highly significant in explaining aggregate default rate over the period. The explanation for this is that during high growth periods, companies’ earnings increase, leading to the stronger financial position necessary for repayment of debt-payments. So, generally, with strong growth outlook, credit risk lowers. The same effect is clearly evident from the empirical findings here.
TABLE 2-2
Credit Risk Estimation for the U.S. Economy

(Dep. Variable: default rate)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Notation</th>
<th>Lag</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>GDPG</td>
<td>0</td>
<td>$-1.98e-06^{***}$</td>
<td>(1.22e-07)</td>
</tr>
<tr>
<td>Interest rate</td>
<td>IR</td>
<td>1</td>
<td>$-0.0151588^*$</td>
<td>(0.0104201)</td>
</tr>
<tr>
<td>Industrial</td>
<td>INDPROD</td>
<td>3</td>
<td>$0.0111739^{***}$</td>
<td>(0.0049233)</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt-to-GDP</td>
<td>DEBT</td>
<td>4</td>
<td>$6.248025^{***}$</td>
<td>(0.2901925)</td>
</tr>
</tbody>
</table>

Obs. 54
Prob > F 0.0000
Adj R2 0.9020

Note: Standard errors are in parentheses. ***, **, * indicate 1%, 5%, 10% levels of significance, respectively; estimation has a constant term and a dummy for structural change.

The real interest rate and industrial production variables are either insignificant or have unexpected effect on default, and hence been dropped from the final specification of the model. On the other hand, the level of debt represented by the Debt-to-GDP ratio has a positive sign and is highly significant in explaining the default rate for the U.S. economy. The explanation for this is that in the long-run, excessive leverage increases borrowers’ burden of interest payments and thus, can significantly increase the chances of default. The fit of the model, indicated by the adjusted $R^2$ measure, is significantly higher in the case of the U.S. economy than that for Australia.

2.6.3 DEFAULT RATE: USA

Figure 2.2 below shows the performance of the macroeconomic model of default for the U.S. economy, where the default rate is plotted along the y-axis and time against the x-axis. The fit of model looks promising as the estimated default rate tracks closely
the observed delinquency rate. The estimated default rate clearly shows an increasing trend, as it remains flat at 2.5% until 2001, and spikes before going down to its lowest level of 0.6% at the end of 2005, rising again sharply to its highest level of 6.5% during the peak of the GFC in mid-2009. The model also has good predictive power, as the estimated inflow of defaults has risen above the observed delinquency rate in 2009.
We considered bank lending to firms and households separately by utilising bank lending to GDP ratio, using the IMF estimates of banking sector’s claims on the domestic private sector. The increase in bank lending appears to have been driven primarily by a succession of bank lending booms as documented by Hume and Sentance (2009). However, informed by historical records, the most recent boom between 2003 and 2005 appears unique to the U.S., where the increase in bank lending ratios has been greater than average. Based on the above analysis, it seems reasonable to conclude that the acceleration in default rates for the U.S., beginning in mid-2007, was in large part due to the historically high growth in the use of private sector credit with a pronounced rise in household sector credit. In the latter phase, the magnitude of the rise in credit or the rise in default ratios is not mirrored either in the Australian household or in the firm credit ratios. The bank-lending boom in the U.S. market had several contributing factors. It is argued that a major portion of external capital inflows into the U.S. economy was invested in financial assets, spurring a wealth-consumption spiral there. In the U.S. and European financial centres, scale efficiency in the wealth-generation process was later achieved through increased
securitization and excessive leverage, leading to ever-higher levels of debt being accumulated by borrowers, namely sub-prime household borrowers pursuing wealth through the housing market. The credit-price channel is relatively straightforward in the real estate sector with no margin restrictions, in contrast to equity markets. Unsustainable levels of leverage ultimately went from a housing “bubble” to a complete collapse in the shape of the GFC.

2.6.4 ELASTICITY FOR THE INCLUDED FACTORS

Table 2.3 below shows elasticity measures for both countries. As the relationship among the variables is non-linear, a caution is in order to explain the effect of independent variables \(X_i\) on the default rate \(df\). In this case, the mean-elasticity approach is utilised to overcome the problem of how one explains elasticity in the context of a non-linear model. The following equation is being utilised to calculate mean elasticity.

\[
E_i = \frac{\partial df}{\partial X_i} = \frac{\partial\psi(C + \sum_{i=1}^{k} \beta_i X_i)}{\psi(C + \sum_{i=1}^{k} \beta_i X_i)} = \beta_i \phi(C + \sum_{i=1}^{k} \beta_i X_i) \frac{X_i}{\psi(C + \sum_{i=1}^{k} \beta_i X_i)}
\]

Eq. 2-6

As we observe from Table 2.3, growth rate has a negative effect on default rate for each of the two economies considered; we also find that the U.S. default rate is much more sensitive to adverse macroeconomic shocks than in the case of Australia. Similarly, a relatively large coefficient for the DEBT variable for the U.S. shows more sensitivity to default rates than in the case of the Australian economy. The negative effect of higher-debt levels was particularly evident from the high toll the GFC has taken on the U.S. economy. Some of the ramifications of this might be that bank regulators in the major economies would have to introduce tougher regulations to discourage excessive leverage, curtailing permissive credit standards, generally witnessed in the deficit countries, such as the U.S. Already, in the aftermath of the GFC, governments around the world have introduced regulations that are aimed at tackling the issue of excessive risk-taking and rising leverage: the U.S. now has in place what is called a systemic regulator (Financial Stability Oversight Council) that would regulate non-depository financial firms, and also monitor systemic risk. Similarly, the latest version of the Basel
regulatory framework called Basel III, which the G-20 countries agreed to implement in their banking system, will significantly increase common equity requirements for banks, effectively discouraging the build-up of bubbles in the asset markets.
TABLE 2-3

Elasticity for Australia and the U.S. Economy

<table>
<thead>
<tr>
<th>Variable</th>
<th>Elasticity</th>
<th>Variable</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>-3.77</td>
<td>Growth rate</td>
<td>-4.72</td>
</tr>
<tr>
<td>Interest rate</td>
<td>-2.8924</td>
<td>Interest rate</td>
<td>2.006</td>
</tr>
<tr>
<td>Industrial Prod</td>
<td>0.213206</td>
<td>Industrial Prod</td>
<td>-1.518</td>
</tr>
<tr>
<td>Debt-to-GDP</td>
<td>11.92164</td>
<td>Debt-to-GDP</td>
<td>12.966</td>
</tr>
</tbody>
</table>

2.7 ANALYSIS

The elasticity calculated here corresponds to the coefficients of the estimated parameters of the model. Economic expansion will influence default rate for the aggregate economy as demand for goods and services increase. Accordingly, increased profitability decreases default rate. GDPG with a positive coefficient turned out to be a significant factor in explaining default risk in the case of both countries. This is consistent with the view of Moody’s (cited in Jarrow & Yu 2001) reports on historical default rates; it is argued that cyclical indicators are highly correlated with the number of defaults, the number of credit rating downgrades, and credit spreads. Regarding Debt-to-GDP ratio, weakness in the aggregate economy would depend on the level of indebtedness. The magnitude would thus, depend on the correlation between leverage and probability of default. This will occur in the case of a macroeconomic shock like an increase in the debt-to-GDP ratio. As expected, debt has a positive effect on default rate in the case of both models. Although, interest rates, generally, have a positive influence on default risk, this was not the case here. This is so because short-term (6-month) interest rates instead of longer-term interest rates are used here. This view is

45 The alternative argument by Grossman and Hart (cited in Lange et al. 2007) states that flip side of high leverage may be that of managerial efficiency which can lead to a reduction in the level of default risk.
also expressed in a recent study by the German Central Bank: “The one-year interest rate, by contrast, reflects the economic setting...its sign is therefore negative” (Deutsche Bundesbank 2009, p. 59). One implication of this can be advanced from the cost-efficiency perspective, that is, if short-term interest rates increase, borrowers would tend to deleverage while the majority of them may still be able to draw on their savings and other long-term benefits for timely payment of rising interest payments on loans. Unlike other factors, industrial production being cyclical and forward-looking variable is significant, but has an unexpected positive influence on the default rate. This factor was, therefore, excluded from the final specification of the model.

### 2.8 CONCLUSION

In this chapter, the growth rate, short-term interest rates, and total indebtedness explained default risk in a more meaningful way than industrial production did. The default rate for the U.S. economy is, *ceteris paribus*, much more sensitive to changes in GDP, interest rates, and total Debt than in the Australian case. Research in this chapter explains the dynamics of defaults using limited parameters, namely delinquency rates and several macroeconomic factors that play an important role in the determination of credit risk.
Chapter 3

STRESS TESTING THE AUSTRALIAN BANKING SECTOR

3.1 INTRODUCTION

The use of simulation of extreme but plausible circumstances has existed for a long time. In its earliest form, war games of all sorts were used to prepare for unforeseen circumstances.

The use of such techniques in business, government and other organisations, however, is relatively recent. The first such case was in the oil exploration industry. In the early 1980s, Shell oil developed various scenarios to assess the damage of a hypothetical decline in oil prices on its operations. When the slump in prices did occur in the mid-1980s the company did far better than its competitors, although it was still affected by the crisis.

The success of stress testing lead to significant developments in the way stress tests are conducted, with adoption by business, finance and insurance companies later on. It is now widely accepted as standard for identification and management of credit and other risk in the business industry, especially banking and finance. The developments also had implications for economic policy and the best practices were also incorporated into the regulatory regimes.

Later in 1999, the IMF and the World Bank as part of their financial stability and cooperation mandate rolled out stress tests in various jurisdictions participating in the financial stability assessment programs (FSAP). This was a commendable effort on global scale as previously, stress tests were only practiced by internationally active banks as part of their risk management framework.

The more and more central banks are delegating their traditional role – as a supervisor of the financial system – to their supervisory counterparts, the less they have to rely on direct tools, such as monetary policy to achieve the objective of financial stability. This
has important implications for the financial system, as central banks have to think of alternatives to make the system more resilient to adverse conditions. A lot now depends on how to effectively communicate with both public and private market participants to achieve common benefits. The promise this new form of market discipline has is clearly evident from the numerous publications on financial stability these days. While it is still not entirely obvious where the objective of financial stability stands in the policy list of some of the central banks, it is rather more important to have a clear understanding of how adverse economic conditions and other factors affect the financial system's ability to have uninterrupted provision of its services to the system.

This chapter extends the credit-risk model developed in Chapter 2 by providing a stress test exercise of the parameters already obtained. From a technical perspective, the historical quantile of the various macroeconomic factors considered for credit risk are jointly affected by an exogenous shock, providing a hypothetical but plausible credit loss scenario for Australia and the U.S. The exercise has important implications, as it can be utilised for credit-risk forecasting based on either individual-bank level or aggregate level for the financial sector as a whole.

Section 3.2 discusses different approaches to stress testing, followed by Section 3.5 which discusses stress-test methodology, and the last section discusses empirical findings of the exercise and conclusion.

**3.2 LITERATURE REVIEW**

The GFC has underscored the importance of timely anticipation of potential risks, as the unwinding of the sectoral imbalances had catastrophic consequences for the entire financial system. This makes the issue equally important for both private and public sectors. While the private sector is willing to keep strong safeguards against future losses, they had been particularly less successful in analysing risk that may arise due to the presence of feedback and spill over dynamics within the financial system, and between the financial and the real economy. As for policy implications, leading central banks have been trying to develop a framework that assesses the impact of credit risk on financial stability efforts.

The starting point in this discussion is usually the identification of sources of potential risks. The process for identification of possible sources of risks has been actively
debated. Two classifications emerge from this discussion: one that is based on the impulse or shock that might initiate the risks involved while the other classification is based on risk categorization, for instance, those defined in the regulatory standards, such as Basel II. The schematics of stress testing involve various stages which are identified in the Figure 3.1 below.
Stress-testing or scenario analysis is accomplished by linking various macroeconomic factors with bank-specific factors such as historical default rates. Stress testing practices which initially started as part of the IMF’s financial sector assessment programs (FSAP) at various central banks, have now become an essential tool for monetary policy. In this exercise of macroeconomic stress testing, two different approaches are used to see the effects of shocks on both economic conditions and financial variables: structural models (such as dynamic stochastic general equilibrium, DSGE) and vector autoregressive model (VAR) or vector error correction models (VECM).

The current regimes of structural models that are used for monetary policy forecasts by central banks have been extended to be used for stress testing. Under this approach, various exogenous shocks are assumed, and translated to forecast various variables. These models may also incorporate the endogenous effect of regulators’ responses to the adverse movements. They produce largely consistent outcomes for the scenarios considered for the purpose. Initially the central banks used their in-house macroeconomic models for stress testing, but later upgraded them to incorporate the effects of cross-border liquidity and systemic risks, as they realised the urgent need for doing so. This latest development may be attributed to the fact that in a globalised
world, free movement of capital now accounts for a significant portion of international commerce and trade.

3.3 SYSTEMIC STRESS TEST
A typical stress test and its schematics are explained as part of Figure 3.2 below. In its simplest form, it is considered to have originated from the existing analytical risk-management framework employed by banks and a large number of regulators.

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46 This is clearly evident from the fact that cross-border FX transactions account for 65% of the total volume traded in April 2010 (Triennial Central Bank Survey, BIS, September 2010).
At the heart of this risk management framework are credit and market risk exposures. Credit risk arises from the borrower’s probability of default to repay the interest, or principal on the loan. While credit risk has only one source, market risk can emanate from several factors, such as volatility in the markets for equity, commodities or foreign exchange, or even changes in bond yields. Systemic risk can be thought of as the sum total of risks of all depository and non-depository (intermediaries) institutions. These risks are derived from the trading books of commercial banks, or in the context of regulatory supervision, the risk of the banking sector as a whole. The model assumes that these dynamic exposures are driven by some stochastic factors. The significant part of the methodology is devoted to the data generating process and how it encapsulates the correlations of systemic risk factors among themselves and across time. Lastly, in order to quantify the total risk, it captures the impact of systemic factors on these exposures. The validation process which involves generating various scenarios determines the suitability of a particular specification of the framework.

For banks, the identification process of relevant risk factors is relatively easily achieved by considering their trading book credit or market exposures. On the other end of the spectrum are central banks, which consider the identification phase of the systemic-stress process, a difficult one, as they scramble to identify the more important sources of systemic risk. In order for the central banks’ financial stability (FS) objective to have...
a pragmatic approach, Drehmann (2008) has proposed to evaluate risks for the banking system as a whole, primarily because banks play an important role in the circular flow of money system in a model economy, and feedback effects generated by adverse shocks. Drehmann notes that the current methodology is more domestically focused, primarily because of data limitations. This argument is largely valid, but the shortcoming can be overcome, possibly by using some credit risk measure such as Libor-OIS\textsuperscript{47} spread.

Another strand of models (with common trend structures) that does not require many theoretical assumptions is a vector error correction (VECM), or vector autoregressive (VAR) models. These models are best when dealing with non-stationary times series, and with longer forecasting intervals. In this set of models, macroeconomic variables are affected by an exogenous shock, and the vector process is used to forecast the aggregate response of these variables. As no structure is required to be specified in these models, their application is relatively straightforward, making these models popular among central banks, such as the Bank of Japan and the European Central Bank. These models are used to project the effects of joint shocks of various time series variables over a specific time horizon. These models have particular appeal with central banks, as they take less resources and simpler to adopt.

There are some other approaches which are based on purely econometric underpinnings, and used by just a few central banks, but they do not have wide-spread use, as they lack theoretical foundations which are at the heart of the macroeconomic stress testing regimes.

Mapping models that assume only exogenous factors, notwithstanding, are less successful, as they ignore feedback from regulatory response. Unlike their structural counterparts, these models can be applied to micro-level data (Foglia 2009). Another potential problem is the use of linear form for macroeconomic credit models. Small shocks may have linear effects, but tail risks (for example, asset price volatility during the GFC) could have non-linear effects that require appropriate higher-order-specification for modelling defaults. This transformation of credit risk is widely used to capture the increase in risk sensitivity as a result of asymmetric shocks when an

\textsuperscript{47} Libor stands for London Interbank Offer Rate published by the British Bankers’ Association. OIS stands for Overnight Indexed Swap. It has reference to the Libor-equivalent Federal Funds rate. The spread is widely used as a measure of relative riskiness of international markets.
economy is experiencing extreme macroeconomic conditions. Misina & Tessier (2008) have illustrated why a higher order approximation is necessary when hypothetical shocks are usually quite large. In order to get response approximations with characteristics more appropriately aligned with the stress testing methodology, the assumption of linearity has to be relaxed. Misina & Tessier have suggested quadratic or possibly, cubic functions for assessment of true risk parameters. Nonetheless, this classification is either very exhaustive or very broad-based. Thus, it is difficult to derive any meaningful understanding from this classification. Haldane, Hall & Pezzini (2007) suggest an alternative approach that is based on structural analysis of long-term economic conditions affecting financial system. It is important to identify and assess risks, their associated transmission channels and the impact on the financial system. Figure 3.3 below illustrates how this feedback dynamic works.
A systemic approach to the mapping scheme in figure 3-3 above is based on the development of the transmission mechanism for risks that cause financial fragility, that is, a trigger mechanism has to be identified first. There are several possible components to such a mapping framework. It is relevant to ask: what are the possible triggers or “shocks” that might cause financial fragility? What segments of the financial system would be affected initially, and the side-effects that might be involved in this process. Finally, the aggregate total of all the risks might crystallise as fragility in the financial system and possibly, affect the real sectors of the economy as well. Observe in Figure 3-3 above, the triggers or shocks can be classified as two types: real and financial. Further, triggers are differentiated as either systemic (aggregate) or individual. The shocks represent themselves through asset prices, ultimately funnelling to form various risks. Finally, there might be interaction or feedback effects, i.e., in a
severe crisis, there might develop a vicious trigger–asset-price–fragility loop. In worst cases, the trigger might sever the critical financial-intermediation link that is vital to the efficient functioning of financial markets and risk intermediation.

Cihak (2006b) has analysed financial stability reports (FSRs) used by various central banks, and found them to be a useful new tool in the central bank arsenal meant for the purpose of financial stability. However, FSRs lack in certain areas (such as systemic risk) which may induce triggers, such as contagion and spillover. It is suggested to follow a framework based on clarity, consistency and coverage or CCC-approach. This seems reasonable, as the current regulatory standards, especially Basel II is less capable of considering the effect of systemic risk. Due to their relative success with FSR, more and more central banks are adopting these reports, and some are also publishing stress testing exercise. It is, however, not obvious whether making such information publically available would always have positive externalities, as some commentators, such as Mervyn King, The Bank of England governor, have questioned the idea that information regarding financial stability be available on ex-ante basis. This counter argument can be backed by practical experience, for instance, during the GFC some central banks such as the Bank of England were not willing to disclose details of banks that needed bail out support from the government. Central banks argue that “stigma” may be attached to these bail out programs, such as the troubled asset relief program (TARP), that might cause further lowering in market sentiment, especially detrimental in times of severe market turbulence.

Sorge (2004) has surveyed48 the latest assessment methodologies available to central banks. The techniques are largely successful in our understanding of systemic risk dynamics, but challenges remain, especially the problem relating to how credit and market risk correlation move over time, and across different counterparties in the market? Sorge has identified several methodological problems in accurate assessment of risks. This research largely agrees with Sorge’s rejection of the current “additivity of risk” approach where banks simply add results of various individual models for each function (say, market risk, credit risk, etc.), and the sum total is used as a measure of systemic risk. Instead, we should have a parsimonious model that encompasses all major sources of risk.

48 For current approaches at selected central banks, See also, appendix 3-1.
The current projection duration of possible losses, as used in a standard stress test exercise is set lower, as we expect the economic conditions, and the associated sectoral imbalances (both real sector and between real and financial sector) to persist over longer periods, possibly a decade. It is imperative to understand that macroeconomic innovation (shocks) may be auto-correlated that demands utilising dynamic determination of the constituent risks. Moreover, the issue of feedback effects of portfolio re-balancing in downturns needs particular attention from the regulators. The current methodologies, for the most part ignore the effect portfolio diversification practices by financial agents might have on equilibrium market prices, or economic conditions. An integrated approach that uses early warning indicators similar to those provided by the IMF, and adverse scenarios holds future promise.

Stress tests are out of their infancy stage, as they have found use both in the risk framework of individual banks and the policy tool kit of the central banks. However, we are yet to witness any significant debate as to what are the underlying objectives at the heart of these quantitative methodologies. Because policy objectives determine a significant part of the methodological outcomes, it is imperative to have a consistent view of them across institutions and markets. According to the IMF (cited in Drehmann 2008, p.3), stress tests should ideally have “an integrated forward looking perspective, a focus on the financial system as a whole and a uniform approach... across institutions.” This is, however, not the case and we may see different financial stability objectives adopted at various central banks. Drehmann sees a potential conflict between the key objectives of stress test: to assess the impact of adverse but plausible shocks on systemic risk, and the current methodologies. Analysts face two important challenges: data limitations and feedback effects of monetary policy. This inherent conflict may arise because model-use may be either external or internal. Central banks might be interested in external communications, which requires more transparency. On the other hand, internal models are driven by decision-making and validation, or back-testing considerations. These overarching distinct objectives may, at times, be in conflict with each other. This is summarised in Figure 3.4 below.

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49 See also, National Bureau of Economic Research (NBER) publications, Romer & Romer (1997); Taylor (1999); Bernanke & Woodford (2004), etc. on business cycles.
Gray, Merton & Bodie (2007) have extended the traditional Merton (1974) model of option pricing to analyze risks on an aggregate level. A contingent claims analysis (CCA) approach is used to assess the side effects of shocks to balance sheet items, which are assumed to correspond to sectors within an economy. The approach is well suited to assess and simulate contagion and other spill over effects of policy decisions by regulators. Due to its ability to be aggregated, the approach merits use for systemic-risk assessment.

Nevertheless, the notion of inelastic expectation about interest rates, or a threshold (as in CCA approach), postulated by Keynes as “liquidity preference” theory discussed in his 1936 book “The General Theory of Employment, Interest and Money,” does not hold well, especially in an economic downturn. Tobin (1958a) has argued against the liquidity preference schedule proposed by Keynes. Interest rates are rather independently determined on the basis of future uncertainty: if uncertainty increases, the demand for cash will increase and vice versa. This approach seems more pragmatic, as investor expectation during periods of increased uncertainty, about halving the return is just as likely when the rate is 3% as when it is 6%. Thus, a change in the expected return is not hard wired according to a set benchmark, as suggested in the extended version (CCA) or threshold model.
3.4 DYNAMICS OF SIMULATIONS

The process of stress testing starts usually by identifying potential risks to the financial system. This might involve some classification such as micro-level risk, which underlies various risks at individual institutions, and systemic risk, or aggregate risk. While most of the existing regulations are firm-focussed, it is systemic risk that involves complex assessment of the path-network for risk involved. Thus, there should be greater emphasis on estimation of possible risk to the system as a whole. Some of most common systemic risks documented in the literature are interest rate, output, inflation, foreign exchange rates, and commodity prices, etc.

3.5 DERIVATION OF STRESS-TESTING EXERCISE:

The credit model developed in Chapter 2 has been used to identify potential risks to the economic system.

\[ df = f(C + \sum \alpha_i X_i) \]  

Equation 3-1

where \( df \) is the default rate, used as proxy for credit risk, and is modeled as a function of a vector of various macroeconomic factors, such as GDP growth rate, interest rate, inflation, industrial production, level of indebtedness, etc. This chapter has considered various macroeconomic factors, depending on what factors are more important for a particular economy. Macroeconomic stress-tests are also used by the Bank of England (BOE), which considers the growth rate, short-term interest rate, and equity returns in its stress testing framework.

Next, the model parameters are used to simulate their transmission mechanism, explaining the evolution of defaults in the two economies considered, i.e., Australia and the U.S.

The stress testing methodology is outlined below:

- First, the stress test exercise starts usually with the parameters of an estimated model. Since we already have the parameters of a credit risk model from chapter 2, we would use the same model as a baseline for default rates in both countries.

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50 For a discussion of systemic risk, see also, Chapter 2 on “Credit risk.”
• Second, a stress scenario has to be constructed. In our case, we define such a scenario as Moderate stress (MS) and Severe stress (SS), with adverse change in the predictor variables to the tune of 10% and 20%, respectively.

• Third, a baseline scenario is defined which in our case is 1st quarter of 2009. The rationale for our baseline scenario is that it encompasses at least two periods of turbulent macroeconomic activity, namely the currency crisis of 1997 and the GFC.

• Finally, the default rate is forecasted by applying MS and SS shocks to the historical quantiles of the predictor variables. The projected default rate gives use valuable insight into the extent of credit risk increasing as a result of adverse conditions as in a downturn.

3.6 CONSTRUCTING SCENARIOS

Finally, we construct macro-economic shocks, which are the equivalent of stress testing the financial systems for the presence of potential weaknesses. The scenarios should be carefully selected from available options like replicated, or historical data, as suggested by (Jakubik & Schmieder 2008; Sorge 2004). We use 2009Q1 as a base year and assume a one-year time horizon for forecasting of defaults.
Table 3.1 above outlines the empirical findings of the stress test conducted in this chapter. The stress-test framework discussed here has these underlying assumptions in order:

1. For comparison purposes, the quantiles of all macroeconomic variables for year 2009Q1 have been assumed to be a baseline scenario;

2. Next, the size of shocks has been calibrated as two distinct scenarios: moderate stress (MS) and severe stress (SS), representing an adverse change of 10% and 20%, respectively, in all the macroeconomic factors. The design of these scenarios depends on how large an economic downturn is anticipated, based on the time horizon considered. So, for instance, if a recession in a particular country during the last ten years has had the effect of 20% decline in macroeconomic indicators, a stress test based on similar, or even more conservative estimate would be a good approximation of extreme but plausible adverse events in the future.

51 Same Credit-to-GDP ratio is used in both scenarios as it is already at the 100% level.

52 MS and SS represent moderate stress (10%) and severe stress (20%) change in the unfavourable direction in the historical quantiles of all factors.
3. Lastly, the overall effect of shocks (MS and SS) on the credit risk is assessed through the use of interpolation.

The results in Table 3-1 above show that the default rate does not change significantly (only 4%) in the case of moderate contraction in output, but almost doubles in the case of severe decline in output in the Australian economy.

The stress-test framework discussed as part of Table 3-1 above is also utilised in the case of macro stress-test for the U.S. economy, based on similar underlying assumptions as in Section 3.6 above.
### TABLE 3-2
Macro Stress Test of the U.S. Economy (Aggregate)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>GDP growth rate (%)</th>
<th>Real interest rate (%)</th>
<th>Industrial production</th>
<th>Credit-to-GDP ratio</th>
<th>Default rate</th>
<th>Relative change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual (2009Q1)</td>
<td>-2.4</td>
<td>1.86</td>
<td>100.83</td>
<td>1.83&lt;sup&gt;53&lt;/sup&gt;</td>
<td>4.96</td>
<td></td>
</tr>
<tr>
<td>MS10% Δ</td>
<td>-2.61</td>
<td>2.3</td>
<td>97.09</td>
<td>1.83</td>
<td>7.69</td>
<td>55%</td>
</tr>
<tr>
<td>SS20% Δ</td>
<td>-2.87</td>
<td>3.71</td>
<td>95.94</td>
<td>1.83</td>
<td>12.25</td>
<td>147%</td>
</tr>
</tbody>
</table>

Table 3.2 above shows that default rate significantly increases (by 55%) even in the case of moderate stress. The explanation for this is that U.S. firms, especially investment banks and securitized entities, run significantly higher levels of leverage compared to Australian firms. Although high level of debt tends to increase operational efficiency, it also increases credit risk, should problems develop in the financial markets, or the broader-economy. A second dynamic of the increase in credit-risk in the U.S. is from the credit-grating-standards view. In Australia, low-quality loans account for less than 1 percent of outstanding housing loans, with almost all of these loans granted by non-depository institutions. Moreover, Australian households also experienced high wealth-to-earnings ratios since the late 1990s, which has significantly improved their debt repayment capacity, evident from historically lower household delinquencies rates (Reserve Bank of Australia 2008). From Table 3.2 above, it is also observed that default rate increases by almost 1.5 times, if severe contraction occurs in

<sup>53</sup> Same Credit-to-GDP ratio is used in both scenarios as it is already at the 100% level.

<sup>54</sup> MS and SS represent moderate (10%) and severe stress (20%) change in the unfavourable direction in the historical quantiles of all factors.
the U.S. economy. The Australian economy, ceteris paribus, is relatively more resilient to these shocks.

### 3.7 POLICY RECOMMENDATIONS

The current state of knowledge on stress testing has valuable tools for identification and management of systemic risk. Nonetheless, practices at some of the regulatory authorities need to conform to improvements: First, it should include measure of liquidity risk in the modelling framework. Second, an integrated framework that takes account of correlations between the main sources of risk, such as market, credit, and operational risk, is imperative for accurately assessing system-wide risks. The transmission mechanism needs to be defined for cross-border risks; it should also incorporate contagion risk, as it usually underpins financial instability of modern economies. Finally, regulatory frameworks need to incorporate endogenous effects of monetary policy.

### 3.8 EMPIRICAL RESULTS

The elasticity calculated in section 2.6.4, Chapter 2 is broadly consistent with the coefficients of the estimated parameters of the model. Economic expansion will influence (reduce) default rate for the aggregate economy, as demand for goods and services increase, leading to strengthening of firms’ balance-sheets. Consequently, increased-profitability of firms decreases the default rate. The growth rate, GDPG with a positive coefficient turned out to be a significant factor in explaining default risk in the case of both countries. This is consistent with the view of Moody’s (cited in Jarrow & Yu 2001) reports on historical default rates, as it argues that cyclical indicators are highly correlated with the number of defaults, the number of credit rating downgrades, and credit spreads. As regarding the Debt-to-GDP ratio, weakness in the aggregate economy would depend on the level of indebtedness. High debt levels held by firms increases their debt-repayment burden. As a result, firms might be forced to close out their investment positions at fire-sale prices, leaving them vulnerable to bankruptcies. The magnitude of default would thus, depend on the correlation between leverage and probability of default. This will occur in the case of macroeconomic shock like debt-to-GDP ratio. As expected, the debt level has a positive
effect on default rate in the case of both Australia and the U.S. economies\(^5\). Generally, although interest rates have a positive influence on default risk, this was not the case here: this is so, because we have used short-term (6-month) interest rates instead of longer-term interest rates. This view is also expressed in a recent study by the German Central Bank. The one-year interest rate, by contrast, reflects the economic setting...its sign is therefore negative (Deutsche Bundesbank 2009, p. 59). Unlike other factors, \textit{industrial production} being cyclical and forward-looking variable is significant, but has an unexpected positive influence on the default rate. This factor was, therefore, excluded from the final specification of the model.

\section*{3.9 Conclusion}

Systemic Stress tests employed in this chapter provides useful information on the degree of a financial system’s vulnerability to plausible tail-risk events. The framework can potentially help regulators identify and manage likely sources of systemic risk. Notwithstanding, these risk scenarios need to be complemented by ex-ante estimates of economic conditions, risk assessment of the system as a whole, and consistency of regulations across individual financial institutions.

In this chapter, GDP, short-term interest rates and total indebtedness explained default risk in a more meaningful way than industrial production did. Default rate for the U.S. economy is, \textit{ceteris paribus}, much more sensitive to changes in GDP, interest rates, and total debt, than in the case of Australia.

\footnote{The alternative argument by Grossman and Hart (cited in (Lange et al. 2007) states that the reverse side of excessive leverage may be that of managerial efficiency, which can lead to a reduction in the level of default risk.}
Chapter 4

PRO-CYCLICALITY OF REGULATORY CAPITAL IN THE AUSTRALIAN BANKING SECTOR

4.1 INTRODUCTION

In Chapter 2, we discussed the determinants of systemic risk from a credit portfolio perspective and their implications for regulatory requirements. We now move on to investigate the business-cycle risks attached to a regulatory framework. Basel-II’s main purpose is to align regulatory capital to economic capital in a manner that reflects the true state of risks inherent in banks’ transactions. However, as the standard has been adopted by more and more countries, one aspect that has attracted significant concern is the issue of pro-cyclicality: the current rating-based methodology recommended by Basel II apparently requires less regulatory capital during expansions of economic activity, and more during contractions or troughs of the business cycle. A number of observers have cited procyclicality as a potential problem in the Basel II framework. Following up on the issue of procyclicality, the objective of this chapter is to test the Basel minimum capital requirements for Australian banks, and investigate if capital requirements can potentially exacerbate economic downturns.

Aligning capital regulations to asset ratings might correlate capital to the business cycle, making it counterproductive and, therefore, it might enhance the amplitude of economic volatility. A number of studies have been conducted in Europe and North America on the issue of pro-cyclicality. Research in this chapter on the Australian banking sector also confirms the pro-cyclical nature of the current Basel II and hence, a more TTC capital requirement is highly recommended, instead of the current ratings-based or a point-in-time requirement.
4.2 LITERATURE REVIEW

4.2.1 DEFINITION OF PROCYCLICALITY

According to Financial Stability Board (2008, p.1) “procyclicality is generally used to refer to the mutually reinforcing (positive feedback) mechanisms through which the financial system can amplify business fluctuations and possibly cause, or exacerbate financial instability”

A broader definition encompassing the interplay of various sectors of the economy is: “the term procyclicality refers to the dynamic interactions (positive feedback mechanisms) between the financial and real sectors of the economy. These mutually reinforcing interactions...exacerbate financial instability” (Financial Stability Board (formerly Financial Stability Forum) 2009, p.8)

4.2.2 OVERVIEW

The economic world has undergone significant changes in the recent past. These changes have affected policy makers and their understanding of the underpinnings of these developments. We are confronted with wild amplitudes of credit and asset prices and their heavy toll on the economy. While these booms and busts have affected the global economy more frequently since the oil and currency crisis of the 1970s, it is anything but a new phenomenon. In fact, it dates back to Von Mises’ (Austrian School) idea of the cyclically inclined nature of the financial system.

Policy makers have been successful in reducing some of these distortions, in particular achieving low and steady inflation. The same, however, cannot be said of financial imbalances.

In this regard, White (2006) has suggested that perhaps we should consider a new framework that caters to systemic imbalances that have serious implications for economic policy outcomes. His framework has two components: targeting the peak and trough of cycles with a symmetric response and proactively pursuing cooperation between all regulatory bodies.

The 2007–2008 financial crisis has underlined some of the fundamental policy challenges. In particular, the prominence of steady credit growth, excessive risk-taking and sharp rises in the sovereign debt levels. However, even more important is the fact that while the regulators have been, to a greater degree, able to stabilise the markets with publicly-funded massive bailouts of large corporations, it is now the sovereign
debt levels that undermine the fundamentals of these economies. For example, the
current debt problem in the Mediterranean countries is threatening the very existence
of the Euro. Similarly, trade deficits and debt have seen the value of U.S. dollar
plummet since recovery from the GFC.
According to White (2006), the recent financial crises are overwhelming proof that
financial markets can transmit shocks with the potential to spill over cross-border, and
into other sectors of the economy. Recovery seems even more remote when a crisis is
preceded by a bust in the real-estate sector of the economy. The critical development
in financial markets in the recent years has been the rise and fall of credit and asset
prices.
It is also important to note that economic slowdowns that are preceded by a financial
crisis have the potential to hang over. We have witnessed this in the current Global
Financial Crisis. Other important sources of systemic risk are trade imbalances and
bankruptcies.
The current regulatory regime mainly focuses on a microstabilization framework that
encompasses individual institutions. Banks usually cover their expected losses using
capital they have reserved for this purpose. Minimum requirements in the form of
leverage and capital ratios determine a bank’s ability to absorb such losses. These
measures have experienced high growth since the early 1970s, when the world adopted
a fiat money system. In this system, money is not anchored by a commodity, such as
gold or silver. Instead, it derives value from its relative scarcity, and from the
reputation of the sovereign issuing it. As the money is not backed by any commodity, a
central bank enjoys relative freedom in its pursuit of monetary policy.
In the years that followed since exchange liberalization took place in major economies
of the world, banks saw increase volatility resulting in various risk management
products\(^\text{56}\) making their way to the markets. The regulators also contributed to this
effort and as such, minimum capital requirements have existed since the first Basel
Capital Accord of 1998, called Basel I. Here, the important question is to ask: did
these capital standards work according to the designers’ plans and, if not, what was
done about it?

\(^{56}\) Financial derivatives like swaps and options emerged during this time.
4.2.3 PERFORMANCE OF BASEL STANDARDS

Under the former Basel I standard, capital requirements for credit exposures are hardwired according to the nature of each exposure. As such, a fixed risk-weight is used in the calculation of the required capital. Banks are required to maintain a ratio of capital to risk-weighted assets of at least 8%. Sovereign portfolios have a risk-weight of 0%, exposure to corporate is tagged at 20%, retail portfolio at 50% and the risk weight for unsecured retail exposures set at 100% (Benford & Nier 2007).

This left little flexibility for the dynamic nature of credit default risk of borrowers. This is even more evident in times of financial distress.

The new Basel II standard has left the weights to vary across time. According to Basel II, minimum resilience is not only calculated according to type of exposure but also, for greater risk sensitivity, by ratings assigned to such exposure. Basically, two approaches apply here: banks on the Standardised Approach would use external ratings, while banks on the more advanced approach (FIRB and AIRB) utilise their internal estimates of counterparty ratings to calculate capital requirements. Actually, Advanced approaches of Basel II emanated from the risk-management practices of some large banks, as they had collated large databases of defaults data, and used this data to build internal estimates of counterparty ratings. Accordingly, the existing credit-risk-management expertise at banks is one of the main factors that determine if a bank would be given permission by the respective central bank to adopt either of the two advanced approaches, although it still has to seek formal approval from the central bank. So, generally, large banks tend to be on advanced approaches while smaller banks, which have yet to acquire some sophistication in their credit risk frameworks, use external ratings (provided by rating agencies, such as Moody's, Standard and Poor's, etc.) for their borrowers. Again, foundation IRB (FIRB) requires less sophistication generally, as banks are still required to use central bank estimates for some of the parameters, such as correlation factor, \( \rho \) and a confidence level, \( q \) of 99.99% used for calculating Unexpected Loss (UL).

It appears that Basel II offers greater flexibility in terms of estimating borrower ratings and ultimately minimum capital buffers. However, this is not the case, as the

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57 J.P. Morgan had introduced its version of risk management framework called Risk Metrics in the mid-1990s, which later became the leading algorithm in credit risk management.
translation mechanism of these ratings into capital requirements, is still determined by
Basel II\textsuperscript{58}. This mapping-through-formula approach prescribed by the Basel Committee
on Banking Supervision (BCBS) aims to set a hedge against stressed credit losses over
a one-year window — based on the VaR approach. While losses that occur under
average economic conditions, represented by EL, are covered with special provisions
on the banks’ balance-sheets. On the contrary, more important are those losses that
occur under very extreme macroeconomic events, having a very minute probability of
occurring, UL and are supposed to be covered with regulatory capital (Benford & Nier
2007).

\subsection*{4.2.4 ROLE OF DEFAULT}

The chance of default plays an important role in knowing how good a credit portfolio
really is. Credit granting institutions, such as banks therefore, make an attempt to
forecast the number and magnitude of delinquencies in a particular period, so they
could cover anticipated losses through a variety of hedging measures. Although it
might be difficult to accurately anticipate the amount of losses a bank would suffer at
a certain time, it is possible to forecast an average of such losses called Expected Losses
(EL). Since it is relatively easier to anticipate, and cover expected losses with, say, loan
provisions, prudent-firms focus more on the second important component of risk
called “tail risks” or Unexpected Losses (UL). The value-at-risk (VaR) approach, which
is actually designed to help assess the UL, is employed in Basel II, and is explained in
Figure 4.1 below (BCBS 2005).

\textsuperscript{58} This is done through a formula for unexpected losses, UL. See also, (BCBS 2005) for an explanatory
note on Basel II risk weight function. Simply put, minimum capital requirements, $K$ are calculated as a
function of various parameters such as Exposure at Default (EAD), Loss given Default (LGD),
Probability of Default (PD), and a correlation factor, $\rho$ representing borrower-type. EAD is the total
outstanding loan amount, while LGD is the percentage of EAD not covered by collateral. The
correlation factor $\rho$ is set by the regulator in the case of banks on the Foundation approach of the Basel
Standards. The calculation of UL is explained in detail in Section 4.4 below.
Figure 4.1 above explains VaR, which was developed by the investment bank, J.P. Morgan in the mid-1990s, as the worst loss that is possible under normal market conditions during a certain time period — one-year in the case of Basel II. The calculation of VaR is explained as a hypothetical example below:

Suppose a firm A has invested $20 million in shares of an energy-sector company B, whose shares have an estimated return of zero and a standard deviation (volatility) of 10 percent p.a. Assuming returns are normally distributed, and that a 99% confidence interval is used (Basel II also uses the same level), the VaR can be calculated as:

\[
VaR = 20m \times 10\% \times 2.33 = 4.66\text{million}
\]

Equation 4.1

where the number 2.33 represents the area under a normal curve, using a 99% confidence interval.

In other words, there is a 1% chance of firm A incurring a loss greater than $4.66 million in one year.

The introduction of ratings in the revised framework of Basel II to determine capital requirements and to improve risk management in the banking industry has negative implications for the market. According to Benford and Nier (2007), if credit ratings move in tandem with economic conditions, then under Basel II capital requirements may fall in a boom and rise in economic contractions. The procyclical nature of Basel II comes from the fact that counterparty ratings migrate significantly, that is, they
move with the business cycle. The methodology has the potential to be unstable around the economic cycle. The Monitoring authorities are keeping close watch on the movement of regulatory requirements should they undermine the system. However, there is no substitute for the industry’s own careful consideration of its need for capital (Benford & Nier 2007). The current practice of banks is to focus more on lower-tier capital (bonds, etc.), which is although of a long-term nature, but does have maturity date and in case of a financial crisis, might create liquidity problems for the bank.

The challenge remains as not only risk assessment of assets at a point in time is measured but also how overall risk amplifies with the macro-economy over time. Lowe (2002, p.1) terms this as a “critically important” issue.

According to Repullo (2010), the recent financial crisis, with its increasing amplitude of business cycle, underscores the need to investigate the procyclical aspects of time-varying regulatory capital. The framework should be based on the principle that underlies a mechanism that corrects the potential procyclicality in bank lending, and hazardous distortions that restrict investor confidence and lead to credit rationing in recession and speculative bubbles in economic expansions.

The difficulty, from a practical standpoint, lies in the question as to how credit risk relates to the macro-economy; another difficulty in the process is to measure the impact on the level of capital over time. This also has important implications for the way credit risk models are used to estimate capital requirements- the levels may fall in good times and surge in downturns.

Some authors have commented on the behavioural and theoretical aspects of the procyclicality, noted among them is Rajan (2009). According to Rajan, the environments in which banks and markets operate are not merely static entities. Instead, they operate in a very dynamic environment that requires regulation for the very long run, not just at the onset of the crisis. It is argued that the current effort to stave off the recession is a case of regulation meant just for the time being with no long-term ambitions.

According to Rajan (2009), procyclicality is very much caused by this conflict between market participants and intervention driven regulators. In booms the market dictates low levels of capital as the chance of crisis are ignored. However, regulators might
want them to conserve more capital than the market levels. This is what sways banks into “herd” behaviour and they tend to engage in regulatory arbitrage. For example, increasing investment in off balance sheet products, such as structured vehicles, is usually done to achieve a low cost of capital. Similarly, in a downturn, the conflict between regulators pursuing a growth agenda and the risk-averse market widens. This may result in the market setting very high levels of capital than the regulators recommend and therefore, reinforcing cycles.

Rajan (cited in Jimenez & Saurina 2006) explains why banks might finance, during expansions, projects that do not maximise the value of the firm. This is because misallocations are overlooked if there is a system-wide acceptance of this. Similarly, a management whose institution performs poorly risks being laid off. This results in managers tracking their compatriots, which at system-level amplifies boom-bust cycles. Berger (2004, p.5) has investigated the “institutional memory hypothesis” to explain the boom-bust nature of financial markets. The memory hypothesis is based on lax lending practices by lending officers as time wears on after the last recession. Early in the lending cycle, the credit officers have recent memories of their ex-post experiences with bad loans from the bust. The diligence learnt during past recessions includes risk dynamics, different contract structures and effectiveness of various monitoring techniques for recovery and prevention of insolvent customers.

As banks gradually recover from the last recession, loan officers tend to forget past experiences about bad loans and their impact on the bank. Credit officers do not effectively re-balance their portfolio to reduce potential losses.

However, there is also disagreement on the behaviour of the macro-economy. This can be illustrated by two model economies. In the first type, output is considered as a mean-reverting process which can be modelled by a sinusoid function. Thus, we are likely to observe a recession after a peak and a recovery following a trough of the business cycle. By implication, credit risk would be high at the peak and low at the downturn of the economy.

In the second type, economic output is considered a “trending process” and one which is not stationery. In this case, economic activity is assumed to increase following a boom and decline after a recession, i.e., economic activity is time-dependant. Now by definition, an ex-ante rating system would underestimate credit risk in booms and
overestimate the same in busts. The implication for credit risk is significant as it might lead to an increase in the amplitude of credit risk during business cycles.

According to U.S. Federal Reserve Chairman Ben Bernanke (2009b), financial systems are unique in a way that makes it susceptible to booms and busts. So it is imperative to have controlled intervention in the market to affect a correction. However, the exercise should not distort the market fundamentals or its ability to innovate new products which are extremely important from a policy perspective.

While this view is shared by many there are certain issues with this position. First, the role of regulatory authorities (e.g., Federal Reserve in the U.S.) in the past especially their use of indirect monetary tools seems to have significant role in the current build up of the crisis. And in the tradition of “Austrian school” this artificial bubble has to one day burst with negative consequences for the economy59.

According to Lowe (2002), real world macro-economies in which banks operate are devoid of the above two broad characterisations. In such circumstances, it is hard to model economies on the said basis; rather the past performance of an economy should be taken to be the best guess of its outlook. This random-walk based assessment, which relies on past prices as best predictor approach, leads many rating systems to over-rely on the current state of the economy and current financial position of firms.

An alternative view to this dynamic of credit risk is from the perspective of asset bubbles. Accordingly, an expansion is often associated with imbalances in the financial or real economy. When these asset bubbles finally burst, we may experience considerable losses across different sectors of the economy. The ex-ante assessment of financial imbalances is somehow vague but is characterised by an above-trend increase in risk (Lowe 2002).

The Basel II standard has allowed banks to pick their borrowers according to either of the two approaches: defaults linked to current economic conditions or to perceived adverse shocks to the economy. Eva, Jackson & Tsomocos (2003) have estimated a significant increase of up to 15% in capital requirements calculated under the PIT approach used by ratings agencies. Although this surge in capital requirements

59 See also, for instance, A monetary history of USA (1963) by Milton Freidman and End the Fed (2009) by U.S. Congressman Ron Paul.
originates from defaults, it negatively affects non-delinquent loans as well. This component of Basel II is most significant in causing pro-cyclicality. Basel II is based on fixed constraint of solvency. Capital levels are set so that there is only a very nominal probability default for each bank. This, however, has two regulatory shortcomings. First, insolvency is only considered from a micro perspective. As a result, there is no recognition of correlations amongst banks’ default rates. In such a scenario, regulators might find it extremely difficult to aggregate risk. Second, it does not take into account the amplitude of losses in case a bank is to be liquidated. Regulators need to address above shortcomings of Basel II in their search for an integrated approach to efficient regulatory capital. Banks, however, may hold excess capital as demanded by the market. For example, there is evidence that banks operating in the swap market have to prequalify for excess capital levels above those prescribed by Basel II.

Repullo & Suarez (2008), using the general equilibrium approach, noted that banks would tend to use the countercyclical approach to assigning probabilities of default (PD) to loan exposures.

Cyclicality can also be seen from a cross-border oversight perspective and supervisors should make sure banks are appropriately capitalised. The international community should adopt a holistic approach to the regulatory capital framework based on a longer-term view of crisis (McCreevy 2008). The IMF (cited in Caruana & Narain 2008) cautions against self-selecting various components of Basel II as it might give a false sense of “all is good,” while it is not. It has outlined a strategy to deal with the strong link between effective implementation and financial stability.

Caruana & Narain (2008) also underscore the issue of pro-cyclicality. Inadequate securitization and lax risk management practices would force highly leveraged banks to drastically cut lending in times of stress and others would simply follow suit. The IRB approaches of Basel II are even more prone to wild swings in the regulatory requirements.

However, it is not just the regulatory shortfalls that cause pro-cyclicality, fair-price accounting rules (IAS-39) is also a link in this direction. The absence of active markets or pricing mechanisms certain assets might go into a falling frenzy.
The Global Financial Crisis is an example of just how volatile prices of certain assets became when pricing regimes were opaque and disclosures were inadequate. However, Issing and Krahnen (2009) have a very different view of the issue. The current regulatory regime, especially Basel Accords (both I and II) aims at stabilising individual institutions while having less focus on the systemic risk. Although there had been recent efforts by the regulators in this direction, lack of information on cross-border linkages are making them futile.

Issing and Krahnen (2009) have proposed a global database on the lines of an aggregated form of national credit registers. Although this seems challenging given the private nature of such data, a solution could well be in the form of aggregated data instead of firm level data. This is all the more important as we are dealing with a public good called financial stability.

A robust assessment of whether systemic imbalances are building up is imperative for dampening the effects of procyclicality. This forecast is usually generated as multiplicative measure of the probability of financial volatility and net economic loss. However, measurement of both of the above indicators is extremely complex and further investigation has only recently begun.

The Basel committee itself has acknowledged the difficulty in the assessment of systemic risk and maintains that it is one of the difficult challenges the regulatory bodies are facing. It underlines the need to see regulatory oversight in a macro perspective. Flores, Basualdo & Sordo (2010) have extended the use of traditional regulatory tools to measure systemic risk. They have used the usual parameters (PD, EAD and LGD) to incorporate system-wide information. The use of these parameters from a macro perspective creates valuable information about potential weakness in the financial system. This is realised by taking both a cross-sectional and a business cycle view of the various risk factors.

Basualdo & Sordo (2010) see procyclicality as part of systemic risk that evolves over time and over the cycle. In their study of credit card portfolios, collected from individual statements, credit register and employment profiles, system-wide parameters

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60 Structural models as discussed in Chapter 3 on “Stress Testing” provide a useful starting point in this area.
offers significant potential in assessing systemic risk and as a policy tool. The study also reveals the cyclical impact on PD through time (Flores, Basualdo & Sordo 2010).

The Basel Standard, however, notes the caveat that we should aim to adopt a holistic approach to the standard, not just the capital requirements part of the standard. It was stated that:

“The purpose of Pillar 3 market discipline is to complement the minimum capital requirements (Pillar 1) and the supervisory review process (Pillar 2). The Committee aims to encourage market discipline by developing a set of disclosure requirements which will allow market participants to assess key pieces of information on the scope of application, capital, risk exposures, risk assessment processes and hence, the capital adequacy of the institution. The Committee believes that such disclosures have particular relevance under the Framework, where reliance on internal methodologies gives banks more discretion in assessing capital requirements” (Basel Committee on Banking Supervision 2004a, p.175).

Several other authors share the above-noted view. Gordy (2006) has explored the extent that market ethics affect bank lending procyclicality if there are no regulatory constraints like minimum capital requirements. Basel Committee (cited in Gordy & Howells 2006) expects large, multi-national banks to opt for their own strategic reasons regulatory capital levels which are at least above that of levels prescribed by it. The ultimate success of the Basel II will, in large part, depend on how effectively the banking community adheres to its responsibility of market discipline outlined in the third pillar of the Basel II standard. It is argued that some of innovations, such as securitization and special purpose vehicles (SPVs) in financial markets effectively bypassed some of the regulations of Basel II, with capital arbitrage posing as a major challenge to the effectiveness of regulatory standards. Robust banks would hold capital prudently in excess of the bare minimum, so minimum requirements would not adversely affect their operations and credit worthiness. For these institutions, such an alignment of regulatory capital to economic capital will be considered a good indication of the well being of the banks and market participants will have a reliable view of the credit ratings of these banks, both at a micro level and across time. This would promote a market-based credit rating system where unsound practices by banks
are viewed as downgrades. This leaves little room for an interventionist policy from the regulator. Most of the previous studies see this issue from the point of view of a model-based determination of capital rather than market discipline to which banks subscribe in the market place (Gordy & Howells 2006).

The new standard offers far more risk sensitivity in the form of the IRB approach where model-based calculation of capital is widely used today. For large banks this corresponds to a value-at-risk (VaR) approach at a 99.9% probably level. Despite its shortcomings\footnote{Basel Formula (An Explanatory Note on the Basel II IRB Risk Weight Functions, BCBS 2005) ignores the effect of portfolio diversification}, the IRB regime represents the first standardised approach to portfolio risk. Even with its compromise on diversification benefits, the universality of the approach makes direct comparison of credit worthiness of banks much easier and practically achievable. The standardisation of risk across banks and time is what the current Basel standard aims for.

The issue of procyclicality also has roots in the way regulatory authorities affect prices and the market mechanism. According to the Financial Stability Working Group (2008), some experts cite sustained high asset prices and strong credit growth as precedents to a potential crisis. Some see no time-dependence in business cycles, e.g., a boom is not necessarily followed by a bust and vice versa. Simply put, unexpected shocks are seen as exogenous to the system and hence unpredictable at most.

It is important to note that procyclicality can be attributed to both primary sources and feedback effects from policy settings. First, is the measurement distortion: generally, market participants are prone to herd-behaviour in investment decision making, so in the initial stages it becomes very hard to distinguish long-term trends from temporary cycles. Short-term estimates of risk measures, such as the probability of default, exposure-at-default and loss-given-default all have procyclical aspects. So, they might exacerbate financial vulnerability in a crisis and underestimate potential build-up of risk in the upswings.

One of the main causes of this is that, in the short-term, it is extremely difficult to imagine whether an excess return (risk-adjusted) has been earned, or is it just the return excluding any realization of the inherent risks that could pose itself during future downturn (Rajan, RG 2009).
The argument for inadequate assessment of risk is, however, misplaced, as all diligent financial managers in fact take account of the risk-adjusted return. The problem of inadequate assessment of risk seems to lie in the regulatory regimes and the current risk methodologies practiced in the market. For example, using merely statistical means for diversification of assets is problematic at times. Therefore, it is important to take into account the theoretical relationship among different classes of assets.

The second primary source is incentive distortion. This relates to potential conflict of interest between depositors and lenders. The provision of collateralised loans provides an incentive to prop-up asset prices and secure loans on favourable terms. This potentially creates a strong link between asset valuation and funding and liquidity. The role of ratings agencies during the current crisis is an ample example of this type of distortion. This process of rating assignment should ideally be completely independent of the agents pursing funding needs.

Jimenez (2006) has offered a market-based explanation for the issue. Fierce competition within different levels of the banking industry can erode margins to the extent that it closely tracks inter-bank rates. This may threaten the survival of certain banks and other intermediaries. So, to survive in the market, banks tend to increase loan growth at the cost of lax credit standards without fully realising the implication of such practices for the longer term viability of banks.

Heuvel (2009) has explored the transmission mechanisms of risk-based capital. He uses a dynamic model of banks’ capital structure, regulatory requirements and an imperfect market for bank equity. This creates the bank-capital-transmission channel that affects bank equity buffers and the effects of regulatory policy on bank lending dynamics may feed into the capital levels of the banking sector. Banks with low capital buffers are particularly prone to interest rate shock as the effect amplifies over time. Minimum capital buffers affect lending practices even if regulatory constraints are not deployed.

Regardless of the measurement difficulty inherent in the above parameters, there has been a renewed effort by some of the regulatory authorities to work out a feasible framework. The IMF, for instance, has proposed a list of Financial Soundness Indicators for countries and successfully implemented it in its Financial Sector Assessment Program (White 2006).
According to the Economic & Financial Committee report (cited in Frait 2009), the rise in procyclicality in the recent past is attributed to:

1. The steady growth of credit in both financial and real sectors of the economy; and
2. Interbank linkages and their effect on liquidity drain during financial market turbulence.

While the factors identified in the report are indeed responsible for the decline in asset prices, the main link in this transmission mechanism was actually the exponential growth in opaque instruments based on the ‘originator-to-distributor’ model. This created enormous information asymmetry which ultimately led to the current financial crisis.

Table 4.1 below shows the results of various studies conducted in this direction (Benford & Nier 2007).
TABLE 4-1
Simulation of peak-to-trough variation in capital requirements for the corporate sector

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Time Period</th>
<th>Agency Rating</th>
<th>Market-based Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segoviano &amp; Lowe (2002)</td>
<td>Mexico</td>
<td>1995-1999</td>
<td>16%-70%</td>
<td>-</td>
</tr>
</tbody>
</table>

The studies cited in Table 4.1 are simulations based on either ratings migration system or market indicators of PD; the former is considered a TTC system while the latter is more a PIT system. These simulations track how PD translates into capital requirements for a complete business cycle. The studies show swings in capital requirements under both systems; even the TTC measurement shows significant variations through the period.

The above studies show ample evidence in the direction of cyclicality. However, the results need careful consideration. This variation between the two approaches as well as among studies may be due to heterogeneous time periods and methodologies applied in each of them.

Figure 4-2 below summarises the findings of the model specified by Kashyap & Stein (2004). It is argued that unlike the central bank using a fixed curve that maps risk measures into their equivalent minimum capital charges, a suite of different risk curves should be used, which conform to the changing net-worth of banks. So instead of using procyclical risk-functions such as C99pc and C999pc depicted in Figure 4-2
below, it is optimal to use a point-in-time, lower-gradient risk curve (observed as “flat” in the figure below). A point-in-time risk function can be derived in two ways: in a downturn, the central bank can either reduce the overall minimum capital requirements (currently set at 8% of risk-weighted assets under Basel II), or it can reduce risk weights assigned to different asset classes; similarly, the opposite strategy, that is, an increase in the capital ratio or risk weights would be employed in an economic boom.
4.3 METHODOLOGY

Kashyap & Stein (2004) have pointed to measurement issues in their research on how capital requirements evolve over the course of business cycle. The particular concern is whether the capital requirements are significantly responsive to a particular style of asset management i.e., active portfolio management. This is because active management has an endogenous effect on credit ratings. The results show banks that practice active management of their assets, have their credit worthiness approximately unchanged during a recession. This has a critical policy implication as one explanation would be to simply ignore the issue of procyclicality. This might happen because banks actively pursue their lending to riskier clients and adopt credit rationing to control rating downgrades. This in fact a great policy challenge as there is some pass through effect involved in downturns. This was clearly evident during the recent crisis as despite the massive quantitative easing employed by central banks around the world we saw tightening lending practices by banks, which further exacerbated the crisis. For
example, the TARP (Troubled Assets Relief Program) in the U.S. could not fully recover job losses and the unemployment rate there is still at a high level. The other problem stems from data inconsistency, in particular survivorship bias: firm observations disappear possibly due to mergers, delisting, etc. Gordy (2006) attributes this inconsistency to revisions to the minimum capital standards. However, it is argued that as Basel II scales\textsuperscript{62} the formula to maintain consistency across the various versions of the Basel standard. Accordingly to the fifth Quantitative Impact Study (QIS 5) of G-10-countries banks conducted by BCBS, minimum capital requirements under Basel II would decrease relative to Basel I. So the scaling factor currently prescribed by the BCBS should bring about consistency between Basel I and Basel II.

Kashyap & Stein (cited in Gordy & Howells 2006) maintain that problems relating to missing observation and survivorship bias were not properly implemented in earlier studies. Two issues, although ostensibly methodological but having important implications for capital assessment of lending institutions, arise. First, whether to take into consideration the effect of provisions in calculating the capital? Second, what assumption underlies portfolio management practices? A passively managed portfolio declines in value. In an active portfolio credit rationing is in order and therefore, bad loans are replaced with low-risk loans and there is no significant change in the value of the portfolio across time, i.e., it is time-invariant.

Kashyap & Stein (2004) observe that if insolvencies are included in the measurement then this determines the collective pressure on bank reserves over the stipulated period. Notwithstanding, this assertion seems misleading because if we accept the proposition we should also single out the of dividend payout from interest income (Gordy & Howells 2006).

As for the issue of management practices, Kashyap & Stein favour a passively managed portfolio. It was stated that:

"...active management muddles together the direct effect of a tightened capital constraint with the bank’s endogenous response. For example, suppose we look at the evolution of a banks’ actively managed portfolio during a recession and find that average credit quality ... is roughly unchanged. Should we

\textsuperscript{62} A scaling factor of 1.06 is applied to risk-weighted assets. See also, (Benford & Nier 2007), http://www.bis.org/press/p060524.htm for further details.
conclude from this that there is no cyclicality problem serving of policymaker attention? Probably not—it may just be that the bank has reacted to a tightening capital constraint by cutting off credit to its riskier borrowers, which is precisely the policy problem that concerns us” (Kashyap & Stein (2004) cited in Gordy & Howells 2006, p.400).

It can be argued that most, if not all, large banks do actively manage their credit portfolio. Hence, capital reserves endogeneity with business cycles is a pursuit that can hardly be denied.

Gordy (2006) maintains there is limited empirical evidence to support either view. However, we do find that banks employ some form of credit rationing during recession and lax controls during economic expansions. The somewhat conflicting views in the previous studies are not fundamental, but possibly because of how we define new credits. This is particularly true if a new loan is actually a drawdown of the previously sanctioned allowance. So it is imperative to outline what we actually mean by fresh credit.

The determination of unexpected loss (UL) under the foundation approach is accomplished using credit agency assigned ratings to arrive at a 1-year probability of default (PD) for each loan exposure. The framework in this chapter has constructed a hypothetical portfolio of loans and their associated PDs using data from RBA\(^63\). The PDs are assumed to be ratings from credit ratings agencies; a sample of those UL as given in Saunders & Linda (2010) is provided in Appendix 4-1.

The following assumptions are in order:

1. Aggregate delinquency rates are assumed to be the relevant PDs of loans; and
2. Loans in the aggregate portfolio are assumed to be homogeneous.

The second assumption is relatively stricter as the aggregate data is obtained for all sectors of the economy, not just one homogenous sector. However, the same methodology can be applied when sectoral data\(^64\) is available.

### 4.4 MODEL FOR UL

Credit risk is usually defined as a function of the following three parameters:

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\(^{63}\) APRA collects aggregated data on loans and delinquencies from all banks operating in the country; this data is also available from the RBA.

\(^{64}\) Sectoral data on loans are usually not available publically due to the private nature of this information; it is maintained in credit register of the country.
\[ crRisk = f(PD, EAD, LGD) \]  

Equation 4-2

where \( PD \) is the probability of default of borrower, \( EAD \) is draw down amount of the loan facility or legal value of loan, \( LGD \) is the loan amount adjusted for any collateral held. \( LGD \) is a cushion against adverse events affecting the cash flow of the borrower. It, therefore, reduces the risk of default.

We have used the Basel-II approach to UL\(^{65}\) (cited in Saunders & Linda 2010):

\[ UL_{loan} = VAR_{loan} - EL_{loan} = (LGD \times PD_A) - (LGD \times PD) \]  

Equation 4-3

where \( EL_{loan} \) is the expected loss which is covered by loan loss provisioning; the component of loss that is to be covered by regulatory reserves is \( VAR_{loan} \), and \( PD_A \) is estimate of probability of default during downturns.

Basel II prescribes a 99.9 \% VAR calculated as:

\[ VAR_{loan} = LGD \times N\left(\frac{G(PD) - RG(0.999)}{(1 - R)^{1/2}}\right) \times EAD \]  

Equation 4-4

Where \( LGD \) is a constant the value for which is provided by the regulator, \( N(.) \) is normal distribution and \( G(.) \) is the inverse of normal distribution, \( R \) is default risk correlation.

\( R \) is the asset’s correlation with systemic risk factors like the state of the economy. It is different for each sector of the economy. For instance, \( R \) would be lower for the retail sector than it is for the corporate sector as both sectors are affected differently by macroeconomic shocks (BCBS 2005).

The portfolio diversification effect is not considered in Basel II; BSBS maintains that it may lead to complications in implementing the framework and hence would have been less appealing in some jurisdictions.

Jackson (2002) shows how to calculate the value of \( R \) for corporate, sovereign and interbank exposures:

\[ \rho(PD) = 12\% \times \left(1 - e^{-50 \times PD}\right) + 24\% \times \left(1 - \frac{1 - e^{-50 \times PD}}{1 - e^{-50}}\right) \]  

Equation 4-5

The above equation is simply to determine an interpolated value of 12\% and 24\%.

Substituting Eq.1-2 into Eq.1-1 above yields:

---

\(^{65}\) Under FIRB, banks use own estimates of an exposure’s PD and M (maturity) while EAD and LGD are set by regulator; banks on AIRB, generate own est. for all of the above-noted parameters.
In the above equation, exposure-at-default (EAD) is an estimate of total loan amount outstanding (including future draw downs), loss-given-default (LGD) is percent of EAD which might be lost in the case of default; it depends on the collateral and type of borrower and also on a bank’s recourse to loan collateral. PD in Eq. 4.4 above and the rating methodology is explained in Annexure 4-1 and Annexure 4-5, respectively.

### 4.5 RESULTS

The UL function in Eq. 4.6 above is the basis for calculating Basel II minimum capital reserves for the Australian banking sector. Simply put, UL is the minimum capital requirements calculated to cover for losses almost 99.9% of the time. For the sake of brevity, we simply present our findings of the model. The main finding is that even under through-the-cycle (smoothed) estimation, the minimum capital requirements for the Australian banks is highly procyclical, i.e., the regulatory regime currently in place might amplify the effects of recession to the detriment of the banking sector. Figure 4-3 and 4-4 below show the PIT and TTC minimum capital requirements, respectively calculated for the Australian banking sector.

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66 Basel II has set 1-year as the time horizon for the 99.9% confidence level, which equates to 1-in-1000-year default event.
FIGURE 4-3
PIT Capital Requirements

Pattern of Regulatory Capital
Australian Banking Sector, 1994-2010
The smoothing is based on a 5-year minimum data history requirement set by the Basel Committee (BCBS) in the Basel II accord.
### TABLE 4-2

Illustrative IRB Risk Weights for UL Asset Class

<table>
<thead>
<tr>
<th>(Maturity-2.5yr)</th>
<th>Corporate</th>
<th>Residential</th>
<th>Other Retail</th>
<th>Revolving Retail</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGD (Big) 45%</td>
<td>(SME) 45% 45%</td>
<td>25%</td>
<td>45%</td>
<td>85%</td>
</tr>
<tr>
<td>PD 0.03%</td>
<td>14.44%</td>
<td>11.30%</td>
<td>4.15%</td>
<td>2.30%</td>
</tr>
<tr>
<td>PD 0.05%</td>
<td>19.65%</td>
<td>15.39%</td>
<td>6.23%</td>
<td>3.46%</td>
</tr>
<tr>
<td>PD 0.10%</td>
<td>29.65%</td>
<td>23.30%</td>
<td>10.69%</td>
<td>5.94%</td>
</tr>
<tr>
<td>PD 0.25%</td>
<td>49.47%</td>
<td>39.01%</td>
<td>21.30%</td>
<td>11.83%</td>
</tr>
<tr>
<td>PD 0.40%</td>
<td>62.72%</td>
<td>49.49%</td>
<td>29.94%</td>
<td>16.64%</td>
</tr>
<tr>
<td>PD 0.50%</td>
<td>69.61%</td>
<td>54.91%</td>
<td>35.08%</td>
<td>19.49%</td>
</tr>
<tr>
<td>PD 0.75%</td>
<td>82.78%</td>
<td>65.14%</td>
<td>46.46%</td>
<td>25.81%</td>
</tr>
<tr>
<td>PD 1.00%</td>
<td>92.32%</td>
<td>72.40%</td>
<td>56.40%</td>
<td>31.33%</td>
</tr>
<tr>
<td>PD 1.30%</td>
<td>100.95%</td>
<td>78.77%</td>
<td>67.00%</td>
<td>37.22%</td>
</tr>
<tr>
<td>PD 1.50%</td>
<td>105.59%</td>
<td>82.11%</td>
<td>73.45%</td>
<td>40.80%</td>
</tr>
<tr>
<td>PD 2.00%</td>
<td>114.86%</td>
<td>88.55%</td>
<td>87.95%</td>
<td>48.85%</td>
</tr>
<tr>
<td>PD 2.50%</td>
<td>122.16%</td>
<td>93.43%</td>
<td>100.64%</td>
<td>55.91%</td>
</tr>
<tr>
<td>PD 3.00%</td>
<td>128.44%</td>
<td>97.58%</td>
<td>111.99%</td>
<td>62.22%</td>
</tr>
<tr>
<td>PD 4.00%</td>
<td>139.58%</td>
<td>105.04%</td>
<td>131.63%</td>
<td>73.13%</td>
</tr>
</tbody>
</table>

Source: (Saunders & Linda 2010)

### 4.6 POLICY RECOMMENDATION

The issue of procyclicality has been on the agenda of policy makers, academics and the banking community in recent times. This rise in interest is attributable mainly to globalisation, boom bust cycles which were very much part of the financial crisis in the
developing countries in the late 1990s and potential adverse effects of crisis spill over to other sectors of the economy. Of course, some degree of procyclicality will almost certainly be associated with an economy that is performing at optimal levels. However, it is the increased volatility that demands greater attention. Efforts, both at Basel II level as well other national regulators, are underway to devise models to accurately measure procyclicality and amend the existing policy framework to better reflect desired outcomes of financial stability.

4.7 MACRO-PRUDENTIAL MEASURES

External imbalances are frequently the source of much criticism, and that is precisely the reason why they are always on the radars of regulatory authorities. Unfortunately, we no longer have a coherent system like Bretton Woods to maintain order in international markets. The demise of the previous system has led us into an era where on the one hand there is free flow of capital, and on the other hand there are fixed-exchange-rate mechanisms operating in some Asian economies, such as China and Malaysia. This has led to some degree of macroeconomic cyclicality, more recently evident in the form of the GFC; external capital inflows played a role in bidding up the housing market in the U.S. Several observers such as Bernanke (Bernanke 2010) have underscored the role of external imbalances in the build up to the GFC.

There are several other options that could as well serve the much-debated objective of macro-prudential and financial stability.

We may consider adopting a universal currency much like the IMF’s Special Drawing Rights (SDRs). Although similar efforts in the 1980s failed and there does not seem much enthusiasm among regulators and market participants on the move to SDRs, but it still has the potential of being a more robust exchange instrument.

However, according to Eichengreen (2010) the fact that SDRs are not issued by a state but instead by the IMF that makes them less promising in our search for a “robust” currency.

Second, bilateral solutions are based on market inter-linkages and the common goal of avoiding circumstances detrimental to the overall health of the global economy. This arrangement might be initially more promising amongst surplus and deficit countries,
but it will ultimately involve facilitation from globalised institutions like IMF, OECD, etc. (White 2006).

Gordy & Howells (2006) have suggested three methods to address the issue of procyclicality associated with the IRB approach. First, banks could adopt through-the-cycle ratings, which would smooth out economic cycle effects on ratings. This premise is based on the preposition that if the probability of default (PD) corresponding to each rating is assessed as a function of some long-term mean it would potentially alleviate some of the procyclicality that co-varies with the amplitude of economic cycles. This smoothing function could be obtained at either the input level (LGD, EAD, PD, ρ) or at the output level i.e., the IRB risk weight function. Secondly, procyclicality could be avoided by flattening the capital function in order to reduce slope or sensitivity of risk capital to changes in borrower rating. Third, the same result could be achieved if regulators could scale the objective function. Let \( C_{it} \) denote the regular IRB capital formula for bank \( i \) at time \( t \), being the carrying value for portfolio, and let \( \hat{C}_{it} \) denote the corresponding minimum capital applicable to the bank. An AR-1 moving average function would look like:

\[
\hat{C}_{it} = \hat{C}_{i,t-1} + \alpha (C_{it} - \hat{C}_{i,t-1})
\]

Equation 4.7

The new standard actually sets the value of \( \alpha \) as unity. This framework could be set either as static or time-dependant. Perhaps the best alternative would be to devise a time-varying scaling factor to the IRB output, \( \hat{C}_{it} = M_t \times C_{it} \). The scaling factor \( M_t \) would be set low during the trough of a business cycle to reduce the gradient of PD on capital. Similarly, it would be set higher during the boom to offset declining PD. Gordy & Howells (2006) call this “counter-cyclical indexing.” According to their findings, filtering can significantly reduce procyclicality in the IRB function.

It can be argued that regulators should promote the use of more stable ratings. First, because in a downturn, unstable ratings can lead to negative sentiment even for otherwise good companies, and their existence could be jeopardised. Second, unstable ratings could potentially propagate contagion, leading to severe financial intermediation problems, such as loss of funding and market liquidity. For instance, ratings from the credit ratings agencies Moody’s and Standard & Poors can be a good
proxy for stable ratings as they work well over long horizons. On the other hand, ratings generated by the IRB processes are considered to be PIT, which has critical implications for regulatory reserves.

If the long-run average of default frequencies is considered in the calculation of PD then we might as well have a situation in which stable rating calibration corresponds to a stable PD. Consequently, we can achieve low capital volatility (Gordy & Howells 2006).

There is yet another very promising regulatory tool suggested by the Squam Lake Working Group on Financial Regulation (2009). A hybrid security (having the ability to be converted to equity) has great potential in recapitalising weak financial institutions. The instrument would be adopted before any potential crisis and depending on specific conditions would trigger mutation into equity that would help insolvent banks recoup. This appears a superior alternative to the tax-payer funded bailouts which have serious negative implications for sovereign debt levels. The measure clearly has advantages in terms of transparency and low cost. The design is also clearly laid out with specification for the trigger mechanism and hence would be paid for by bank investors instead of being publically funded.

Rajan (1994, p.411) proposes some sort of regulatory intervention to check the "expository bias" prevalent in the credit creation mechanism. This is usually achieved through imposing credit controls. However, the capital efficiency problems are associated with credit rationing polices deployed by the regulators. Rajan recommends targeted intervention to overcome problems of long memory of origination and continuation of bad loans by the banks.

The above suggestion seems unnecessary as central banks already use their existing arsenal of monetary instruments to achieve the same goal. It would be preferable to integrate the policy measure with the market-based mechanism. For example, banks with higher proportion of bad loans are penalised by being assigned low credit ratings, resulting in an increased cost of funding for banks. So under a market-based mechanism there would be little need for a direct intervention by the regulator; such direct interventions, however are usually perceived negatively by the market due to the stigma attached to them and might have serious negative repercussions for systemic risk.
There is a wide body of literature that suggests significant differences between the PIT and TTC rating methodologies. Consequently, there is a strong urge among the banking community for a more consistent approach to ratings. According to Aguais et al. (cited in Ong 2007) the inconsistency has several components. For example, AIRB models tend to produce inconsistent parameters. Second, the key risk objectives at the core of a bank’s risk management practices will support either of the two approaches to calculating minimum capital requirements. Aguais et al. suggest having ratings measurements based on corresponding specific objectives and time horizons prescribed by the bank’s management will greatly reduce inconsistency. For instance, a 1-year horizon for credit defaults would be more accurately measured given an equivalent (1-year) measure for PDs that fully encompasses the PIT or current credit market conditions. The suggestion is quite robust. However, given that we only have a fixed time window for measuring PDs as suggested by BCBS, there would be difficulty in the use of corresponding measure, i.e., whether PIT or TTC.

The distinction between PIT, TTC or a hybrid is also based on the underlying assumption about nature of the credit development process. Just like economic output credit growth is also assumed to be some sort of a predictable cycle. We can, therefore, make a clear distinction between the different measures of PDs. Basically, we assume there is a time dependence involved in credit processes, so a decline will follow a steady rise in PDs and vice versa. Empirically, the mean of the loan prices is used as the best estimate of the general equilibrium of the credit cycle.

This view has, however, been contrasted, by many, with systemic factors being considered unpredictable at best and that they follow a random walk process. The same is true for the more traditional credit models like KMV, etc. Under these models, there are no predictable credit cycles. Hence, no meaningful distinction can be drawn between the different measures of PDs (PIT and TTC). However, according to Aguais et al. (cited in Ong 2007) mention these intuitive factors for the case of credit cycles:

1. Macroeconomic policy tends to dampen recessions and defaults which leads to attaining some sort of equilibrium level; and

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68 For example, Nelson and Plosser (1982)
2. Various macroeconomic and finance variables (unemployment, interest rates) usually exhibit cyclical variations from which we can get information about defaults changes.

The study by Aguais et al. (2007) strongly suggests for the presence of cyclical tendencies in various measures of PDs (see also, Figure 4.5 below).
FIGURE 4.5
Cyclical variation in credit factors

Note: Moody’s Med PD = index derived from median PDs in each Moody’s grade
Moody’s DR = index derived from Moody’s annual corporate default rates
S&P Med PD = index derived from median PD in each S&P grade
Moody’s DR = index derived from S&P’s annual corporate default rates
U.S. Banks C/Os = index derived from U.S. Banks C&I charge-off rates
MKMV median EDFs = index derived from median EDFs in North America

Source: Aguais et.al (2007)

Repullo & Suarez (2008, p.1) consider a dynamic equilibrium model for minimum capital, and conclude the shift to Basel II would not mitigate volatility of capital requirements.

It is stated that:

“Banks anticipate that shocks to their earnings as well as the cyclical position of the economy can impair their capacity to lend in the future and, as a precaution, hold capital buffers. We find that the new regulations change the behaviour of these buffers from countercyclical to procyclical. Yet, the higher buffers maintained in expansions are insufficient to prevent a significant contraction in the supply of credit at the arrival of a recession. We show that
cyclical adjustments in the confidence level behind Basel II can reduce its procyclical effects without compromising banks' long-run solvency.”

4.8 MICRO-PRUDENTIAL MEASURES:

There are several possible measures that can be applied to individual institutions. The back-testing technique can be used to validate the accuracy and predictive power of IRB approaches adopted by banks. Here the usual prescription is based on a 250-day window suggested by BCBS. Basically, banks have to check on an ex-post basis, whether they are within the risk bounds predicted by their IRB models under a 99.9% confidence level. Banks failing to have consistency in their projected losses are penalised by their regulators. They have contrasted their counter-cyclical Comit index (Italy) to the DJ EuroStoxx 50 index proposed by Himino (see also, Figure 4.6 below). However, the problems with the use of index are that idiosyncratic shocks associated with dividend policies and other extraordinary events (e.g., M&A activities) may distort the very purpose of the adjustment process.
The problem with this methodology is that it is based on a very short window of 130 working days; it is argued that it should be based on a relatively longer horizon of 1-year, also prescribed under Basel II. However, we might still experience problems related to availability of data; this is more so for loan data as the vast majority of them are not traded. Another problem with this methodology is the limitation of the use of just delinquencies in the cyclicity modelling. It is argued to use specific loan characteristics, such as loan size, incomes levels, interest burden, etc., in the determination of Basel II minimum capital.

Second, a simulation-based approach might be more appropriate (a sample of this methodology has been provided as Annexure 4-2 at the end of thesis). An empirical exercise in this direction has been conducted by Lopez and Saidenberg (cited in
Gallati 2003). They have assumed a large sample consisting of $N$ loans and then simulating sub-samples and generating loss distribution for expected loss and unexpected loss (UL). However, there are several caveats in order. In particular, sample-selection bias that may arise due to structural breaks in the data; in which case, the predictive power of models estimated on different strands of data would be significantly compromised.

In a study of the volatility of minimum capital requirements Purhonen (cited in Ong 2007) has suggested a very pragmatic approach to the issue. Purhonen also suggests flattening of the IRB risk weight function. It is mentioned that the Moody’s KMV approach to IRB risk weight function should be considered as an upper bound on volatility. A bank using agency assigned ratings (through the cycle) could transform the KMV (point in time) default frequency into their longer-term counterparts by using a credit function derived from corresponding PD’s median. Recently, Himino (cited in Conciarelli & Quagliariello 2009) suggested to apply a scaling factor to the risk-weighted assets, based on broad indicators, such as a stock index, output, a real estate index, etc. However, the suggestion of using an adjustment factor is also fraught with measurement issues such as the presence of unit roots in the various macroeconomic variables that are considered in the proposal. Conciarelli & Quagliariello (2009) consider implications for Italian banks. They argue linking capital requirements in this fashion would lead banks to face difficulty in arriving at meaningful projections for their capital needs. Moreover, using macroeconomic factors for individual banks needs would seriously undermine the transparency and even treatment that are at the core of the other components (Supervisory Review and Market Discipline pillars of BCBS) of the regulatory requirements.

### 4.9 OPTIMAL CAPITAL LEVELS

Estrella (2003) has investigated the procyclicality of VaR-based minimum requirements by establishing a dynamic model to track both VaR and optimum bank capital. He has suggested some solutions to the problem. First, it is imperative to deploy an accurate assessment of VaR-based capital to overcome any likelihood of a liquidity and credit crunch during recessions. The caveat, however, is to consider the time-specific relationship between the VaR-based capital and optimal capital.
Supervisory insight is also very helpful for avoiding the moral hazard problems which arise as the gap between optimal and VaR-based capital widens during economic downturns. The supervisor’s oversight would be imperative to make sure individual banks maintain contingent capital buffers to reduce the gap between bare minimum regulatory capital and economic capital.

Estrella sees VaR as being instrument for acyclical regulatory requirements.

It is stated that:

“...one that does not conflict with optimum levels over the cycle — if it is applied to net external capital raised. In a scheme of this sort, the minimum capital raised could be some fraction of the amount that would be raised in the absence of adjustment costs. In that case, minimum requirements would not tend to conflict with optimum capital at cyclical frequencies, and would be less likely to exacerbate normal cyclical fluctuations (Estrella 2003, p.1493).

4.10 CONCLUSION

Since the inception of the Bretton Woods System, there has been an unwavering focus on external imbalances and the factors that affect it. The policy responses have also focused mainly on achieving stable capital flows between debtor and surplus countries. However, since the collapse of the fixed exchange rate system, we have seen imbalances to have serious implications for the financial system. While it is worthwhile that most developed economies no longer have exchange controls, we still have countries that manage their currency. This is responsible for a significant amount of external imbalances.

Having said that, it would be futile to just blame external imbalances for the current crisis rightly identified as a “savings glut” by Ben Bernanke (2010, p.10). Because domestic deficits can be seen to be a counterpart of the global imbalances, it is desirable to also consider their role in the crisis. These have seen an unprecedented rise in domestic consumption and unsustainable growth of credit and asset prices.

As suggested by Mervyn King (cited in White 2006), we need to have a coherent system that is mutually accepted by both the creditor and debtor countries and has the ability to address imbalances in an effective manner.
Our results, based on our models of PIT and Smoothed “PIT” models, confirm previous studies that Basel II capital requirements are highly pro-cyclical. It is, therefore, necessary that a more stable measure of regulatory capital should be used in enforcing the regulatory standards. This should encourage banks to hold sufficient capital in a boom and not be consumed by the “irrational exuberance” phenomenon coined by Greenspan (1996). It is even more important not to consider regulatory requirements as panacea for all perils, rather it should complement the fundamental good practices of credit granting, disclosures, and regulations.

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Chapter 5

FINANCIAL STABILITY REVIEW AS A NEW POLICY TOOL: AN AUSTRALIAN PERSPECTIVE

5.1 INTRODUCTION

The use of monetary policy by central banks has a long history dating back to Keynes’s theory of “liquidity preference,” which he used to reject classical economics and its fundamentals of free market and individual choice. Notwithstanding, monetary policy has become ever-more prominent after it was formalised by Milton Freidman and his followers of the Monetarist school of thought. It is best considered as the magnum opus of central banking. On the other hand, financial stability (FS) is a relatively new pursuit of most central banks. This lack of attention is due to the fact that although FS is widely practiced and regarded as the second most important function after price stability, yet it has the standing of a formal policy only for a handful of central banks (a few exceptions are RBA, Bank of England, etc.). The financial crises of the last few decades, however, have put FS at the centre stage of the policy debate in banking and regulatory circles. This new vigour in our fixation with FS is due to the realization of huge losses and decline in output as a result of the perilous economic conditions prevailing these days.

Adverse macroeconomic conditions have led to the creation of various policy tools, such as enhancing macroprudential oversight and the adoption of a new version of Basel capital accord called Basel III. However, there is at least one such potential tool that has been in existence since 1997, but has not been adequately considered for this purpose: the financial stability review (FSR). Swedish regulator Riskbank was the first central bank to publish an independent report on financial stability back in 1997. There were other central banks, such as Bank of England and Norway’s Norges Bank that also had some form of publication on financial stability, starting around the same
time. Nonetheless, their reports were rather a compilation of articles on financial stability instead of an independent report like Riskbank’s FSR – the articles were not directly affiliated with those central banks that issued them, making these research reports less of official policy on financial stability.

These reports are now published by most regulatory authorities, including the Reserve Bank of Australia (RBA), which has been publishing its version of the financial stability review (FSR) on a bi-annual basis since 2004. We will discuss its performance during the global financial crisis (GFC) and whether it is useful as a new tool that can be included in the central banks’ policy arsenal.

The RBA publishes financial stability reports (reports) to alert financial market participants to what it might perceive as potential threats to the financial stability, whether emanating from domestic or foreign markets. Theoretically, “external communication” seems a very powerful tool to forewarn market participants of the impending dangers in financial markets. The relative importance of this channel (monetary policy) can also be judged from the fact that a framework based on the same principle called “Market Discipline” has existed as part of Pillar 3 of Basel II since its inception in mid-2004. The main research thrust of this chapter lies in the investigation of the RBA reports’ success in the identification of potential risks to Australian financial markets. Simply put, the main contribution of this chapter is a validation exercise that tests the usefulness of the policy-objective of central banks to publish these reports for the benefit of the markets. Section 5.2 of the chapter outlines how FSRs were developed, and their general characteristics. The subsequent Section 5.4 discusses the impact of the GFC on Australia’s economy. The discussion in Section 5.5 is about the assessment of risks contained in FSRs, followed by critical validation of these risks. The discussion is summed up in Section 5.6.

5.2 LITERATURE REVIEW

There is no broad consensus as to the definition of FS; some central banks have the concept outlined in one or another form of their statutes or legislation\textsuperscript{70}. Our aim

\textsuperscript{70} For a definition of financial stability by selected central banks, see Appendix 5-2 given at the end of the thesis.
here, nonetheless, is not to state definition of FS\textsuperscript{71}. Instead, we will look at a pragmatic framework for monetary policy with focus on FSR.

Cihak (2006a) is probably the first author who has discussed financial stability from the standpoint of FSRs. In the last few decades or so, financial stability has gained importance as a public-policy pursuit, resulting in enhanced focus on the financial sector and its stability, especially in the developed countries. One of the main reasons why FS gained such importance is the high cost, both losses in the finance industry itself and the possibility of spillover problems, associated with financial crises. Moreover, these costs occur frequently against the backdrop of increased volume of trades, and tremendous growth in new and complex financial instruments.

The increased globalisation, growth in the volume of foreign exchange transactions, and increasing integration of markets has caused institutions to trade in the interbank market more frequently than before. This has highlighted the issue of financial stability, particularly contagion risk. Cross-border capital flows, which are considered beneficial for growth (under normal conditions), have the potential to distort asset markets and undermine economic policies. As a result, we see central banks pay undivided attention to macroprudential oversight and stability of the financial markets (Crockett 1997).

Traditional supervisory policy was largely unsuccessful in estimating the building-up of systemic risks. In the wake of increased uncertainties that unravelled during the crisis, it was important to restore confidence quickly and conduct a diagnosis of the factors that caused it.

According to Ingves (2009), it is imperative for regulators to intervene in the market to safeguard financial stability, and to curtail negative externalities, particularly a slowdown of the economy. The big challenge, however, is that the scope of the crisis demanded altogether new tools of monetary policy. This made the work of central banks more difficult, as they not only had to restore confidence in the market, but also risked their conservative role as a result of implementing non-traditional policy instruments.

Many regulators found it necessary to look for new methods and tools for monetary policy As a result, we have witnessed governments, central banks and other authorities

\textsuperscript{71} For FS definition, See also, Chapter 2 on “Credit Risk.”
taking extraordinary measures to restore confidence in the financial markets, primarily to avoid the risk of contagion, and to inhibit spillover of risks into the real economy. During the crisis, the extraordinary measure taken by central banks to extend much-needed credit to the private sector through monetary expansion is evident from Figure 5.1 below.
Almost the entire monetary policy is about the central bank buying and selling government securities, so a particular stance of monetary policy can be observed by looking at central bank balance sheets showing monetary aggregates. One such measure is the ratio of balance sheet size to GDP. Observe in Figure 5-1 that during the period 2007–2008, the relative balance sheet size for the U.S. Federal Reserve and the European Central Bank increased steadily, but remained below 7% and 16%, respectively. However, the rate has increased tremendously since the latter-half of 2008, indicating a very accommodating monetary policy pursued by almost all major central banks, such as the ECB and U.S. Federal Reserve. Monetary expansions, such as the one being discussed here, usually last a couple of months. However, given the nature of intermediation problems seen during the GFC, several countries such as U.S., Canada, U.K. and Japan, etc., have retained loose monetary policy for a relatively extended period now, with most of these countries having an interest rate close to the zero bound.

Most central banks strongly advocated expansionary monetary policy during the crisis. Likewise, governments used fiscal measures to stimulate their economies at the
expense of their housekeeping (budgets deficits and rising sovereign risk). We are now seeing interest rates at their lowest levels combined with unprecedented increases in national debt in several countries. These adverse economic conditions are making it very hard for regulators to continue using traditional tools for returning things to normal, with the normal conditions usually judged from counter-party risk premium such as Libor-OIS spread\textsuperscript{22}.

According to Krugman (2010), with negative interest rates (real) prevailing in many countries today, many of the usual rules of economic policy no longer apply, i.e., an economy is in a liquidity trap when a conventional open-market operation is ineffective because short-term interest rates are very low.

Despite these limitations of monetary policy, central banks have, under difficult circumstances, implemented various non-traditional measures to support markets. For instance, the Swedish central bank (Riskbank) aimed to help banks meet their short-term and medium-term funding needs. Given that central banks normally focus on the short-term funding needs of market participants, longer-term lending is a considerable innovation in monetary policy. At times, central banks have to act as intermediaries to support markets, which have developed serious disruptions to their smooth operation.

Apart from longer-term lending, many central banks, especially those that face balance of payments difficulties, have also entered into swap arrangements with other central banks. Another development to monetary policy has come from the need to secure lending based on a variety of collateral, not just treasury paper. For example, many central banks have recently recognised commercial paper as an eligible security for lending to banks.

Nonetheless, one of the most important outcomes of this enhanced focus on financial stability is, for instance, the rise in the number of FSRs being published by central banks in the last few years. More recently, almost 50 central banks have FSRs incorporated as part of their standard policy objectives, and many more are considering their publication in the future. They are being implemented as an

\textsuperscript{22} Libor is London Interbank Offered Rate, while OIS stands for Overnight Indexed Swap. The former involves lending principal amount, while the later is an interest rate derivative, and just involves the exchange of interest-payment at maturity. There is usually a very nominal (around 10 basis points) premium for the Libor rate, generally representing counterparty risk.
addition to the price stability function by the majority of the central banks operating in the G20 countries.

5.2.1 STRUCTURE OF FSR

As a new tool, FSR offers valuable information on central banks’ conduct of financial sector surveillance. While central banks use a range of tools for FS, these reviews are at the heart of their overall program for external communication with the market. More specifically, they outline central bank objectives and how these would be pursued to achieve financial stability. In addition, these reports also identify channels for external communication of policy responses of the central bank.

Cihak (2006a) has noted that the concept of an FSR varies considerably among different regulators. Some central banks may even consider their annual report, which might have a small section on financial stability, to be the equivalent of an FSR. This assertion might have come from the IMF’s Code on Monetary and Financial Policies, which considers any publication program to be good practice, with no specific mention of an FSR. However, an FSR is little more than just a short section on financial stability: it is a regular, independent publication that focuses on systemic risks and contagion in the financial system. The key elements of this new tool are:

a) Focus on risks and uncovered positions in the market; and

b) Systemic risks.

From a central bank’s point of view, FSR discusses those risks that are different from individual exposures, which are usually catalogued by rating and other private-sector agencies, with more emphasis on aggregate risks identification and implication for the system overall.

The content of FSR varies from one central bank to another. However, it typically starts with an overall assessment of the global economy. The discussion includes identification of important risks, both domestic and international, followed by evaluation of the relevant risk factors. Some central banks may also include empirical assessment of risks, such as stress tests, to supplement the overarching objective of financial stability. Figure 5-2 presents the ratio of those FSRs that also incorporate the result of stress tests conducted for financial stability. Initially, the vast majority of FSRs did not consider stress tests as an integral part of the report, primarily because many central banks had yet to implement a stress test framework in their jurisdictions.
However, since 2001 the ratio of FSRs that also publish stress tests has increased to as high as 50% at the end of 2005, underlying the rising significance of stress tests.
In its very basic form, an FSR contains information on the payments system and existence of any standby liquidity arrangements offered by the regulators. The more advanced version of the report, published by central banks, such as Bank of England and Riskbank, contains structural analysis, typically integrating various sources of risk, including the payments systems, earnings outlook, linkages between the macroeconomy and asset values, and contagious exposures (see also, Figure 5.3 below).
Although Riskbank, Sweden’s central bank has pioneered FSRs, contemporary central banks have had little interest in their use in the past. The idea of “external communication” in the form of publication was, initially, very controversial among internationally active central banks. Some central banks, such as the U.S. Federal Reserve, considered publication of this sort of information for public consumption as a gross deviation from the traditional stance (conservative) of central banks. The critics cited endogenous feedbacks, resulting from the publication of such information, as a possible trigger for materialising risks instead of reducing such risks.

It is perhaps for this reason why some developed economies, including the U.S., have not yet adopted publication of these reports. Nonetheless, there are numerous benefits of publishing them:

a) Facilitates Communication

One of the major problems market participants face is when the market fails to optimally perform its function of price signalling and hence, the assumption of efficient markets is no longer valid. It is in these circumstances that severe mispricing and sectoral imbalances in the macroeconomy and financial markets might develop, possibly evading close attention from market participants and regulators. FSR can actually help market participants rein in
“irrational exuberance”\textsuperscript{73} about asset prices. This may also help to provide transparency in the workings of central banks.

We can identify many stress points in the regulatory structure that prevailed prior to the financial crisis (GFC), notably, over reliance on the market mechanism to regulate capital buffers. For example, in the U.K., credit standards were, at best, very liberal, and it relied on market (wholesale) funding for the provision of liquidity to individual banks. This idea has serious flaws, and is in contradiction to the “matching principle”: asset and liabilities are matched on the basis of their maturity. Later on, at the time when the crisis began unfolding, it was argued that the U.K. banks had seriously undermined their liquidity buffers — aggregate liquidity was significantly less than the regulatory minimum. Similarly, the idea that banks could always turn to the wholesale market for their liquidity needs, was a major flaw on the part of central banks, making them rethink the existing systemic risk framework (Barrell & Davies 2011).

The short term nature of the wholesale market for banking funding meant that it was less of an ideal for unprecedented credit growth, and it did just that as soon as the crisis began to squeeze credit markets.

b) Counteracts Negative Market Sentiment

It is important for central banks to pre-empt any build-up of risks, as unruly winding up of these risks are often a considerably costly exercise – increasing chances of a need to bail out banks and moral hazard problems. Given that markets can easily get into overdrive, even without improvement in the fundamentals, central banks need to provide accurate and robust assessment of economic conditions and their linkages with the financial system. In fact, one of the reasons why some central banks adopted FSR earlier than others was that most had recently experienced some form of financial crisis (Andersson 2008).

The idea of micro-prudential regulation by the central banks is often considered undesirable, not worthy of being associated with modern monetary policy. On the

\textsuperscript{73} See also, Shiller (2005) who explains the phenomenon of “irrational exuberance.”
contrary, market measures are usually considered public good that can help achieve financial stability.

According to Svensson (2001), micro-prudential oversight, especially in developed economies, is largely ineffective, as it causes distortions in asset markets, and might compromise the principle of transparency (due to size bias, and inefficient allocation of resources). This is more evident from the fact that many central banks now issue an FSR in addition to their regular inflation reports, which can provide an early warning signal, if problems arise in financial markets. Such reports are considered a positive externality, as they highlight the prudential oversight function of central banks.

Schinasi (2003) argues that central banks have a natural role in achieving a financial-stability objective. It is because features associated with a central bank, make it most suitable for this purpose. First, a central bank can act as the lender of the last resort. Therefore, its existence is imperative for liquidity, and the very survival of the banking sector. A central bank’s role gives credit worthiness to the entire payment system.

Second, central banks have a role in maintaining the smooth functioning of the payments system. It is important in the context of systemic risk, as perceived default at one institution could create problems at other banks, possibly in a domino fashion, leading to liquidity strains in some of the most important financial institutions. The payment system being at the very heart of the financial system has been the subject of much debate and reforms. To this end, some of the recent improvements are the efficient settlement of payments (such as the Real Time Gross Settlement System, RTGS) and stand-by swap arrangement between various central banks of the world.

Third, another role emanates from the fact that the banking sector serves as a transmission mechanism for monetary policy. If banks experience difficulties, it would be hard for the regulator to achieve its policy objectives, for instance, to stimulate growth and have low unemployment. This makes it imperative for central banks to act to stabilise financial markets.

This intervention, however, usually comes at an enormous cost (usually taxpayers bear the burden), and can possibly distort the market mechanism and efficient allocation of resources. For this reason, the use of state-sponsored measures to stabilise wild swings
in the business cycles, are the subject of much debate by the Austrian school\textsuperscript{74}. Nonetheless, given the enormous cost associated with boom-bust cycles, the role of regulators is sometimes warranted in a controlled and careful manner, without much cost to the taxpayers and the free market mechanism. Finally, there is an explicit link between monetary stability and financial stability. Milton Friedman has suggested that a financial crisis is entrenched when the money supply collapses, and the regulator fails to make concerted efforts to increase the money supply. This idea was successfully applied during the GFC, as national governments around the world bankrolled stimulus packages to sustain growth levels. However, regulators should not sway to the idea of stimulating their economies, especially when the fundamentals of their economy are significantly different than those countries which face imminent downturns. For example, the Australian economy is usually showcased as being a success story in the GFC episode. Its success story stems from the fact that it did not experience technical recession, as unemployment was low during the GFC. Moreover, its banking sector remained intact during the crisis. In fact, Australia’s four major banks were highly regarded for their top-notch credit ratings.

Had it not been, however, for depreciation in the exchange rate and strong growth in its trading partner economies, government-sponsored stimulus would have had little effect on the output and employment in the Australian economy. Even if loose monetary policy has been useful in countries experiencing downturn, we are now witnessing fiscal-related problems in those countries. Due to rampant bailouts and tax cuts, we now risk yet another recession; only this time there would be fewer tools available to the regulators to calm the jittery markets.

Oosterloo (2004) has conducted a survey of the central banks of the OECD countries to see whether they have any formal objective for FS. It is summarised in Appendix 5-1 provided at the end of thesis. It is not surprising to note that only a handful of central banks have some sort of formal objective of FS. There can be five different elements of a framework on FS function:

a) The overarching objective of maintaining financial stability;

b) Identification and management of systemic risk;

\textsuperscript{74} For instance, Ludwig Mises argued that money is demanded for its usefulness in purchasing other goods, rather than for its own sake and that any unsound credit expansion causes business cycles. See also, Mises’ book \textit{In Interventionism, an Economic Analysis} (1940) for more details on the subject.
c) Policy tools that can be used to address structural difference between the above two;  
d) Decision-making process; and  
e) Validation of the FS process.

The argument for declaring FS a public-policy objective of central banks largely rests on two main propositions: first, the financial system has a tendency to be cyclical. Second, any instability can generate negative contagion effects. Runs on the banks and protection of systemically important institutions are those factors that make the banking sector different—it is a highly fragile sector needing careful handling—and largely dependent on the regulator, should problems develop in some of the systemically important banks. The second risk, contagion, is potentially more damaging than bank runs, and arises when there is the development of a belief among market participants that losses at some banks would affect others as well. This can happen, either because of actual counterparty exposures, or by the perceived loss of confidence in an institution believed to have the same characteristics as a failing institution (Crockett 1997).

There is also a debate as to what extent central banks should be responsible for maintaining FS. Because a stable financial sector is considered a public good, the role of government and legislature is often emphasised in the matter. The subject of central bank independence was discussed in a recent study, which looked at the policy objectives of central banks of various countries. It is stated that:

"Many governments still seem to entertain the trade-off model between independence and accountability (as opposed to the complementarity model), and their revealed preference is for more accountability rather than for more independence" (Quintyn, Ramirez & Taylor 2007, p.4).

Although maintaining financial stability, including a properly functioning payments system, has become one of the core objectives of a considerable number of central banks, its implementation is far from simple—possibly in conflict with the other function of price stability. Svensson (2003) has discussed how to achieve a
reconciliation between the two objectives. The most effective way of having an inclusive regime for policy (one that includes financial stability, as well) is by putting a constraint on monetary policy instead of having a separate function for the latter objective. This should work well, especially in industrialised economies where under normal conditions, financial stability (FS) is quite robust and does not merit putting constraints on monetary policy. It should be considered like a “switching mechanism,” which activates when a financial crisis occur. In most cases, central banks address FS by expanding the monetary base and fiscal measures or both, in order to restore confidence in markets, allowing for an orderly unwinding of the imbalances. Another reason why the two policy objectives — monetary policy and financial stability — need to be accomplished in a coordinated manner is that central bank desires to have transparency, and at the same time preserve its operational independence, which would be undermined, if it were to have these objectives intertwined.

Typically, the conflict situation between the two objectives may arise in a financial crisis. For example, in a particular situation, a monetary policy calls for a tightening, but such action might further weaken the financial sector, possibly leading to a freeze in the credit market and payments system. Svensson (2001), however, notes that the emergence of such a conflict situation is unlikely given that central banks, particularly those in developed countries, vigorously manage their inflation target. A financial crisis most likely would see inflation falling below target, and in such a case both financial stability and monetary stability would call for similar actions — in this case, monetary easing.

Although, this perceived harmony between the two objectives seems to provide support for the way monetary policy is managed in the post-crisis era in most developed countries, there are countries, such as Australia, where this idea has lost traction75— there were several hikes (post-GFC) in the benchmark cash rate by the Reserve Bank.

75 See also, (Krugman 2010) for more details on this area.
Nonetheless, central banks will find it very hard to explain their deviation from the other objective (for instance, by deliberately compromising an inflation target) in the absence of external communication, and transparency in the conduct of the policy. Equally important is the question of how the central banks would assess the trigger mechanism for FS. It can do so, for instance, by constantly monitoring the financial system, and one possible way of doing this is to conduct a detailed analysis (either at a micro or macro level) of the financial sector — reports like the FSR published by many central banks hold a very good prospect here, as they typically contain analysis on the state of the financial sector, notably early-warning indicators of potential problems. These publications serve to report the true state of the economy and the financial sector when this is the case. They may also forewarn market participants and regulators when possible imbalances build up, allowing for corrective measures that might pre-empt a crisis.

### 5.3 PERFORMANCE OF FSR

Central banks use a variety of methods to address the issue of financial stability — employing both theoretical, as well as empirical tools. These approaches can differ in the way information is collected, or how stress test models are designed. For a solution to various problems related to financial stability, such as inefficient financial intermediation, information asymmetries, etc., we can look at Fracasso, Genberg, and Wyplosz (2003) who, as part of their survey of inflation targeting central banks, came up with a criterion for central bank publications. Their assessment of inflation reports — based on clarity, consistency, and coverage of key issues — can be applied to FSR, and the way it should be evaluated.\(^7\)

In this section, we look at the FSRs published by the Reserve Bank of Australia (RBA) from 2006 to 2009, covering the period before and during the 2007–2008 global financial crisis. Australia makes a good case for this analysis, as it was drawn into the GFC as a result of liquidity and credit contraction problems that followed the initial shocks experienced in the U.S. It is worthwhile discussing the Australian case because the RBA has developed considerable experience in publishing these reports. Moreover,

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\(^7\) A checklist of questions, which should be considered for evaluation of a typical FSR, is given in the appendix at the end.
it continued to evaluate potential risks to the economy during the crisis, and its views were expressed in the FSRs at the time.

5.4 THE GLOBAL FINANCIAL CRISIS AND AUSTRALIA

The Global Financial Crisis had its thrust in deteriorating sub-prime market in the U.S. The falling house prices then created significant problems for home owners, with many losing their homes to foreclosures beginning in 2007. Although many commentators had initially argued that these losses would be limited to just the housing market, without significant negative impact on the overall economy. On the contrary, when markets in the U.S. experienced abrupt an jump in counterparty risk prompted by losses at IKB, a German-bank, ABN-Amro Bank, and BNP Paribas (one of largest investment banks) in the summer of 2007, it was evident that the U.S. housing market was in serious turmoil. Despite the Federal Reserve's injection of liquidity, the markets could not fully recover and, in September 2008, the financial system was already experiencing severe tightening of funding and market liquidity, spurred by the bankruptcy of several investment banks, notably Lehman Brothers and one of the largest U.S.-based insurers AIG.

Much like the sub-prime losses spread to the other sectors of the U.S. economy (through a variety of channels, such as “balance sheet” and asset price declines) as the crisis deepened, the crisis also affected other countries, especially the ones which had direct exposures to the U.S. housing market. For example, in the U.K., which was directly affected by the U.S. sub-prime foreclosures, market conditions were analogous to those in the U.S., as evident from the collapse of several U.K. banks, particularly Northern Rock and The Royal Bank of Scotland which were ultimately bailed out with public funding.

At the same time, adverse conditions in other major economies were somewhat less pronounced from those in the U.S., primarily because they were indirectly affected by the ensuing global recession, and did not have major exposure to the U.S. markets. Australia is a case in point, as it has weathered the Global Financial Crisis of 2007–2008 relatively well so far and, as previously argued, it owes much of this to its

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77 In fact, had the subprime losses not spilt over to the rest of the U.S. economy, they would, at worst, parallel typical market losses on any given day. This was highlighted by the Federal Reserve Chairman Bernanke during his 2010 testimony before the Financial Crisis Inquiry Commission (U.S.)
conservative credit-granting standards, and a relatively small sub-prime share of the total mortgage market (including both domestic and international).

Nonetheless, Australia did experience some losses, although they were not as contagious as their counterparts in the U.S. or U.K. and more generally, Europe. For example, the residential mortgage backed securities (RMBS) arrears in Australia increased marginally from 1.1% in 2006 to 1.6% by late 2008. Similarly, around the same time, there were some losses experienced on the more complex collateralised debt obligations (CDOs), with a total exposure of A$7 billion. Household asset values saw a minor decline of 3% during the year 2008–09, compared to 17% in the U.S.

At the individual level, Australia experienced losses at several institutions, such as ABC Learning, Allco, and Babcock and Brown, totalling not more than A$66 billion (during the entire duration of the crisis). Individual investors also made losses on their investments with Opes Prime and Storm Financial.

Overall, however, owing to a strong economy, a conservative regulatory regime, strong banking sector, and to some extent, government stimulus, Australia was relatively unharmed by the GFC. Notwithstanding, Australia did experience a contraction in economic activity, with unemployment rising from 4.1% in March 2008 to 5.8% by mid-2009.

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78 This section draws on the crisis-assessment of Chairman Australian Securities and Investment Commission D’Aloisio (2010).
79 A CDO and RMBS differ only in their composition of underlying assets; CDO are usually called “exotic” products as they combine a variety of assets in their asset pool, and deemed to be relatively more opaque, posing considerable difficulty for them to be rated.
80 The Australian Government had responded to the GFC by announcing various fiscal and monetary measures to stimulate the economy and void a possible recession. The first macroeconomic response was RBA’s cash rate cut early October 2008 of 100 basis points (bps) to 6%, followed by bank-deposit guarantee scheme announced in the same month. These financial stability measures were soon followed by fiscal measures from the government: in line with recommendations from the IMF and The Group of Twenty (G-20), the Australian Government outlined stimulus package to the tune of A$10.4 billion, or almost 1% of GDP, with the bulk of the stimulus handed out as cash bonuses to low-income families. This was followed by a second-round of injection of A$42 billion (almost equivalent in relative terms to the February 2009 U.S. stimulus of U.S.$ 787 billion), called Nation Building and Jobs Plan, with much of the funding (almost 70%) reserved for infrastructure projects such as construction projects in education and housing sectors. Note: It is worth mentioning here that there is currently disagreement among economists as to whether it was mainly because of stimulus package or other factors such as exchange rate and interest rate that afforded Australia to weather the GFC relatively well. Some of these commentators that proposes this view are: Kates (2011) and Makin (2010).
5.5 PERFORMANCE OF RBA FINANCIAL STABILITY REPORTS (FSRS)

The Reserve Bank of Australia’s FSRs, which are published bi-annually in March and in September, identified some of the risks that served as a prelude to the 2007–2008 Global Financial Crisis. The September 2006 report noted in its outlook for the world economy, the strong growth in business credit prompted by rising leverage and below-average interest rates in a number of jurisdictions. In all major financial centres, both securitised investments (carrying higher liquidity and operational risk), and banks’ profitability was strong. On the domestic front, the report noted that overall the household sector had performed well, with consumption increasing in line with incomes. Notwithstanding, mortgage-related arrears increased somewhat, mainly due to permissive credit standards adopted since the last ten years or so which could pose a threat to financial stability. It further noted strong domestic financial conditions, prompted by economic expansion over the last 15 years. In terms of funding liquidity, the report warned about a decline in household savings placed on deposit with banks from 40% in the early 1990s to less than one quarter of the total funding recently.

5.5.1 EVALUATION OF FSRS

The effectiveness of risks identified above by the FSRs are analysed using the financial stability framework used for this purpose. In this respect, the stress testing exercise, which the RBA regularly conducts under the IMF’s Financial Sector Assessment Program (FSAP), tested two major-risk sources of a recession: a large fall in property prices, and a rise in Australian banks’ foreign funding costs. In a plausible scenario, Australia could witness a rise in the unemployment rate from 5% to 9%, a house price decline of up to 30%, and a decline in household consumption of 2.5%. The fact that Australia’s financial sector, historically, has had very low exposures to international markets may lead to the perception that people here are somehow immune to adverse conditions. However, this is entirely contrary to the reality, especially when nearly all recessions in Australia have had their roots in global recessions. Therefore, FSRs’ discussion of both domestic as well as global events is a critical task for the Australian authorities. Australia’s FSRs have, on the whole, evaluated some of the risks involved in causing the GFC. The March 2008 FSR noted the heightened uncertainty in the
global markets to have three facets, namely the credit standing of banks, position of various securitised investments, and the U.S. housing market, all of which later played important roles in propagating the GFC. So, overall, this study believes that the Australian FSRs’ performance in achieving their objective of communicating potential vulnerabilities in the financial markets, particularly about the pre-crisis period, was successful. Notwithstanding, these reports underestimated some of the risks, particularly funding and market liquidity risk that also played an important role in exacerbating the GFC.

5.6 CONCLUSION

Financial stability has been adopted by national regulators as the main focus of their macroprudential oversight. It is different from monetary policy, which only concerns with how to anchor public expectation for prices. It encompasses a large set of indicators and economic conditions, which we only recently have come to known. While central banks have been able to achieve success on the inflation front, the same cannot be said of financial stability. Any measures are welcome steps in achieving this rather elusive pursuit of central banks, that is, financial stability. The FSRs published by RBA are vital for resolution management of systemic risks, such as payment system problems, sectoral imbalances, and large bilateral exposures. Notwithstanding, these FSRs underestimated some of the risks to the financial system but on the whole, they were successful in providing pricing information, potentially helping unfreeze the domestic credit market, and restoring investor-confidence.
Chapter 6

GLOBAL FINANCIAL CRISIS, MORAL HAZARD, AND POLICY PRESCRIPTIONS

“I think at the LSE [London School of Economics] you may have heard of someone named Adam Smith, who said that the remarkable thing about a market system is that the greed and self-aggrandizement of individuals is somehow mysteriously transmuted into the welfare of the public as a whole, and markets working effectively and properly can do that, and we certainly do not want to lose the strengths of the market system as we, for example, consider new regulations. Having said that, financial system is a peculiar case, is on one hand a tremendous source of growth and innovation, source of income here in London and many other places, but on the other hand, for hundreds of years, periodically, the financial system has gone into booms and crises and some of these crises have been very costly. 1930s comes to mind and the recent interference shows how powerful the effects of financial crises on the real economy can be. So without passing judgments on the morals of investment bankers, some of whom are probably very decent people, the purpose is not to impose morality, the purpose is to make the market system work so that when individuals act in their own interest, as they are inclined to do in matters of business and finance, that the resulting outcome will be good for everybody. And in the financial system because of this tendency to booms and crises, a certain amount of regulation and oversight appears to be necessary. The trick is to do it in a balanced way that will control excessive risk-taking, excessive leverage, crises, while not abandoning all the benefits of venture capital and lending to new industries and all the things that are important for economic growth” (Bernanke 2009a).

6.1 INTRODUCTION

In the U.S. and many other countries such as Japan, the past decade was marked by a relative calm and a generous monetary policy, with interest rates at their lowest levels. This resulted in the enormous growth of new financial products and increased velocity of money and credit. Part of the surge in credit growth in the developed world, especially in the U.S., was fuelled by what U.S. Federal Reserve Chairman Bernanke (2010) calls the “global savings glut.” The savings in surplus countries were spurred by the lack of domestic spending in those countries.

81 The Federal Funds Effective rate was less than 2% during the 2002–2004 period. See also, www.federalreserve.gov for more details.
This era of prosperity and enhanced belief in leverage ended with the 2007–2008 financial crisis, which saw many financial institutions going bust, and many economies going into recession, provided new dimensions for the traditional view of monetary policy and economic stabilisation. For example, many commentators including Alan Greenspan, former chairman of the U.S. Federal Reserve believed in the self-regulating mechanism of the financial system. The complacency on the part of central banks believing in the benevolence of markets was clearly evident from the deregulation policies pursued in their jurisdictions since the early 1980s, in particular the U.S. and the U.K. The numerous developments in derivative investments were seen as a panacea to many, if not all, the risks in the financial markets — using hedging instruments, risk has been completely diversified away, when this clearly might not be the case.

Our discussion of systemic risk and financial stability (discussed in Chapters 2, 3 and 4) is largely in the context of conventional tools of monetary policy. However, since the GFC demanded extraordinary measures (for instance, money expansion beyond the zero-bound)\(^{82}\), it provides a suitable test case for financial-stability issues related to questions like: (1) what is the role of excessive leverage in the economy? (2) How various forms of liquidity is important? (3) what role, and in what form, is there for the government in all of this? (4) What is role for effective disclosure by market participants? These are the research questions particular to unconventional monetary policy being discussed in this chapter.

The extent to which central banks were involved in the extraordinary measures can be judged from the fact that, while they were expanding reserves to unprecedented levels, there was still a significant lull in the financial markets, which was seriously affecting their normal operations. Taylor & Williams (2008) call this a “black swan” event that impinges on the availability of long-term credit (as judged from the spread between the daily interbank interest rate, interest rate swap, such as OIS, and term rates such as the 3-month Libor) despite the Federal Reserve’s aggressive expansion of its balance sheet. More specifically, the Federal Reserve’s new term auction facility (TAF) was not having

\(^{82}\) Conventional monetary policy assumes money aggregates cannot be extended beyond interest rates close to zero. Others, including Ben Bernanke, believe expansion is indeed possible at very low interest rates through measures such as duration commitment (DC), quantitative easing (QE), and credit easing (CE) by the central bank. In CE, a central bank alters the composition of assets held in lieu of reserves, so it moves from riskless securities to more risky securities.
its intended effect in reducing the Libor-OIS spread. Instead, it was counterparty risk that was responsible for the unusual jump in the spread.

This contribution of this chapter is that it provides an overview of the crisis, which started initially with an ostensible freeze in the credit markets in early-August 2007 and still continues to affect economies all over the world. It will investigate the GFC from the information-asymmetry theory aspects, later extending it to include financial intermediation, in particular funding and market liquidity dynamics. Although this chapter will discuss crisis events that took place mainly in the U.S. and Europe, which obviously was what started the crisis in the first place, the analysis has unequivocal usefulness in the context of other countries including Australia, which was ultimately affected by the GFC—although, indirectly and not as severely as the other countries.

The discussion will elaborate the dynamics of the crisis and what the regulators and governments did, in somewhat arduous circumstances, to contain it, protecting their economies from a complete stall. It is worthwhile to discuss the developments in the lead up to the crisis because that could help us identify symptoms and causes of the crisis. To do this, we will start by discussing the recent developments, especially the leverage-related innovations in the financial markets. This will be the subject of section 6.2. It is also worth exploring what central banks do in their normal course to maintain financial and price stability. The use of traditional monetary-policy tools available to the central banks will be discussed in section 6.4. Next, in section 6.5, we will discuss what indicators are important for indentifying symptoms and plausible causes of the crisis. Section 6.7 will outline central banks and governments’ responses, including the recent G-20 summits, on the crisis, and their implication for the future of the banking industry; this section will be followed by conclusions about the topic.

6.2 A PRECURSOR TO THE CRISIS

Over the past couple of decades, the financial system has become the backbone of any modern economy, with ever more focus on the allocation of resources to their most efficient uses. The developments in the financial markets took a giant leap in the aftermath of the exchange crisis beginning in early-1970s, heralding the arrival of new, complex tools to manage risks that arose, as more and more countries saw their currency float in the market. Not only there was difficulty in the design of tools to manage these new risks, but also the greater challenge lay in the price mechanism of
these new tools. However, the so-called era of great moderation (1980s through to 1989) obscured any urgent need for improvements in risk management practices for these new products.

Later in successive decades, we see enormous innovations in the way financial institutions operate, and pursue their goal of profit maximisation. In the past, lending was usually done by a depository institution, maintaining close oversight of the entire loan-extension process. Then, in an extraordinary episode of innovation, depository institutions experimented relegating their loans from their own book to those of other intermediaries, such as investment banks, brokers, and insurance companies. Although the motive to pass on loans to other financial intermediaries is clearly capital arbitrage, which is a way to avoid maintaining high levels of equity, the origin of the idea of originate-to-distribute models is less evident — perhaps it might well have come from the manufacturing sector, which increasingly involves, for cost cutting purposes, distributing production across stages and locations.

However, this securitization process has profound implications for the financial system. In the past, an income stream and its associated risks would come as one separate unit, so risks could be associated easily with their corresponding exposures, making their pricing much more transparent and easy to understand. Under this slicing-and-dicing approach, income streams could now be split into any number of fragments and combined into pools containing similar or even different securities to the ones that are being pooled.

Securitization may be good from an efficiency point of view, but not so good from risk point of view, where much focus is instead on transparency and pricing of these complex products.

In order to increase the volume of trade in securitized instruments, the offering was extended to the retail sector: mortgages, credit cards, automobile loans, and personal loans, etc. Here mortgage backed securities (MBS) are more important for our

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83 Banks usually have funding constraints such as Basel II standard (revised Basel III), which sets the required capital as a function of the riskiness of their assets, so passing on assets (loans) to other intermediaries provides a clear incentive to work around the regulatory capital rules enforced by the authorities. Sponsors as they are called offering such services clearly benefit from efficiency gains, as they are not required to hold enough equity which tends to be a costly source of funds.

84 Mortgage backed securities (MBS) or residential mortgage backed securities (RMBS) are backed by a pool of one-asset class, i.e., mortgages; collateralised debt obligations (CDO) are anchored by a pool comprising not only mortgages but all sorts of loans such as credit cards and personal loans; a synthetic
discussion of key developments in the crisis. These assets were all bundled together to form pools of assets that would serve as collateral for securities being issued to investors. This enabled the sponsors of these originate-to-distribute transactions to diversify risks for owners of the securities, through large pools of collateral, and at the same time gain access to unconventional sources of funding for structuring these products. Recall that conventional funds are acquired from the retail sector, and serve as most stable, longer-term form of financing compared to those acquired from the wholesale market.

The retail sector looked like a very promising area for an expansion of non-traditional forms of financing, but this increasing level of securitization did not stop there, as more exotic forms of asset pools were being designed and marketed to the corporate sector. Then there is the unprecedented increase in derivatives that reference these asset pools. So, basically, we have a financial system built as layers upon layers, with each layer representing an innovation of existing asset pools — much like changing squares on a Rubik’s cube.

### 6.2.1 HOUSING BOOM

The tremendous growth of retail credit looked good, until the beginning of 2007 when doubts were raised as to the quality of some of these mortgage securities. As there was much activity going on in the housing sector, it would be worthwhile to see trends in this sector and make sense of the events taking place around the time. We can, for instance, look at Figure 6.1 below which shows trends in the housing sector few years prior to the crisis. The use of this measure (house price to rents) is the equivalent of price-earnings (P/E) ratio used for stocks, and is used to see if there is any indication of overpricing in the housing sector. The ratio is usually adjusted for inflation as in the case of Shiller’s price-earnings ratio for stocks. In simple terms, this

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CDO is actually a derivative which references some pool of mortgage backed securities. It can be used for either hedging or speculation. A credit default swap (CDS) is a good example of this type of derivative, involving a buyer, who pays regular premiums in return for protection against default, and a seller, who receive premiums in exchange for providing protection against default.

85 This can also be derived from the Gordon growth model used for valuation of stocks. According to this model, total return, \( r = \text{income} + \text{expected capital gain} \). So a rise in the ratio of home prices to rents indicates that investors are expecting increasing capital gains typical of a speculative bubble in the housing market.

86 See also, Shiller (2005) for the concept “Irrational Exuberance.”

120
ratio represents the number of years it would take the investment (in this case, a house) to pay back its price.
If we look at the left of Figure 6.1 we observe that the long-term average of the ratio of home-price-to-rent, with data starting in 1955, is around 10, which seems reasonable as it represents a cost of around 10% to the home buyer. However, in the next five-year period from 2000 to 2005, it has jumped to a level as high as 14.5, which is indicative of a plausible “bubble” in the housing sector. The existence of excessive investment in the housing sector can also be judged from its deviation from fundamental values, that is, replacement cost. At this high level, which can be thought of as a tipping point, a massive downturn — of at least 20 percent — in the housing sector is highly likely.

6.2.2 HOUSING BOOM, LEVERAGE, AND WEALTH GENERATION

Now the important question is why and how so much excessive investment was taking place in the housing sector instead of just any other sector of the economy? To understand this, we can look at the housing sector from the point of view of incentives the sector may have offered to investors who wanted ever-higher yields on their investments.
As the housing sector was seen to be generating ever-higher wealth and income, a significant portion of this was being dissipated into consumption, encouraging the wealth-consumption spiral. Investors realised the best way to achieve quickly the wealth-increasing effects of rising prices is to use leverage to fund their exposure to the housing sector. Increased leverage gave rise to levitating housing prices, which were already at their historical high levels.

6.2.3 RISING HOUSE PRICES AND FINANCIAL SECTOR INNOVATION — SECURITIZATION

There is indication of the contribution of securitization in the current financial crisis. So it may help if we explain how the process works, by using Figure 6.2 below.
The process starts when a borrower obtains a loan (let’s say, a mortgage), possibly with the help of a broker, from a traditional depository institution, such as a commercial bank. Most often, lender and broker keep no further liaison with borrowers once the loan is granted. Then, the lender combines all those loans that have similar risk characteristics, and transfers (sells) the loans to the special purpose vehicle (SPV), a separate legal entity, with the borrowers making regular payments, through the nominated registrar, to the SPV instead of the bank that originated those loans in the first place. The SPV then offers securities, backed by a pool of assets, such as mortgages, to investors. The offer may be substantiated by the appointment of an underwriter and a rating agency. Lastly, the registrar manages collection of loan payments from borrowers, and transfers the proceeds to the SPV for onward payment to investors. The registrar or the trustee manages delinquencies and write-offs according to the terms stipulated in the securitization contracts.

The securitization process achieves scale efficiency as the sponsor (bank) separates the traditional financing-investment function from its balance sheet by creating the special purpose vehicle. The process is beneficial to the sponsors not only because it could
generate significant commissions (from underwriting), but also because it created the incentives to hold ever-lower levels of economic capital, endangering the long-term survival of sponsors of the SPV.

6.2.4 THE SURGE IN HOUSE PRICES

Now, coming back to the issue of why excessive investment made its way to just the housing sector. We can explore this by looking at the structure of the U.S. mortgage market. We basically have a two-tier system: the government sponsored entities, or GSEs, such as Fannie Mae (Federal National Mortgage Association) and Freddie Mac (Federal Home Loan Mortgage Corporation), and privately-held securitization companies whose securities are generally called asset backed securities, or simply ABS. The GSEs are actually guaranteed by the U.S. Government, and have a certain level of regulation and inclusion criteria, with emphasis on the size and quality of mortgages. On the other hand, the ABS issues were more lenient in terms of quality and loan size, which enabled them to increase their market share significantly during the period 2000–2004. Loose regulation in the case of ABS issues helped their tremendous growth, reaching unsustainable levels, which ultimately caused problems in the housing sector.

According to Greenlaw et al. (2008), during the period 2001–2004, securitization in the high-quality group sponsored by the GSEs actually had little change while those in the ABS group, consisting of subprime mortgages, rose sharply from around 10% of total issues to nearly 25% in 2004, and kept rising well above that level during the next two years.

87 Effective 1 October 2011, GSEs’ maximum single loan limit will be reduced from the current $729,750 to $625,500.
Later during that period (2000–2006), we see all sorts of innovations taking place in the securitization market, introducing an ever-increasing variety of assets to the securitization pool. We can observe the increase in both collateralised debt obligations, or CDOs, and derivatives such as credit default swaps, or CDSs.

The CDO, which is a special purpose vehicle, buys a portfolio of income-generating assets, and finances the purchase by issuing different classes of risks in the financial markets. The tranches involved are usually: (1) a senior tranche, rated AAA; (2) Mezzanine tranches, rated somewhere from AA to BB; and (3) equity tranche (unrated), which comes last in order of payment, and suffers the first default.

Although the pooling of various types of assets has portfolio diversification benefits, it does suffer from a loss of transparency required for fair assessment of risk.

Gorton (2008) attributes this to the practice of intertwining securities, structures, and derivatives all together, inhibiting information-generating processes and our ability to look through the underlying securities to have a fair assessment of the different layers of these structures. This had generated a vast network of interconnectedness between the counterparties who had exposures to these products, making it difficult to ascertain the path or location of where the risk might eventually end up.

### 6.2.5 SECURITIZATION AND THE ROLE OF RATINGS

In a critical development, the market participants dealing in securitizations had their task of risk assessment (for assets underlying securitization) delegated to rating agencies, such as Standard & Poors, Fitch, and Moody’s, leading to a rating system which clearly had many shortcomings, notably, “conflict of interest.”

It was stated that:

“Investors placed too much faith in the rating agencies – which, to put it mildly, failed to get it right. It is tempting to take the rating agencies out for a public whipping. But it is more constructive to ask how the rating system might be improved” (Blinder 2007).\(^\text{88}\)

Although many institutional investors were required by their statutes to invest only in AAA securities, they still suffered losses because their AAA-rated investments were not what they were supposed to be in terms of certainty of repayments.

6.3 ADVERSE SELECTION, LIQUIDITY SPIRAL, AND LEVERAGE

Monetary theory tells us that central bank’s policy actions are transmitted to the real economy through various channels, such as the traditional channels of interest and exchange rates and non-traditional channels of credit, balance-sheet and asset prices. While central banks are usually able to achieve desired policy objectives through the transmission mechanism, the process is not always so straightforward. Aside from the weak connection of monetary policy with the traditional channels (interest rate and exchange rate), there are times when even the relatively more responsive channels of bank lending and asset prices balk.

The central banks targeting mechanism becomes less responsive when there is a supply or demand shock to the economy, much like in a financial crisis. It appears that because the central bank’s policy is best applied when market participants have confidence in the regulators’ ability to stabilise markets, adverse economic conditions somehow hinder propagation of monetary policy to the targeted sectors of the economy.

George Akerlof’s (1970) Nobel-Prize-winning article “The market for Lemons” may help us understand why such imperfections arise in the intermediation of monetary policy. When car buyers are unable to distinguish an inferior-quality car from a good car, they would be willing to pay only an average price for the car. So the good-car owners, who were expecting a premium for the good condition of their cars, would simply take their cars off the market. The fact that the seller knows more about the true condition of the car creates what is called the “information asymmetry problem.”

The concept can also be applied to bank lending as, again, we are concerned with a product, a financial instrument in our case, whose worth is more accurately known only to the borrower. Again, if the lender is unable to distinguish a good investment from a bad one, this will create adverse selection and moral hazard problems. Now turning back to our discussion above, we can ask the question: how information

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89 See also, “Thinking about the liquidity trap” by Krugman (1999).
asymmetry relates to intermediation of monetary policy in the case of a financial crisis? Although we know that monetary policy is transmitted to the economy through credit and asset price channels, what caused it not to work during the financial crisis of 2007–2008, even as central banks were aggressively expanding their monetary base, and changing the composition of their balance sheet.

According to Cecchetti & Schoenholtz (2011), the financial crisis, in fact, reinforced the problem of asymmetric information. Since so much of the financial intermediation is based on the normal flow of information between lenders and savers, any drop in its quality is likely to choke the credit intermediation process. In the financial crisis, mortgage-related losses at many institutions and the unprecedented rise in uncertainty about the viability of some of the big players — such as Bear Stearns, Lehman Brothers, and Washington Mutual, etc., who had large exposure to the household sector — affected confidence in their ability to stay afloat and thus, almost stalled the availability of credit to them.

6.3.1 LIQUIDITY SPIRAL

This initial bout of “pessimism” among market participants caused funding liquidity to grind to a halt. Figure 6.3 below explains how the lack of funding liquidity causes a destabilising feedback loop between dwindling economic prospects and worsening economic conditions that are so much part of a stable-growth process.
Under normal conditions, shadow banks\(^{90}\) access funding liquidity through their use of securities, which are subject to very nominal levels of *haircuts*\(^{91}\), so they can easily roll over their short-term liabilities as soon as they mature. In the last decade or so, they have seen a tremendous increase in the size of interbank market, successfully providing funding to a variety of businesses. For example, in the U.S., their market share reached the equivalent of the traditional banking system by mid-2008.

This interbank funding model however faced a crucial setback at the onset of the current crisis, creating what is now called a *modern bank run*\(^{92}\), in which concerns about the credit worthiness of a borrower lead to a complete lull or significant decrease in wholesale funding, usually marked by low volumes of trade and rising security haircuts. The collapse, for example, of U.S. investment and brokerage firm Bear Stearns in

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\(^{90}\) These are non-depository banks and financial institutions, e.g., investment banks, hedge funds, mutual funds, etc., who raise their funding from the inter-bank market instead of depositors, principally through Repo transactions which are simply borrowing in return for handing over approved securities, oftentimes issued by governments and other public entities.

\(^{91}\) A haircut is a safety margin specified in the lending contract. For example, a bank lending $100 through a Repo transaction, may ask $110 in securities from the shadow bank, so $10 would serve as a “haircut” in this case.

\(^{92}\) See, among others, (1) *Securitized Banking and the Run on Repo*; and (2) *Haircuts* by (Akerlof, GA 1970; Taylor & Williams 2008); (3) *The Failure Mechanics of Dealer Banks* by (Cecchetti, Stephen G & Schoenholtz 2011) and (4) for a more-detailed description of how the modern bank run works. See also, French et al. (2009a) for a general overview of the concept of modern bank runs in their book “The Squam Lake Report: Fixing the Financial System.”
early-2008 was, according to some commentators, precipitated by a run on the bank, including withdrawal of $5 billion by its client Renaissance Technologies. This lead to a perception of stigma surrounding the investment bank and, although it had enough liquidity the week before the collapse, it quickly ran out of cash in a spiralling loop of liquidity-asset price-liquidity.

Similarly, the other important channel of monetary policy, that is, changes in the balance sheet size, remained ineffective as well, as the net worth of more and more households was wiped out due to declining asset prices.

### 6.3.2 LEVERAGE

Leverage is often associated with the plausible causes of financial crises. This idea has been recently popularised by many as a “Minsky moment,” referring to the contribution of late Hyman Minsky in explaining economic cycles. Specifically, Minsky’s “Financial Instability Hypothesis” states, in simple terms, that over a prolonged period of good times, modern economies tend to rely more on speculative (highly leveraged) firms. These firms see their net worth being quickly wiped out, as they sell out assets to clear their positions, as soon as some liquidity constraint entrenches, leading to significant price declines, possibly a financial crisis. This resurgence of the “Minsky moment” can be attributed to many economists, noted among them are: Krugman (2009), Wolf (2008) and Calomiris (2007), all explaining the importance of leverage in the current crisis.

### 6.4 TRADITIONAL TOOLS AVAILABLE TO A CENTRAL BANK

It is important to discuss the traditional role of the central banks and what they do in terms of monetary policy, so as to be able to analyse effectively the various developments that took place during the GFC. Although the discussion here will draw mostly on one central bank, i.e., the U.S. Federal Reserve, it can be related to other central banks including Australia, as almost every modern central bank derives its policy from common principles. Bernanke (2011) more fully describes this universality principle of central banking: monetary policy today is mostly about buying

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93 See also, (Minsky, HP 1986, 1992) for details on “Financial Instability Hypothesis.”

94 Although policy priorities may differ among central banks, for instance, unlike the Federal Reserve, the European Central Bank (ECB) maintains only one objective, that is, price stability, this will have little effect on our analysis of traditional-tools of monetary policy.
and selling government securities, so as to achieve a stable price level and sustained economic growth.
Almost anything a central bank does to set up a particular monetary policy stance, relates to its balance sheet management. It would be useful to discuss stylised facts about the balance sheet provided in Table 6.1 below.
<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities</td>
<td>717,819</td>
</tr>
<tr>
<td>Federal Reserve notes</td>
<td>719,436</td>
</tr>
<tr>
<td>Repurchase agreements</td>
<td>33,000</td>
</tr>
<tr>
<td>Reverse repurchase agreements</td>
<td>30,783</td>
</tr>
<tr>
<td>Loans</td>
<td>43</td>
</tr>
<tr>
<td>Balance, U.S. Treasury account</td>
<td>5,912</td>
</tr>
<tr>
<td>Float</td>
<td>927</td>
</tr>
<tr>
<td>Other liabilities and capital</td>
<td>27,745</td>
</tr>
<tr>
<td>All other assets</td>
<td>56,130</td>
</tr>
<tr>
<td>Balances, all depository</td>
<td>24,043</td>
</tr>
<tr>
<td>Total assets</td>
<td>807,919</td>
</tr>
<tr>
<td>Total liabilities</td>
<td>807,919</td>
</tr>
</tbody>
</table>

Source: (Federal Reserve System 2005)

### 6.4.1 FEDERAL RESERVE ASSETS

The Federal Reserve’s most used function to influence the supply of money and credit is its use of open market operation (OMO) conducted by the Federal Open Market Committee (FOMC) to buy and sell government securities. If the Federal Reserve, for instance, wants to lower its target interest rate called the “Federal funds rate” and affect ultimately the interbank rate and retail interest rate, it would announce an OMO inviting bids from primary dealers (usually investment banks) for funds to be secured from it. Successful bidders then get their reserve accounts with the Federal Reserve credited with the proceeds of the auction. This increased supply of reserves in the financial system puts downward pressure on interest rates, bringing them within the desired range of interest rate.

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95 Float is a kind of temporary account that affects the size of Federal Reserve balance sheet, and arises out of the accounting mismatches of the payment system. It would temporarily increase reserve balances when a beneficiary account is credited for the proceeds of the cheque that is yet to be presented to the paying bank for reasons such as inclement weather, etc. Similarly, it would drain reserve balances when a depository institution’s account is debited but the beneficiary bank account is credited only on designated dates.

96 These typically include assets such as foreign currency (FX) reserves, gold, etc.

97 It is important to note that only eligible securities such as Treasury bills, notes and agency-issued securities are purchased.

98 The name derives from the fact that this rate applies to securing funds from the Federal Reserve.
One very important technical point worth noting is that the Federal Reserve, like any other central bank, cannot purchase securities directly from the U.S. Government, because otherwise it would be called “debt monetizing,” which historically had seriously undermined the credibility of central banks. In fact, today only a handful of the world currencies are considered investment-grade, primarily because those central banks that issue them, have earned themselves a name for being highly independent and fully in control of their monetary policy.

This role of the central bank involving open market operations has increased during recent times, mainly due to an increase in demand for reserves.

While OMO involves outright purchase or sale of securities, the repurchase agreement (Repo), which is really the work horse of almost all central banks, involves increasing the supply of reserves in return for securities. They are held more frequently for the purpose of providing short-term, typically overnight, liquidity to banks. At the maturity of these transactions, simply the opposite occurs, that is, the collateral (or security) is returned and reserves previously created are drained from the system.

The primary lending facility, or discount window as it is commonly called, is the Federal Reserve’s traditional method of extending emergency credit, typically overnight, but extendible up to 14 days, to depository banks. The facility, however, is less-frequently used because borrowing banks have to provide some justification for the use of this facility. This creates a perceived reluctance by banks to make use of this service.

6.4.2 FEDERAL RESERVE LIABILITIES

Federal Reserve notes is one of the most important exogenous, or autonomous, factors that affect the conduct of monetary policy, primarily because the Federal Reserve does not have this factor under its day-to-day control.

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99 Eisenbeis (2011) argues that by vast increases in the amount of government securities, the Federal Reserve is actually indirectly monetizing the debt.

100 Although, the idea of independent central banking has existed long ago – for example, the establishment of U.S. Federal Reserve in 1913 was a move towards a stable currency, and stable financial system – it was widely adopted in the aftermath of persistently high inflation of the 1970s. Independent central banks now operate in countries such as U.S., the U.K., Switzerland, Japan, Canada, Australia, New Zealand, and European Union (EU).
At times, depository institutions may want to convert part of their reserve holding at the Federal Reserve into currency to meet customer demand; this is accomplished by debiting the reserve balance of a bank, and paying the equivalent amount in cash, reducing the reserve balance in the system. The demand for cash may increase over time, primarily because of increase in consumption due to growth in the economy, and in the case of reserve currencies, such as U.S. dollar, U.K. pound, etc., a rise in international demand may be due to the network externality effect. The decline in reserves as a result of currency supply has to be offset by an increase in the securities held at the Federal Reserve.

Reverse Repo is the opposite of Repo transactions and involves selling securities by the central bank and destroying reserves. Short-term temporary operations are held more frequently than long-term operations, mainly because daily fluctuations, such as payments system pressures (also called contractual clearing balance), may create imbalances between the demand for and supply of money that might cause the funds rate to deviate from the target rate.

Another important input in the monetary policy is the Treasury account held at the Federal Reserve. The Treasury uses this account for making payments for spending. Similarly, it receives the proceeds from taxes or other income in this account. The trend analysis of withdrawals from this account can be used for important policy questions relating to public-private spending decisions.

Reserves are the balances depository institutions hold at their respective central bank, and may include both required as well as excess-reserve balances. The level of these reserves are integral to the conduct of effective monetary policy, as the central bank desires to supply reserve balances in line with the demand for these balances at the target rate. These are closely associated with the size of the central bank balance sheet. For instance, if the central bank wants to increase reserve balances, it may simply purchase government securities, possibly through an open market operation.

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101 Network Externality effect is attributed to the presence of economies of scale as one currency dominates trade and debt securities markets. U.S. dollar is a good example of the network effect, as almost 2/3 of the world’s total FX reserves are denominated in dollar; similarly, U.S. dollar also dominates currencies used for settlement for gold, oil, or other commodities.

102 Known as Cash rate in Australia, Federal Funds rate in the U.S.
(OMO) and credit the account of the beneficiary bank maintained with the central bank.

6.5 SYMPTOMS AND PLAUSIBLE CAUSES OF THE CRISIS

Banks and financial intermediaries usually utilise arbitrage opportunities by borrowing in the interbank market and lending long-term to households and businesses. This enables them to take advantage of the upward-sloping normal yield curve. Their business model, being discussed, is based on the assumption that they will be able to manage their liability-side risk, that is, short-term borrowing. This is usually realised through some sort of insurance or capital buffers meant for this purpose. Nevertheless, banks still retain a certain level of credit risk that requires them to pay a nominal premium over securities that are considered highly safe, such as bills, notes, and bonds issued by the U.S. Treasury. The amount of this premium or excess yield at any time can be read from indicators, such as Libor-OIS spread and the short-term commercial papers. This is a very useful measure for evaluating conditions in the credit market — more like a pulse of the financial market. Here is how it works: Libor is an indicative rate published by the British Banks Association (BBA). The fact that it is a benchmark rate derived from submissions by some of the leading banks having expertise in a particular currency, makes it one of the most-widely-used reference rate for derivatives and loan contracts. It indicates the lowest cost for unsecured borrowing in the London market, as the rate is based on a trimming technique that makes sure it is unaffected by any bank trying to manipulate the rate. While Libor represents the cost for unsecured borrowing including principal, the overnight indexed swap, or OIS, which is an interest-rate derivative, indicates risk for only interest rate movement, with no involvement of any principal. OIS is, therefore, considered less risky than Libor, and a spread (normally 10–15 basis points) between the two rates indicates the level of riskiness of lending funds in the credit market.

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103 These are called Treasury Bills, Treasury Notes, and Treasury Bonds, respectively.
104 Libor is currently calculated for ten most-traded currencies with 15 different maturities. See also, BBA website for more details: http://www.bbalibor.com/rates
105 OIS is based on a notional amount, with only an interest exchange (between the counterparties, with the borrower accepting variable for fixed rate and the lender, usually a bank, assuming the opposite position) taking place at maturity.
106 A basis point is 1/100 of a percent. So a 100-basis point change would be equivalent to one percent.
We will analyse the dynamics of this and other similar risk spreads to see what actually went wrong during the GFC. Figure 6.4 below shows the Libor-OIS spread for the period encompassing the crisis.
If we look at the left of Figure 6.4, which effectively represents counterparty-risk dynamics, the spread has remained around 10-basis points in the early-2007. It has sharply increased to almost 100-basis points in mid-August 2007, stabilising after that period. However, it reached a new historical-high of around 350-basis points in mid-September 2008. These spikes point to critical developments in the credit markets at the time.

It is important to distinguish factors that triggered the crisis from those that caused amplification or prolonging of the crisis, helping us understand the crisis and suggest plausible policy actions.\(^{107}\)

Lately, there has been some debate within central banks and academic circles, as to what was the actual trigger event in the current financial crisis. Some economists, such as Bernanke and Cecchetti\(^{108}\), have cited the French-owned investment bank BNP Paribas' (one of the largest investment banks in the world) suspension of redemptions.

\(^{107}\) See also, (Bernanke 2011; Eisenbeis 2011; Federal Reserve System 2005), among others, for a historical account of various financial crises.

\(^{108}\) See also, Bernanke (2010) and Cecchetti (2008) for further details on possible trigger-events of the GFC.
from some of its asset-backed money market funds in August 2007 as a possible trigger
touching off the GFC. However, the government-funded bailout of IKB, a German
bank on 30 July 2007, was more-relevant trigger factor that set in motion, a series of
events that were associated with the GFC.

We clearly had a housing market in the U.S. and elsewhere which had accumulated
significant excesses during the previous period, and when house prices started to
decline in early-2007, it became evident that firms having exposures to the housing
market, especially the sub-prime sector would experience significant write downs on
bad loans. This worry as to which bank is having exposure to the housing market,
caused severe contraction in the capital market, partly due to the inaction on the part
of the Federal Reserve, as it had no direct responsibility for providing funding to non-
depository institutions, such as brokers, mutual funds, etc. These contractions in the
money market are clearly noticeable in the Libor-OIS figure above, with spikes of 100-
basis points and 350-basis points.

Another measure used for the counterparty risk, which also incorporates total volumes
traded, is the commercial paper market. Figure 6.5 below plots the spread between
U.S. Agency-issued debt, such as Fannie Mae and Freddie Mac securities collateralised
by mortgages, and U.S. Treasury-issued debt. Although under normal economic
conditions, the premium for agency-issued securities would be nominal, around 10–15
basis points, as they too are backed by the U.S. Government guarantee, it did start to
increase erratically at the outset of the crisis, as more and more people dumped their
corporate investments for Treasury securities. The rising trend in this spread also
confirms our suspicion that rising counterparty risk has resulted in the widening of the
spreads.
Although those initial losses were large in absolute terms, they could have easily been absorbed by the market, had there not been significant vulnerabilities in the financial system. The severity of the crisis can be attributed to the various vulnerabilities caused by structural shortcomings in the financial system, and in regulation and oversight of the system. There were many sources of these amplifying factors, such as securitization, “too big to fail” firms, etc. These factors have been discussed separately in the following section on G-20 summits.
6.6 ROLE OF GROUP OF TWENTY\textsuperscript{109} SUMMITS IN THE ‘TOO BIG TO FAIL’ DEBATE\textsuperscript{110}

Several G-20 summits\textsuperscript{111} were held to address the problems that arose from the fall out of the financial crisis. These summits, and other efforts at the national government level, were framed on the broader international consensus about the proactive role of governments and their central banks in bringing about a clam in the financial markets and the global economy\textsuperscript{112}. The role of these summits was to prescribe policies that would avoid the collapse of the financial system worldwide, with the effectiveness of global actions in the aftermath of the crisis can be attributed to the fact that world economies are ever more connected with each other. Thus, uncoordinated efforts in various countries may not have achieved globally-coherent outcomes. These summits have defined the broader causes of the crisis, and taken remedial actions to be implemented on a phase-in basis in line with the global recovery. Some of the causes are: (1) failures in risk management practices prevalent in the financial industry; (2) Excessive risk-taking by financial firms; (3) inadequate oversight from the regulators; (4) lapses in transparency, corporate governance, and rating methodologies.

So far, financial-sector reforms\textsuperscript{113} that have been agreed to by the G-20 member-countries at these summits have focused on broader principles below:

\textsuperscript{109} Current members are: Argentina, Australia, Brazil, Canada, China, European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, Republic of Korea, Turkey, United Kingdom, and United States of America.

\textsuperscript{110} “Too big to fail” are those firms whose market size, complexities and interconnectedness are such that, should they go unexpectedly into receivership, the rest of the financial system and the economy would face severe disruptions.

\textsuperscript{111} A brief chronology of these summits is: Washington (2008); London (2009); Pittsburgh (2009); Toronto (2010); Seoul (2010). More elaborate details about these summits and the inquiry by the U.S. Financial Crisis Inquiry Commission are noted in the appendix attached at the end of the chapter.

\textsuperscript{112} Although there were significant efforts at the national level as well, such as fiscal and monetary stimulus arrangements in Australia, Euro area, and the U.K., etc. they were much in line with the G-20 consensus on global action to address the financial crisis. Therefore, what is being discussed in this chapter may also be pertinent to the actions taken by the individual countries to address the financial crisis.

\textsuperscript{113} For further details, see also, Appendix 6-1 provided at the end of the document.
1. Establish resolution and systemic regulations that discourages the bail out of “too big to fail” institutions at the cost of the taxpayers (systemically-important institutions will have capital buffers calculated according to their representation in the overall systemic risk, not just for themselves);
2. Establish a Financial Stability Board (FSB) to promote financial stability. Similarly, launch of early warning exercises by IMF and FSB;
3. Enhanced scope for regulation and oversight for OTC derivatives, securitization markets, rating agencies, and hedge funds;
4. Implementation of Basel II in all important financial centres by 2011; and
5. The establishment of a simple, consistent risk measure in addition to the existing capital regulations.

6.6.1 THE ASCENT OF BASEL III

In a critical development, the existing capital regulations have been amended to include many of the shortcomings that were highlighted in the recently held G-20 summits. Some countries also passed their own regulations to curb excessive risk taking in the financial markets. Most notably, in the U.S., the Dodd-Frank Act (2010) aims to limit the high-risk investments practices of investment banks. Basel II had more emphasis on the lower-ranking capital, such as bonds and preference shares while the new proposals are focusing on equity capital and higher capital buffers. The new standard commonly known as Basel III is already endorsed by the G-20 summit held in Seoul in 2010, and is the outcome of efforts undertaken by the FSB. Some of the changes are: (1) Focus on common-equity for capital regulations and as a soundness indicator; (2) Broadening the coverage of risky assets to include off-balance sheet vehicles (securitization); (3) Increasing the minimum common equity requirement from 2% to 4.5% of the risk-weighted assets. Similarly, there will be an additional conservation buffer of 2.5%, bringing the required common equity ratio to 7%. According to the Basel Committee for Banking Supervision (BCBS), tougher capital requirements together with an increase in minimum requirement would represent a sevenfold increase in the economic capital requirement; and (4) It has been

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114 The new standard will be effective from 1 January 2013, with full implementation by January 2019.
115 Common equity is more closely aligned to the concept of economic capital, and include equity contributions from the owners. It is considered more stable source of capital as it has a residual claim on a firm’s assets.
recognised that the “too big to fail” firms should have higher capital requirements, with the modalities still continuing. One very important suggestion is to have some sort of long-term hybrid capital requirement, which will convert to equity when triggered by a crisis-like situation. Lastly, a firm’s distribution practices (dividends, bonuses, etc.) would need to be consistent with sound capital conservation practices.

It is clear that vulnerabilities that were caused by inadequate regulations, was the result of regulation not keeping pace with the enormous innovation that have taken place in the recent years. The Basel III standard has touched upon most of the shortcomings of the financial system, and is expected to bring about long-term stability in the banking sector.

**6.7 THE NEED FOR REGULATORY RESPONSE**\(^{116}\)

Central banks have had valuable lessons from the numerous crises, both large and small, that dot the past century. The initial phase of the Great Depression, which was marked by controversial economic theories, saw neo-classical economics determining our course of action, resulting in the complete collapse of the financial system, as the U.S. Federal Reserve\(^{117}\) waited for the notion of “long-term” to automatically stabilise markets.

The GFC has seen the revival of the Keynesian economics, which although it acknowledges the boom-bust nature of the financial system, strongly advocates the use of fiscal and monetary policy to stimulate demand in the economy. Although the explanation of business cycles by the Austrian School economists Friedrich von Hayek and Joseph Schumpeter seems tempting, as it apparently provides a simple idea of how investment cycles move in close tandem with booms and recessions, it does not explain why excesses just in the investment sector can possibly cause the whole economy to slump. They view deviation from the “neutral” rate of interest caused by central bank intervention is what causes and reinforces recessions.

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\(^{116}\) In the U.S. the crisis response has seen the 21st July 2010 implementation of Dodd-Frank Wall Street Reform and Consumer Protection Act. The Act lists broad guidelines, such as the establishment of Consumer Financial Protection Bureau at the Federal Reserve, and an independent body to monitor systemic risk called The Financial Stability Oversight Council, with the finer details planned to be available by the end of 2011, after it is worked out with various stakeholders.

\(^{117}\) Both Friedman and Bernanke blame money contraction as the main cause of the great depression of the 1930s. However, Federal Reserve’s actions were also largely constrained by the minimum gold backing (at least 40% of all reserves) regulations of the time; Federal Reserve had already reached this limit as early as1920, and could no longer increase the money supply, until an amendment in its mandate was approved by the U.S. Congress.
If there was excessive growth in investment and credit in the previous period, it might be followed by a reversal in the subsequent period, but the idea that it should affect the entire economy, without any intervention from the government, is akin to amplifying the downward spiral and the collapse of the entire financial system, with economic consequences for almost everyone.

The reason a recession happens is when everyone tries to hold onto liquid assets at the same time. If we recognise that a slump is about liquidity preference, then increasing money supply (just as the most central banks did during the recent crisis) seems to be the plausible cure for the problem.

It is stated that:

“For if the problem is that collectively people want to hold more money than there is in circulation, why not simply increase the supply of money? You may tell me that it is not that simple, that during the previous boom businessmen made bad investments and banks made bad loans. Well, fine. Junk the bad investments and write off the bad loans. Why should this require that perfectly good productive capacity be left idle?” (Krugman 1998, p. 3).

The case for intervention becomes even more convincing when it is established that the initial shocks, such as the mid-2007 failure of a German Bank, IKB, and BNP Paribus funds, were amplified by inadequate regulations. There is this belief that were the financial system more resilient to adverse shocks, it would not have caused such a wide-spread slump in the economy, as the initial losses were not that colossal, and the market could have easily absorbed them without developing problems in the clearing and payment systems.

Several central banks have expressed their opinions about why there is a need to strongly support measures to restore lending and investment to pre-crisis levels, leading to sustainable growth.

For instance, According to Bernanke (2010), given that initial sub-prime losses were never more than equity market volatility on any given day, it was indeed the system’s vulnerabilities — created by lapses in both the corporate practices and government regulations — that caused the crisis to a snow-ball effect, dwarfing the whole economy.
In hindsight, the vast majority of economists strongly advocate the use of traditional, as well as non-traditional tools of monetary policy. We are going to discuss the various interventions\textsuperscript{118} the Federal Reserve did, and their effects on financial markets and the economy.

6.7.1 LENDING AND TERM AUCTIONS

At the beginning of the crisis, after it was indicated that the Federal Reserve officials were not anticipating a potential recession, monetary policy relied mostly on the traditional discount window, with only few modifications that saw increase in the total size of the facility, as well as a significant reduction in the premium charged under abnormal circumstances. However, the facility mostly had a lacklustre performance, probably due to the “stigma” attached to such lending, and the short tenor (usually only overnight) stipulated for the facility.

A decline in the early 2000 in the funding needs of the U.S. Government lead to the belief that there might be a lower number of treasury securities available in the future.

This anticipated decline in the availability of these securities lead to the creation of the term auction facility (TAF) by the Federal Reserve. It is an auction-based facility that enables commercial banks to bid for relatively longer-term funds (28 or 84 days) secured through a variety of collateral, whose value must not be less than twice the requested bid amount. It is worth noting that both investment banks and brokers cannot secure funding from either the discount window or the TAF.

Sometimes, primary dealers\textsuperscript{119} experience difficulties in clearing for the securities they had already offered to their clients, leading to payments system problems and liquidity constraints. In such an event, the central bank offers to lend the required security (usually on an overnight basis) to the primary dealer, as it usually holds enough inventories of these securities (shown as outright purchases on its balance sheet). The current facility has tended to support the long-term liquidity, allowing 28 days as the

\textsuperscript{118} The Federal Reserve’s actions might differ from those in other large economies, reflecting the nature and scale of the shock to their respective economies. For instance in the U.K., failing companies were not nationalised as opposed to U.S. Government’s purchase of stakes in several corporations such as General Motors (GM), Freddie and Fannie, etc., rather they were granted loans repayable within a fixed time frame of 3–4 years.

\textsuperscript{119} Primary dealers are primarily large investment banks and brokers who are qualified to deal in securities with the central bank. They may act on behalf of their clients such as commercial banks to participate in open market operations (OMO) with the central bank.
term of the credit instead of the previous arrangement, which was based on overnight lending.

In order to support prices of a broad range of securities, such as investment-grade corporate bonds, mortgage-backed securities, and municipal bonds, etc., with the aim to stabilise the market for these securities, the Federal Reserve offered to accept these securities, much like it does in the case of discount window for commercial banks, as collateral for the funding needs of primary dealers.

6.8 CONCLUSIONS

The financial-crisis of 2007–2008 has changed our perception of the effectiveness of monetary policy, given highly unusual macroeconomic and financial conditions typically manifested in a “crisis of confidence.” Some of the underlying causes of the crisis were excessive leverage, securitization and, above all, information asymmetries. We also found that government intervention to stabilise markets is less effective when problems arise in the pricing mechanism of counterparty risk. When countries are in a liquidity trap, as much of the developed world is at the moment, central banks are left with not many options, causing them to devise unconventional measures, and assesses how to make the transmission mechanism effective again. So far, they have been successful in achieving this objective through unconventional tools, such as quantitative easing (QE) and duration commitments. Their true success, however, would be judged from the fact whether they would be able to stabilise markets, should another bubble build in the asset markets, again.

This chapter does not seek to provide a conclusive set of diagnostics of the crisis, nor does it pinpoint causes of the crisis in any particular order. Instead, we aim to provide an insight into the crisis, which might help prevent or mitigate losses from any future crisis.

Kindleberger, Reinhart and Rogoff, among others, have pointed out the cyclical nature of investments bubbles and financial crisis, and that they are very much part of any modern economy. So considering the difficulty in our understanding of systemic risks, we do not believe there is any exhaustive set of regulations or policy pursuit that can fully insure against any future crisis. We believe, the best we can do is draw important lessons from this crisis, and contribute to making the financial system more stable — without the need for public bailouts.
Chapter 7

CONCLUSION AND POLICY IMPLICATIONS

7.1 INTRODUCTION

This thesis has offered a holistic investigation into theoretical and empirical determinants of financial stability, taking a cross-country view of credit risk. It has also attempted to explore the procyclical nature of current regulatory capital requirements (Basel II). Several other important aspects of financial stability, such as financial stability reports (FSR) and the current Global Financial Crisis (GFC) have also been investigated, providing us with valuable lessons as to the best design of financial regulations. In the later context, the most important issue that has come out of the financial crisis of 2007–08, that is, the too-big-to-fail debate has been discussed, and possible suggestions to solve this issue have been outlined in Chapter 7. A hypothesis formed in this scholarship is that indebtedness (unsustainable levels of leverage) is one of the most important factors that explain credit risk, and has the ability to spur often-costly “bubbles.”

From a technical perspective, the overarching theme of financial stability has been investigated through a mix of both theoretical as well as empirical determination of credit risk and systemic or financial system-wide risk. For credit risk, we have utilised time series quarterly data on defaults, spanning 10-years, from 1994–2010, for both Australia and the U.S. The factors’ parameters have been determined using weighted least squares estimation (WLS), suitable particularly for heteroscedasticity observed in

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120 Basel standards as they are called were first rolled out in 1988 by the Basel Committee on Banking Supervision (BCBS) based at Bank for International Settlements (BIS), Basel, Switzerland, with the latest version called Basel III planned for gradual implementation effective 2013, and full implementation by 2019.

121 Reinhart & Rogoff’s (2009, p. xiv) has also recently advocated this assertion as “Bubbles are far more dangerous when they are fueled by debt, as in the case of the global housing price-explosion of the early 2000s.”
our data. Similarly, for systemic risk (overall risk), the recent episode of financial crisis has been used as a real-life example of a typical crunch in the credit markets, drawing valuable lessons for the conduct of monetary policy that fosters stability when it is most needed in a financial-crisis situation. We have also discussed the role of “transparency” in financial regulation through our investigation of the usefulness of the recently-adopted financial stability reports (FSR) as a potential new tool of financial stability. This has been realised by analysing Reserve Bank of Australia (RBA)’s FSRs published in the run-up to the recent financial crisis.

7.2 RESEARCH FINDINGS

This thesis explains the regulatory credit-risk view of financial stability by utilising financial-intermediation and asymmetric-information theories of financial markets. As an introduction, the research devises a credit-risk framework to determine factors that are important in explaining default, which is central to the discussion of financial crises. The initial findings suggest leverage and economic activity play important roles in financial-stability policy. The next episode of the thesis analyses the business-cycle theory of minimum capital regulations of Basel II, and the GFC as a practical experiment for testing the financial-stability framework developed in this thesis. Finally, the “external communication channel” theory of financial markets is used as a new tool for financial stability, which links nicely all the components of financial stability, i.e., financial stability is analysed through an integrated framework of credit risk–business cycle–FSR. An overview of the main findings of the component parts of FS is explained below:

The empirical study in Chapter 2 argues that credit risk is still one of the most important determinants of borrower-default, although interest rate risk and foreign exchange (FX) are also important, especially from the point of view of an integrated approach to systemic risk. Accordingly, defaults are used as an appropriate proxy for conditions in the credit markets. It has been noted that short-term interest-rate expectations and debt levels play an important role in insolvency rates, which are at the heart of credit risk models. The important implication of the interest rate for defaults ostensibly seems to contradict economic theory, which expects interest rates
to have inter-temporal (long-term) effects on economic activity. However, a closer investigation informs us that, because only short-term interest rates have been used in this thesis, it affects economic activity with a shorter time lag. In contrast to the traditional view of the effect of interest rates on defaults, it is argued that the former has a negative effect on defaults; it might happen as firms increase their operating efficiency to remain viable even when profit margins are being slashed. So the increased efficiency might decrease the chances of default by the firm. Hence, the finding supports our hypothesis about short-term interest rates. On the other hand, some of the other factors such as industrial activity turned out to be less important.

Several important policy recommendations are made in Chapter 3 on the stress-testing exercise outlined in our study for Australia and the U.S. The current Basel requirements focus on limited sources of risks, namely credit, market, and operational risks, which is obviously a drawback in the current financial-stability arsenal used by central banks. Future attempts to make the current regulatory regime more robust, should include some measure of liquidity risk, such as the Libor-OIS spread, in banks’ modelling frameworks. Then there is the current practice of banks to adopt the “additive” methodology for the prescribed sources of risk, which needs to have an integrated framework, covering diversification aspects as advocated in the chapter.

The main argument of Chapter 4 rests on calculation of unexpected loss (UL) for the Australian economy, for the period 1995–2009. We have constructed a hypothetical portfolio of borrowers by aggregating default rates for the Australian banking sector. The Basel’s prescribed formula has been used to estimate UL, which assesses losses under extreme events called tail-side risks, and evaluate its behaviour over time. It is not surprising that both UL and smoothed UL can potentially exacerbate business cycles, i.e., pro-cyclicality, which supports our hypothesis that the current Basel regulatory requirements tend to decrease in the upswing of business cycles, and increase in downturns. There has been re-emergence of the issue of “pro-cyclicality” post-financial crisis (for instance, underlined by the latest-version of the Basel standard).

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122 Basically, this means that Basel standards require banks to estimate risk for each of the three areas of risk considered under “Pillar I”, i.e., credit risk, market risk, and operational risk, separately, and then simply add them all, to arrive at a total figure for the bank’s risk; alternatively, banks may consider the interactions between these three classification of risk for more accurate calculation of overall risk.
In Chapter 5, the theoretical discussion relating to non-conventional monetary policy is based on the use of the financial stability reports (FSR) of the Reserve Bank of Australia. Financial Stability Reports first emerged in 1997, with Sveriges Riksbank (the Swedish central bank) and the Bank of England publishing these reports containing analysis on a variety of risk factors that are important for the smooth-functioning of the financial system. It is argued that the FSRs published by the RBA are vital for resolution management of systemic risks, such as payment system problems, sectoral imbalances, and large bi-lateral exposures; notwithstanding, these FSRs underestimated some of the risks to the financial system but on the whole, they were successful in providing pricing information, potentially helping unfreeze domestic credit market, and restoring investor confidence.

A real-world test case of financial stability has also been analysed in this study (Chapter 6), taking a cue from the 2007–2008 financial crisis. In pre-crisis U.S., we notice a period that is characterised by tremendous growth in “securitization” and “off-balance sheet” investment products, coupled with an accommodating monetary policy and widening fiscal deficits. These factors then gave rise to unsustainable debt levels in the U.S., with market participants deleveraging soon after problems started to surface in the housing market, which had attracted much of the past capital inflows. Initially, the problems in credit markets were deemed to be limited to the U.S. housing market, with only very small prospects for a potential spill-over into other sectors of the U.S. economy, or in the extreme case, affect the rest of the world.

However, the adverse conditions that prevailed in the U.S. in the summer of 2007 were much more than just a temporary freeze in the inter-bank market, as evident from market conditions at the time, improving only marginally after the U.S. Federal Reserve tried to replenish liquidity through its traditional “lender of the last resort” actions. It is theorised that traditional central-bank measures to improve liquidity is less effective during severe contractions than in normal times. Empirically, this anomaly can be evidenced from the Libor-OIS spread, which increased sharply in mid-August 2007 and trended higher thereafter, except for a brief period when it reverted to normal level despite the term auction facility (TAF) offered by the Federal Reserve in early 2000 in anticipation of likely improvement in the fiscal position of the U.S. Government, hedging future decline in Treasury Securities and bonds. The
Reserve. This was likely a case of rise in the counterparty risk than just liquidity constraints, qualifying for what Taleb (2007) terms as a “black swan” event — requiring non-traditional monetary policy actions, spurring a whole new debate about the so-called “crisis economics”\(^\text{124}\).”

### 7.3 MAIN POLICY OUTCOMES

The pursuit of financial stability is set to become one of central banks’ major roles in stabilising the financial system, with much more focus attracted to this issue in the backdrop of the recent inclement economic conditions and perilous credit markets. However, the recent recurrence of adverse-macroeconomic episodes seen in the U.S. and elsewhere cannot be tamed simply by stimulating the economy through a mix of fiscal and monetary concessions for sovereigns and big corporations.

Because these publicly-sponsored measures cannot last for a protracted period, without a drag on fiscal and inflationary outcomes, a timely exit from these measures and effective regulations for the financial system need to be in place to check any future build-up of systemic vulnerability. In this regard, various regulations introduced in the U.S. and other markets post-GFC would greatly help bring normalcy to jittery financial markets. Nevertheless, most of these steps are destined for a gradual implementation and some of them clearly have shortcomings that need to be addressed on an urgent basis. For example, regulatory capital regimes such as Basel III is set for full implementation in 2019, which seems like a protracted implementation, given the enormous pace of innovation in financial markets.

Similarly, although the recent implementation of the Dodd-Frank Act\(^\text{125}\) has outlined various macro-prudential measures, in particular the introduction of a systemic facility offers lending to depository institutions against a variety of collateral, for a relatively longer tenor of 28-day or 84-day, helping effective dissemination of liquidity even when the unsecured-funding markets are experiencing difficulty in getting short-term funds.

\(^{124}\) There is no wide consensus on the definition of Crisis Economics; however, most commentators attribute this to revival of “Keynesian economics,” with greater role for financial regulations that fosters financial stability, with resolution mechanism for the large corporations some of which were bailed out with public funding—these bail outs were more explicit in the U.S. and U.K. but followed in other forms such as bank guarantees in other countries, such as Australia, as well.

\(^{125}\) Already, in response to the financial crisis, there are new financial regulations in place in various jurisdictions. In the U.S., for example, several measures have been taken as a result of the Dodd-Frank Act of 2010 to ensure stability of financial and payment system. Establishment of Financial Stability Oversight Council for systemic risk and Consumer Financial Protection Bureau (at the U.S. Federal Reserve) for transparency are some of the steps recently taken to protect the U.S. financial system to withstand any future vulnerability.
regulator, it has yet to show how it will address the issue of systemically-important institutions’ role in the future. Looking at the Wall Street Reform Act, we notice that even the new authority on systemic risk has not yet outlined the design of a resolution mechanism for failing institutions. Therefore, the new regime of regulatory reform in the U.S. and elsewhere needs to be further refined so that a uniform, pragmatic, and rule-based approach is introduced in major financial centres. Research in this thesis indicates that the current financial-system reform agenda should include two major sets of regulations: (1) the effective resolution of big corporation (the too-big-to-fail debate); and (2) excessive-leverage problem and effective capital buffers.

Moreover, the enhanced role for central banks could potentially outstretch their existing resources, especially when even some of the factors such as systemic risk considered in the Basel III standard are in their infancy, and need more research to be developed and implemented as a rule-based policy objective.

### 7.4 BROADER IMPLICATIONS

Although this thesis has focused on regulatory standards affecting financial stability in a cross-country setting, it has wider policy implications, especially important given the fickle nature of the financial system. From a policy perspective, the empirical results presented in Chapters 4, 5 and 6 point to the comprehensive determination of risk (that is, systemic risk) instead of the current practice of estimating risk of individual institutions. Similarly, as for the existing capital regulations such as Basel II, latest version III, this thesis (see also, Chapters 2 and 3) points to diversification-based determination of the three main risk types (market, credit, and operational), which takes into account the interaction effects of these risk — not merely adding individual risk sources (the additivity approach), which might misinterpret the true state of financial fragility.

The implementation of Basel III has cost implications as well. The proposed regime, which is scheduled for gradual implementation in 2013, will significantly reduce incentives for capital arbitrage. The new standards will have an almost seven fold increase in the capital requirements, mainly achieved through enhanced minimum requirements and stricter definition of risk weights. Having more emphasis on equity

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126 For example, the U.S. Federal Reserve has recently been assigned additional responsibility to act as a systemic regulator and as a consumer protection watchdog.
capital instead of regulatory capital will increase banks’ cost of funds. The effect will ultimately flow to bank customers as they will be paying higher interest on their loans. Stricter capital requirements will also affect financial intermediation in financial markets, as non-depository institutions will experience difficulty raising funds from the wholesale markets.

7.5 LIMITATIONS OF THIS SCHOLARSHIP

We observe some limitations in this thesis, which can potentially affect the outcomes suggested for financial-stability discourse. For example, in Chapter 2 which discusses credit risk comparisons for Australia and the U.S., only the banking-crisis channel of defaults has been considered. This is because in the post-central bank independence era (since the early 1980s), there have been few, if any, sovereign or foreign-exchange initiated financial crises in developed countries. In many ways, the other two possible triggers of financial crisis (i.e., sovereign debt and foreign exchange) are perceived to be mitigated, if a country’s central bank enjoys independence in its operation of monetary policy. Nonetheless, the recent events, particularly the sovereign debt crisis in Europe and less so the foreign exchange crisis in Asia back in 1997, has once again underscored that other channels, such as sovereign debt can play an important role in touching off financial fragility. This has been discussed briefly in the thesis (Section 2.3, Chapter 2, p.16). Moreover, in discussing the results in the same chapter, the interest rate turned out to be unconventionally determined in the case of one of the two economies discussed. Although in Chapter 2, we have found unconventional behavior of short-term interest rates, the concept may need to be explained in future research in this area.

Moreover, the stress-test analysis in Chapter 3 is based on aggregate measures of default, primarily because credit register (database containing borrowers’ details) data is not publically available. It will be interesting to see the implications using micro-level data in a similar exercise of quantifying credit risk.

Chapter 4, which discusses Basel-related capital standards, has employed a hypothetical portfolio of Australian borrowers based on aggregated measure of regulatory capital needed for “unexpected loss (UL).” In future studies, it will be worthwhile to investigate sectoral classification of capital buffers (margin of safety),
with borrower-related data to be accessed from credit register usually maintained at central banks or similar authorities.

Finally, our discussion in Chapter 5 on financial stability from the point of view of “transparency” has theorised the use of financial stability reports (FSR), which is not yet accepted as a mainstream pursuit of monetary policy. This is so perhaps, because the concept of “transparency” itself has no consensual definition by the central banks, as evidenced from the lack of such reports in some jurisdictions (for example, the U.S. Federal Reserve does not publish similar report). Part of this controversy is caused by the conservative stance of central banks, which advocates that not all financial information should be made public by the central banks, especially when there is considerable fragility in financial markets, which could lead to a “crisis of confidence” (Reinhart & Rogoff 2009).

7.6 RECOMMENDATION FOR FUTURE RESEARCH

This scholarship may help extend future research on regulatory-capital standards and systemic risk, which already receive significant attention in the aftermath of the intermediation-related problems that has plagued international financial markets for the last few years. A broad range of potential offshoots of this study are summarised below:

In Chapter 4, a portfolio of borrowers in Australia has been constructed hypothetically as against a real portfolio, mainly because of the unavailability of such data, which is usually archived by either individual banks or a credit register. As a potential solution to this problem, aggregated loan characteristics were obtained from the Reserve Bank of Australia and the Australian Bureau of Statistics (ABS). However, future research on pro-cyclicality could make use of actual-loan data, with more robust results for an analysis of effective Basel-type regulatory regimes. One potential suggestion could be the use of sectoral data instead of the aggregated data used in this thesis, more like the study by Kashyap & Stein (2004), which lists several benefits to analysing, for instance, the household sector’s potential vulnerability to higher debt levels. It would be interesting to see individual sectors’ potential vulnerability to higher debt levels.

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127 A credit register, listing individual borrower details such as industry sector, size, collateral, etc., is maintained usually by a central bank or similar agency, with restricted access provided to credit rating agencies such as Moody’s, Standard & Poor’s, etc., or the agency itself when, for example, conducting research.
households) default probability and their behaviour over a business cycle, giving useful central bank direction in adopting a particular regulatory regime, suitable for mitigating adverse effects of the business cycle.

The discussion in Chapter 2 and Chapter 3, is mainly about banking-crisis channel of financial stability which, of course, is one of the most important aspects of financial crises, one which academics, such as Gerard Caprio et. al. (2005), used for understanding the trigger-mechanisms of financial crises. Sovereign debt, another source of financial crises, has re-emerged as an important factor affecting systemic risk, and its inclusion could potentially enhance the current knowledge on financial stability. Historically, we have seen little to no sovereign defaults in only a few countries including Australia, New Zealand, etc. and, therefore, sovereign-debt discussion for these countries could offer new insights into why only few countries have evaded this aspect of the GFC.

128 Europe's sovereign-debt issue has caused a sense of déja vu throughout 2011, prompted by socio-economic problems arising from the fiscal-consolidation programmes pursued by some of the advanced economies, such as PIIGS countries (Portugal, Ireland, Italy, Greece and Spain), where the problem was consider the thing of the past, attributed mainly to their embrace of "central-bank independence" since the early 1980s.
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**APPENDIX 2-I**
Correlation Matrix for X’s variables (Australia)

<table>
<thead>
<tr>
<th>Variables</th>
<th>GDPG</th>
<th>IR</th>
<th>INDPROD</th>
<th>DEBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPG</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>0.4978</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDPROD</td>
<td>0.5837</td>
<td>-0.0474</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>DEBT</td>
<td>0.8466</td>
<td>0.2576</td>
<td>0.8447</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
**APPENDIX 2-2**
Correlation Matrix for X's variables (USA)

<table>
<thead>
<tr>
<th>Variables</th>
<th>GDPG</th>
<th>IR</th>
<th>INDPROD</th>
<th>DEBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPG</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>-0.4380</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDPROD</td>
<td>0.9221</td>
<td>-0.3400</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>DEBT</td>
<td>0.9453</td>
<td>-0.3685</td>
<td>0.8489</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
## APPENDIX 2-3
Definition of variables (model for Australia)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition /measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IR</strong></td>
<td>interest rate measured as money market bank accepted bill ,180 days maturity, percentage , p.a. (source: Reserve Bank of Australia.)</td>
</tr>
<tr>
<td><strong>GDPG</strong></td>
<td>gross domestic product measured as quarterly levels in millions of U.S.$ (converted), seasonally adjusted (Source: Australian Bureau of Statistics.)</td>
</tr>
<tr>
<td><strong>INDPROD</strong></td>
<td>is industrial production, seasonally adjusted, indexed to year 2005 (source: international finance statistics of IMF).</td>
</tr>
<tr>
<td><strong>DEBT</strong></td>
<td>represents ratio of total loans and advances of all financial institutions (AFI) to GDP, millions of U.S.$ (converted). (Source: Reserve Bank of Australia.)</td>
</tr>
<tr>
<td><strong>Df</strong></td>
<td>is default rate, measured as ratio of provision on bad debts to total loans and advances of all financial institutions (Source: Statistics Bulletin of Reserve Bank of Australia).</td>
</tr>
</tbody>
</table>
## APPENDIX 2-4
Definition of variables (model for the U.S. economy)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition /measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR</td>
<td>is interest rate, measured as market yield on U.S. Treasury notes at 6-month constant maturity, quoted on investment basis (source: Federal Reserve Board, U.S.)</td>
</tr>
<tr>
<td>GDPG</td>
<td>is gross domestic product, measured in millions of U.S.$ at current prices, quarterly levels, seasonally adjusted (source: national accounts set of OECD stat.)</td>
</tr>
<tr>
<td>INDPROD</td>
<td>is industrial production, measured as production of total industry, seasonally adjusted and indexed to year 2005. (source: main economic indicators of OECD stat.)</td>
</tr>
<tr>
<td>DEBT</td>
<td>DEBT is ratio of debt to GDP. Debt is measured as all interest bearing loans and leases, quarterly average of all commercial banks, Millions of U.S.$ (Source: Federal Reserve Board, U.S.)</td>
</tr>
<tr>
<td>df</td>
<td>is default rate, measured as ratio of provision on bad debts to total loans and advances of all financial institutions (Source: Federal Reserve System.)</td>
</tr>
</tbody>
</table>
## APPENDIX 3-I
Stress Testing Methodologies at Selected Regulators

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Y variable</th>
<th>X variable(s)</th>
<th>Data Estimation &amp; Modelling philosophy</th>
<th>Stress Methodology</th>
<th>Impact Measure</th>
</tr>
</thead>
</table>
| 1 Bank of Canada | Logit transformation of sectoral default rates (six nonfinancial corporate sectors, household sector) | ➢ GDP growth rate  
➢ Unemployment rate  
➢ Medium-term business loans rate  
➢ Credit/GDP | Nonlinear regressions (higher-order polynomials)  
Sample: 1988:Q1–2005:Q4 | Bank of Canada’s Global Economic Model (GEM), which is a version of the IMF’s GEM | Paths of the macro variables under stress, coming from the macro model, were used to obtain the paths of sectoral default rates under stress. These were applied to loan portfolios of individual banks to obtain loss distributions. Expected and unexpected losses were used to assess the impact on banks’ Portfolio loss Distribution (expected and Unexpected losses), mapped into impact on CAR |
<table>
<thead>
<tr>
<th>Bank of England</th>
<th>Logit transformation of aggregate default rates</th>
<th>GDP growth, Short-term interest rate, Equity return</th>
<th>Linear OLS regressions on quarterly data (various samples)</th>
<th>Macroeconomic scenarios are generated by a two-country GVAR (U.K., U.S.) model, which includes six country variables and a foreign variable (see also, ECB box).</th>
<th>Conditional/unconditional GVAR simulations, historical recessions, parameter breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank of Italy</td>
<td>Corp or rate default rate</td>
<td>Output gap, Inflation rate, Three-month interest rate, Real exchange rate</td>
<td>1990:Q1-2005:Q2; quarterly data; VAR(1) estimation</td>
<td>The BOI's quarterly macroeconometric model. For shocks affecting the euro area and/or the world economy, satellite models used for the Eurosystem projections or IMF models were also applied.</td>
<td>The outputs of the macro model (stressed output gap, stressed leverage, and interest rate) are the input of the credit-risk VAR model.</td>
</tr>
<tr>
<td></td>
<td>Logit transformation</td>
<td>GDP growth, equity index, competitiveness</td>
<td>1990:Q1-2006:Q3; quarterly data;</td>
<td>The BOI's quarterly macroeconometric model (under way)</td>
<td>The outputs of the macro model (stressed credit loss Distributions (under way).)</td>
</tr>
<tr>
<td>4</td>
<td>Bank of Japan</td>
<td>Probit transformation of the probability of a rating transition</td>
<td>Data on bank borrowers SUR regression for a system of five equations (one for each rating category) 1985–2005</td>
<td>A VAR model comprising five variables: GDP, CPI, Bank loan outstanding, Effective exchange rate, Call rate</td>
<td>VAR forecasts to (i) a negative GDP shock, of which probability is 1 percent; (ii) a negative GDP shock equivalent to the financial crisis since 1997</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>Bank of Spain</td>
<td>Probit transformation of the default rate</td>
<td>Ten sectoral equations for corporates; two equations for households; 1984:Q4–2006:Q4</td>
<td>VAR(1) estimation for the macroeconomic variables and for the latent factors</td>
<td>An artificial shock (three standard deviations) to the GDP and interest rate variables is introduced in the vector of innovations.</td>
</tr>
<tr>
<td>Factors</td>
<td>A system of two simultaneous equations; annual data 1990-2004; panel estimation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logit transformation of the default rate</td>
<td>(i) The domestic macroeconomic model developed at the DNB plus NIGEM world model. They are used to generate projections of the macroeconomic variables given the initial shock to the exogenous variables; (ii) A VAR(2) model for the macroeconomic variables included in the credit-risk equations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**De Nederlandse Bank (DNB)**

First type of stress: The deviations of the macro variable from the baseline scenarios—obtained as output of the macroeconomic model—are input in the credit-risk model.

Second type of stress: A stressed credit loss distribution is simulated by taking random draws of the innovations in the macro variables used in the "stressed" VAR(2) model.
<table>
<thead>
<tr>
<th>7</th>
<th>Deutsche Bundesbank Logit transformation of the LLP ratio</th>
<th>A system of two simultaneous equations; panel data from 1993; dynamic panel estimation</th>
<th>The macroeconometric model developed at the Bundesbank used to generate projections of the macroeconomic variables. Given the initial shock to the exogenous variables, the stressed values of the macroeconomic variables are used to project an aftershock value of the variables that are input of the credit-risk model.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit growth</td>
<td>Lagged dependent variable</td>
<td>Lagged credit growth, Real GDP growth, Variation in short-term IR</td>
<td>Loan loss provisions</td>
</tr>
<tr>
<td>Credit growth</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8</th>
<th>ECB EDF of euro-area corporates</th>
<th>Regression model of the median EDF (one aggregate/eight sector specific); quarterly data, 1992–2005</th>
<th>Macroeconomic scenarios are generated by a global VAR (GVAR) model which includes seven variables (six country/region variables and a vector of foreign variables specific to each country/region)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Euro-area real GDP, CPI inflation, Real equity prices, Real euro/U.S. dollar exchange rate, Short-term interest rate</td>
<td></td>
<td>The impulse responses from the GVAR model to five standard deviation shocks to one of the macro variables of the GVAR model</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stressed credit loss distribution</td>
</tr>
</tbody>
</table>
and thirty-three countries, where eight of the eleven countries that originally formed the euro area are grouped together and the remaining twenty-five countries are modeled individually by a VECM.

<table>
<thead>
<tr>
<th>9</th>
<th>French Banking Commission and Banque de France</th>
<th>Logit transformation of the probability of a rating transition</th>
<th>GDP</th>
<th>Short-term interest rate</th>
<th>Long-term interest rate</th>
<th>Logit/probit estimation based on observed transition matrix and macroeconomic variables</th>
<th>The Mascotte macroeconometric model developed by the Banque de France for macroeconomic forecasts.</th>
<th>The outputs of the macro model (stressed GDP, short-term and long-term interest rates) are the input of the credit-risk model.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Norges Bank</td>
<td>Loan loss ratio RWD=PD × DEBT</td>
<td>Lagged risk-weighted debt (RWD)</td>
<td>House prices</td>
<td>A logit model that predicts individual bankruptcy</td>
<td>The scenarios are developed using a small macro model (SMM) that is</td>
<td>The change in the macro variables from the macroeconometric</td>
<td>Expected losses, capital adequacy ratio, and results of the five largest</td>
</tr>
</tbody>
</table>

Norges Bank

Loan loss ratio RWD=PD × DEBT

Lagged risk-weighted debt (RWD)

House prices

A logit model that predicts individual bankruptcy

The scenarios are developed using a small macro model (SMM) that is

The change in the macro variables from the macroeconometric

Expected losses, capital adequacy ratio, and results of the five largest
Probability of bankruptcy (PD)

- Age,
- size, and
- financial ratios measuring corporate earnings,
- liquidity, and
- financial strength


Scenarios are compared with the official baseline scenario of Norges Bank.

The model is designed for stress-testing purposes. Scenarios are compared with the official baseline scenario of Norges Bank.

Scenarios are compared with the official baseline scenario of Norges Bank.

A bank model takes the output from the macro model and the distribution of PDs across industries from the enterprise model as input.

ML estimation of the joint distribution of macroeconomic and market risk factors through a 4-group grouped copula approach with four groups (macroeconomic variables, interest rate, and market risk factors).

(i)Within SRM: Risk factors (macroeconomic variables and market risk factors) are increased by percentage or percentage points or set to the stressed levels.

Norwegian banks are translated into changes in accounting variables and a stressed PD is obtained. A bank model takes the output from the macro model and the distribution of PDs across industries from the enterprise model as input.

(i)Within SRM: Risk factors (macroeconomic variables and market risk factors) are increased by percentage or percentage points or set to the stressed levels.

Stressed capital adequacy ratio (CAR) and expected losses;

with the Systemic Risk Monitor.
- Real short-term IR
- Real five-year IR

All variables (except unemployment rate) were taken as logarithmic changes of the moving average over four quarters.

- estimation for seven sectors (total eleven sectors); quarterly data; 1969-2007.

- For FSAP 2007:
  - Domestic model developed at the OeNB plus NIGEM world model to project macroeconomic variables given an initial shock value.
  - Projected outputs of the macroeconometric model are used as input for the credit-risk model.

- For FSAP:
  - Projected outputs of the macroeconometric model are used as input for the credit-risk model.

- The VEC model is used to forecast a stressed EDF by conditioning the model on ad hoc stressful scenario based on the DSGE model.
- The conditioned or stressed EDFs are also used as inputs for the simulation of a credit loss distribution.

- The DSGE model used for policy simulation generates forecasts and stress scenarios for the three macro variables included in the VEC model.

- The VEC model is used to forecast a stressed EDF by conditioning the model on ad hoc stressful scenario based on the DSGE model.
- The conditioned or stressed EDFs are also used as inputs for the simulation of a credit loss distribution.

- Conditioned or stressed EDFs

- The conditioned or stressed EDFs are also used as inputs for the simulation of a credit loss distribution.
National Bank transformation of the LLP ratio

- Unemployment rate
- Level of three-month IR spread
- Corporate bond spread
- Bank control variables

Static and dynamic panel estimation variables are replaced by the values assumed in the stress scenarios. Given an initial shock to one of these variables, the change in the remaining variables is determined through historical correlations.

Source: (Foglia 2009)
**APPENDIX 4-1**  
Loss Scenarios (using Monte Carlo Simulations)

<table>
<thead>
<tr>
<th>Portfolio, BBB grade</th>
<th>Simulated portfolio Loss rate, %</th>
<th>Loss distribution, percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Yes</td>
<td>Good (1986-1989)</td>
<td>0.09</td>
</tr>
<tr>
<td>Yes</td>
<td>Bad (1989-1990)</td>
<td>0.15</td>
</tr>
<tr>
<td>Yes</td>
<td>very bad (1991)</td>
<td>0.16</td>
</tr>
<tr>
<td>No</td>
<td>Good (1986-1989)</td>
<td>4.18</td>
</tr>
<tr>
<td>No</td>
<td>Bad (1989-1990)</td>
<td>2.53</td>
</tr>
</tbody>
</table>

Source: Mark Carey (cited in Gallati 2003)
### APPENDIX 4-2
Loss Provisioning (pioneered by U.S. office of Comptroller of Currency (OCC))

<table>
<thead>
<tr>
<th>Loss category</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low-quality ratings:</strong></td>
<td></td>
</tr>
<tr>
<td>Other assets especially mentioned (OAEM)</td>
<td>0</td>
</tr>
<tr>
<td>Substandard assets</td>
<td>20</td>
</tr>
<tr>
<td>Doubtful assets</td>
<td>50</td>
</tr>
<tr>
<td>Loss assets</td>
<td>100</td>
</tr>
<tr>
<td><strong>High-quality ratings:</strong></td>
<td></td>
</tr>
<tr>
<td>Pass or performing</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: (Gallati 2003)
### APPENDIX 4-3
Ratings by National Association of Insurance Commissioners (NAIC)

<table>
<thead>
<tr>
<th>NAIC Ratings</th>
<th>Rating equivalent</th>
<th>Agency Internal Ratings</th>
<th>Required Capital for Life Insurance Companies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AAA, AA, A</td>
<td>1,2,3</td>
<td>0.3</td>
</tr>
<tr>
<td>2</td>
<td>BBB</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>BB</td>
<td>5</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>6</td>
<td>9.0</td>
</tr>
<tr>
<td>5</td>
<td>Less than B</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>6</td>
<td>Default</td>
<td>7</td>
<td>30.0</td>
</tr>
<tr>
<td>Cash and U.S. Government bonds</td>
<td></td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Residential mortgages</td>
<td></td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Commercial Mortgages</td>
<td></td>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>Common stock</td>
<td></td>
<td></td>
<td>30.0</td>
</tr>
<tr>
<td>Preferred stock</td>
<td></td>
<td></td>
<td>NAIC rating capital factor plus 2.0</td>
</tr>
</tbody>
</table>

Source: Carey (Gallati 2003)
## APPENDIX 4-4
Illustration of Loan rating and bond rating mapping

<table>
<thead>
<tr>
<th>Bond Rating</th>
<th>Score</th>
<th>Risk Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>1</td>
<td>Minimal</td>
<td>Excellent business credit, superior asset quality, excellent debt capacity and coverage; excellent management with depth. Company is a market leader and has access to capital markets.</td>
</tr>
<tr>
<td>AA</td>
<td>2</td>
<td>Modest</td>
<td>Good business credit, very good asset quality and liquidity, strong debt capacity and coverage, very good management in all position. Company is highly regarded in industry and has a very strong market share.</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Average</td>
<td>Average business credit, within normal credit standards: satisfactory asset quality and liquidity, good debt capacity and coverage; good management in all critical positions. Company is of average size and position within the industry.</td>
</tr>
<tr>
<td>BBB</td>
<td>4</td>
<td>Acceptable</td>
<td>Acceptable business credit, but with more than average risk: acceptable asset quality, little excess liquidity' modest debt capacity. May be highly or fully leveraged. Requires above-average levels of supervision and attention from lender. Company is not strong enough to sustain major setbacks. Loans are highly leveraged transactions due to regulatory constraints.</td>
</tr>
<tr>
<td>BB</td>
<td>5</td>
<td>Acceptable with care</td>
<td>Acceptable business credit, but with considerable risk: acceptable asset quality, smaller and /or less diverse asset base, very little liquidity, limited debt capacity. Covenants structured to ensure adequate protection. May be highly or fully leveraged. May be of below-average size or lower-tier competitor. Requires significant supervision and attention from lender. Company is not strong enough to sustain major setback. Loans are highly leveraged transactions due the obligor’s financial status.</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>Management attention</td>
<td>Watch list credit: generally acceptable asset quality, somewhat strained liquidity, fully leveraged. Some management weakness.</td>
</tr>
</tbody>
</table>
Requires continual supervision and attention from lender.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCC 7</td>
<td>Special mention (OAEM)</td>
<td>Marginally acceptable business credit; some weakness. Generally undesirable business constituting and undue and unwarranted credit risk but not to the point of justifying a substandard classification. Although the asset currently protected, it is potentially weak. No loss of principal or interest is envisioned. Potential weaknesses might include a weakening financial condition; an unrealistic repayment program; inadequate sources of funds; or lack of adequate collateral, credit information, or documentation. Company is undistinguished and mediocre.</td>
</tr>
<tr>
<td>CC 8</td>
<td>Substandard</td>
<td>Unacceptable business credit; normal repayment jeopardy. Although no loss of principal or interest is envisaged, a positive and well-defined weakness jeopardises collection of debt. The asset is inadequately protected by the current sound net worth and paying capacity of the obligor or pledged collateral. There may already have been a partial loss of interest.</td>
</tr>
<tr>
<td>C 9</td>
<td>Doubtful</td>
<td>Full repayment questionable. Serious problems exist to the point where a partial loss of principal is likely. Weaknesses are so pronounced that on the basis of current information conditions, and values, collection in full is highly improbable.</td>
</tr>
<tr>
<td>D 10</td>
<td>Loss</td>
<td>Expected total loss. An uncollectible asset or one of such little value that it does not warrant classification as an active asset. Such an asset may, however, have recovery or salvage value, but not to the point where a write-off should be deferred, even though a partial recovery may occur in the future</td>
</tr>
</tbody>
</table>

Source: (Gallati 2003)
## APPENDIX 5-I
Financial Stability role at Selected Central Banks

<table>
<thead>
<tr>
<th>Country</th>
<th>Central bank responsible for maintaining financial stability</th>
<th>Banking supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Yes</td>
<td>Australian Prudential Regulation Authority (APRA)</td>
</tr>
<tr>
<td>Austria</td>
<td>Yes</td>
<td>Financial Market Authority (FMA)</td>
</tr>
<tr>
<td>Belgium</td>
<td>Yes</td>
<td>Banking and Finance Commission(BFC)</td>
</tr>
<tr>
<td>Canada</td>
<td>Yes</td>
<td>Office of the Superintendent of Financial Institutions (OSFI)</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Yes</td>
<td>Czech National Bank</td>
</tr>
<tr>
<td>Denmark</td>
<td>Yes</td>
<td>Danish Financial Supervisory Authority</td>
</tr>
<tr>
<td>Finland</td>
<td>Yes</td>
<td>Financial Supervisory Authority</td>
</tr>
<tr>
<td>France</td>
<td>Yes</td>
<td>Banque de France or Commission Banqaire</td>
</tr>
<tr>
<td>Germany</td>
<td>Yes</td>
<td>Bundesanstalt fur Finanzdienstleistungsaufsicht (FinDAG)</td>
</tr>
<tr>
<td>Greece</td>
<td>Yes</td>
<td>Bank of Greece</td>
</tr>
<tr>
<td>Hungary</td>
<td>Yes</td>
<td>Hungarian Financial Supervisory Authority (HFSA)</td>
</tr>
<tr>
<td>Country</td>
<td>Yes/No</td>
<td>Regulator</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Ireland</td>
<td>Yes</td>
<td>Central Bank of Ireland</td>
</tr>
<tr>
<td>Italy</td>
<td>Yes</td>
<td>Bank d'Italia</td>
</tr>
<tr>
<td>Japan</td>
<td>Yes</td>
<td>Financial Services Agency (FSA)</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>Yes</td>
<td>Commission de Surveillance du Secteur Finance (CSSF)</td>
</tr>
<tr>
<td>Mexico</td>
<td>Yes</td>
<td>National Banking and Securities Commission (CNBV)</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>Yes</td>
<td>De Nedelandsche Bank (DNB)</td>
</tr>
<tr>
<td>Norway</td>
<td>Yes</td>
<td>Federal Kredittilsnet (The Banking, Insurance and Securities Commission of Norway)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Yes</td>
<td>Reserve Bank of New Zealand</td>
</tr>
<tr>
<td>Poland</td>
<td>Yes</td>
<td>Commission for Banking Supervision (CBS)</td>
</tr>
<tr>
<td>Portugal</td>
<td>Yes</td>
<td>Banco de Portugal</td>
</tr>
<tr>
<td>Slovakia</td>
<td>Yes</td>
<td>Slovak National Bank</td>
</tr>
<tr>
<td>Spain</td>
<td>Yes</td>
<td>Banco de Espana</td>
</tr>
<tr>
<td>Sweden</td>
<td>Yes</td>
<td>Financial Supervisory Authority (FSA)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Yes</td>
<td>Federal Banking Commission (FBC)</td>
</tr>
<tr>
<td>Turkey</td>
<td>Yes</td>
<td>Banking Regulation and Supervision Agency (BRSA)</td>
</tr>
<tr>
<td>United</td>
<td>Yes</td>
<td>Financial Services Authority (FSA)</td>
</tr>
<tr>
<td>Kingdom</td>
<td>United States</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------------------</td>
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</tr>
</tbody>
</table>

Source: (Oosterloo & de Haan 2004)
APPENDIX 5-2
Definition of Financial stability in selected FSRs

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Definition</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Explicit definition not provided, but a box on the inside cover lists components of the financial system and notes that serious disruptions to one or more of these components “can create substantial problems for the entire financial system and, ultimately, for the economy as a whole.” It also notes that inefficiencies in the financial system may lead to significant economic costs over time and contribute to a system that is less able to successfully cope with periods of financial stress.</td>
<td>Box on the inside cover</td>
</tr>
<tr>
<td>Denmark</td>
<td>Explicit definition not provided, but the FSR contains it implicitly in a description of its purpose, namely “to assess whether the financial system is so robust that any problems in the financial sector do not spread and impede the functioning of the financial markets as efficient providers of capital for companies and households.” It also notes that “The approach is to consider</td>
<td>Introduction</td>
</tr>
</tbody>
</table>
the general risks to the financial system
rather than the situation of the individual
financial institutions.”

Euro Area
“A condition where the financial system is
able of performing well at all if its
normal tasks and where it is expected to do
for the foreseeable future.”

Iceland
The FSRs made several references to Andrew Crockett’s (1997) definition that financial stability broadly hinges upon the
stability of the key institutions and markets
that make up the financial system. “This
requires (1) that the key institutions in the
financial system are stable, in that there is
high degree of confidence that they
continue to meet their contractual
obligations without interruption or outside
assistance; and (2) that the key markets are
stable, in that participants can confidently
transact in them at prices that reflect the
fundamental forces and do not vary
substantially over short periods when there
have been no changes in the fundaments.”

Norway
Financial stability means that the financial
system is robust to disturbances in the economy and is able to mediate financing, carry out payments and redistribute risk in a satisfactory manner. Experience shows that the foundation for financial instability is laid during periods of strong growth in debt and asset prices. Banks play a central part on extending credit and mediating payments and are therefore important to financial stability."

Sweden

“The analysis of financial stability concerns the ability to withstand unforeseen shocks to financial companies as well as to the financial infrastructure, that is, the system that are required for making payments and for trading and delivering financial products. The analysis of financial companies concentrates on the four major Swedish banking groups because it is these that of crucial importance for the payment system’s stability.”

United Kingdom

Explicit definition not provided, even though implicitly the overview section reviews the elements that the Bank of
England assesses (e.g., the major institutions’ profitability, capitalisation, resilience to shocks).

Source: (Cihak 2006a)
APPENDIX 5-3
Criterion for Assessment of Financial Stability Reports

<table>
<thead>
<tr>
<th>Clarity</th>
<th>Consistency</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Aims</strong></td>
<td>Are the aims of the report clearly defined?</td>
<td>Are the aims of the report presented consistently across reports?</td>
</tr>
<tr>
<td></td>
<td>Does the report use a clear definition of financial stability?</td>
<td>Is the definition of financial stability presented consistently across reports?</td>
</tr>
<tr>
<td><strong>B. Overall assessment</strong></td>
<td>Is the overall assessment presented clearly and in candid terms?</td>
<td>Are the overall assessments consistent across time?</td>
</tr>
<tr>
<td><strong>C. Issues</strong></td>
<td>Does the report clearly identify the main macro-</td>
<td>Is the coverage of issues consistent across the</td>
</tr>
</tbody>
</table>
relevant reports?

stability issues?

D. Data, Assumptions, and Tools

➢ Is it clear what tools are used to arrive at the results presented in the report?

➢ Are the tools used in a consistent manner across the reports? Are results presented in a consistent manner that allows comparisons?

➢ Does the report use the available data?

E. Structure and other features

➢ Is the structure of the report easy to follow?

➢ Is the structure consistent across time to make it easier for repeat users?

➢ Are other features of the report designed to follow repeat users?

➢ Does the report allow covering the key topics?
the report—such as its length, frequency, timing or public availability—designed in a way that supports its clarity? Are other features of the report designed in a way that supports its consistency? coverage?

Source: (Cihak 2006a)
## APPENDIX 6-1
Chronology of Regulatory Responses to the Financial Crisis 2007–2008

<table>
<thead>
<tr>
<th>Summit/Report</th>
<th>Objectives</th>
<th>Conclusions</th>
<th>Summit Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2. Enhancing Sound Regulation: to strengthen prudential oversight, and risk management, and exercise strong oversight over credit rating agencies. Also make regulatory regimes more effective over the economic cycle that does not stifle innovation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Promoting Integrity in Financial Markets: Commit to protect the integrity of the world’s financial markets by avoiding conflicts of interest, preventing illegal market manipulation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Reinforcing International Cooperation: Regulators should enhance their coordination and cooperation across all segments of financial markets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Reforming International Financial Institutions: Developing economies should have greater voice and representation in IMF, etc. The IMF should work to better identify vulnerabilities and act swiftly to play a key role in crisis response</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Establish financial stability board (FSB) to promote financial stability;  b. Establish close cooperation for cross-border crisis</td>
<td></td>
</tr>
</tbody>
</table>
Integrity in financial system;
3. Reinforce international cooperation.

2. Prudential Regulation
a. Establish sound capital guidelines by the Basel Committee on Banking Supervision (BCBS);
b. Establish counter-cyclical buffers in consultation with FSB, BCBS, etc.
c. Establish a leverage-based measure that is consistent across all jurisdictions;
d. Adoption of Basel II by all G-20 members;
e. BCBS should promote stronger liquidity buffers at financial institutions.

3. Scope of Regulation
a. Identify macro-prudential risks across the financial system;
b. Identification of systemically-important institutions;
c. To subject credit derivatives to central clearing to achieve transparency.

4. Accounting Standards
a. Improvement in accounting standards to reflect liquidity and investors’ holding horizons;

5. Credit Rating Agencies
a. Establish regulatory oversight for rating agencies;
b. Review of rating agency’s management of conflict-of-interest issue.

G-20 Summit
1. Overhaul of current regulations;
2. Sustain reforms
6. Establish the need to shift from public to private sources of demand;
7. Regulatory system to rein in the excesses that lead to the crisis;
8. Reform the global financial system in line with the recent innovation in financial markets;

Pittsburgh, 24 September 2009
to prevent ‘excesses’ from destabilising the global economy;
3. Sustain policy response to restore the global economy to its pre-crisis levels.

9. Increase (by 3.13%) representation of developing and transition markets in IMF and World Bank. IMF’s New Arrangements to Borrow (NAB) are in place;
10. To achieve balanced growth by helping poor countries access finance and improve future outcomes;
11. Develop exit strategies that coordinate orderly withdrawal from the existing fiscal and monetary stimuli packages;
12. Enhanced the scope of regulation and oversight for OTC derivatives, securitization markets, rating agencies, and hedge funds;
13. Reform compensation regimes that had encouraged excessive risk-taking in the past;
14. Formulate policies to discourage trade protectionism.

G-20 Summit
1. Ensure full recovery with quality jobs;
2. Reform and strengthen the financial system;
3. Create sustainable and balanced global growth.

1. **Macroeconomic Reforms**
   a. Promote sound fiscal policies that are essential to sustain recovery, and provide flexibility to respond to plausible future shocks.

2. **Financial Sector Reform**
   a. Establish strong regulatory framework;
   b. Improve transparency and oversight of hedge funds, rating agencies, and derivatives;
   c. FSB and IMF to work together for creating effective supervision framework;
   d. Promote resolution framework, and address systemically-important institutions;
   e. Discourage moral hazard in the financial system;
   f. Strengthen IMF’s Financial Sector Assessment Program (FSAP) to address assessment of the financial system worldwide;
   g. Implementation of Basel II in all major financial centres by 2011.

Dodd-Frank Act
1. Consumer Financial Protection

   In the U.S., the crisis response has seen the 21st July 2010 U.S., 21 July, 2010

Toronto, 26–27 June 2010
2. Systemic Regulator (based at Federal Reserve)
3. Volcker Rule, limiting activities of investment banks, especially self-trading
4. Establish Office of Credit Rating at the Securities and Exchange Commission (SEC)

implementation of Dodd-Frank Wall Street Reform and Consumer Protection Act. The Act lists broad guidelines, such as the establishment of Consumer Financial Protection Bureau at the Federal Reserve, and an independent body to monitor systemic risk called The Financial Stability Oversight Council, with the finer details planned to be available by the end of 2011, after it is worked out with the various stakeholders.

1. **G-20 Summit**

   1. Job creation;
   2. Coordinate policy actions to address hazards associated with uneven growth in the world economy.

1. **Macroeconomic Policy Actions:**
   a. Promote fiscal consolidation that promotes sustainable growth and stability of financial markets;
   b. Implement a range of structural reforms that boost and sustain global demand;
   c. Enhance the Mutual Assessment Process (MAP) to promote external sustainability;

2. **Financial Sector Reforms:**
   a. Design instruments to strengthen global financial safety nets, helping countries cope with volatility of capital
   b. Reforms to reduce the reliance on external demand and focus more on domestic sources of growth in surplus countries while promoting higher national savings and enhancing export competitiveness in deficit countries;

**Seoul, 11–12 November 2010**
c. IMF surveillance should be enhanced to focus on systemic risk and vulnerabilities;
d. Increase resilience of the global banking system by raising capital and liquidity standards;
e. To complement risk-based measures with a leverage-based measure that restricts excessive leverage and maturity mismatches;
f. Establish resolution and systemic regulations that discourages bail out of “too big to fail” institutions at the cost of the taxpayers.
g. Systemically Important Financial Institutions (SIFIs) and Globally Systemic (G-SIFIs) should have higher levels of regulatory capital to cope with relatively high systemic risk and the risk of contagion that these institutions may pose to the system overall.
h. Support FSB’s efforts such as Global Forum on Tax Transparency and Exchange of Information (Global Forum) and Financial Action Task Force (FATF), to prevent tax heavens posing risk to the global system;
i. Support FSB initiative to reduce reliance on credit rating agencies;

1. The crisis was avoidable and caused by human action and inaction, and not by the very nature of the financial system:
   a. Widespread failures in financial regulations, including the Federal Reserve’s failure to restrain toxic mortgages;
   b. Breakdown in corporate governance rules including too many banks acting recklessly and assuming too much risk;
   c. A combination of excessive leverage and risk by households and Wall Street entrepreneurs that put the financial system in the harm’s way;
   d. Regulators had inadequate tools to overcome the crisis,
lacking a comprehensive understanding of the financial system they oversaw;
e. There were systemic breaches in accountability and corporate ethics.

Source: Compiled using various G-20 and U.S. Financial Crisis Commission (2011) reports