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The Incidence of Bank Default and Capital Adequacy Regulation in U.S. and Japan

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Thesis submitted for the degree of PhD

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Abstract

This thesis provides an original theoretical and empirical analysis of the effectiveness of capital adequacy regulation in promoting the soundness and stability of the international banking system, focusing on two countries: US and Japan. It is argued that capital adequacy regulation is theoretically flawed, taking no account of the process of balance sheet reconstruction banks undertake to achieve overcapitalisation, and ignoring any effect on the rest of the economy.

The analysis uses a macro- economic theory -based approach to examine the impact of capital adequacy regulation on the probabilities of default of US and Japanese banks for the period, 2007-2009 and 1998-2000, respectively. The underlying theory of this analysis is the capital market inflation theory, which looks at the system as a whole and thus making it possible to analyse the role of the Basel capital requirements on the real economy. This thesis also provides an empirical evaluation of the capital market inflation theory, by developing a simple asset-pricing model to estimate the US and Japanese stock price indexes, taking into account the inflows of institutional investors, such as pension funds and insurance companies, into the capital markets. As a reinforcing argument against capital adequacy regulation the shadow banking system is incorporated into the analysis as a cosmetic manicure for risk in balance sheet.

The evidence suggests that risk-weighted capital adequacy regulation gives misleading signals about the soundness of banks. The empirical results imply that banks with higher Tier I capital ratios have a higher probability of default whereas banks with higher unweighted capital ratios have a lower probability of default. The results suggest that the negative relationship between unweighted capital ratios and the probability of default is the effect of illiquidity in the capital market for relatively risk-free assets, whereas the positive relationship between the Tier 1 capital ratios and the probability of defaults is the effect of crowding out in the capital market.

Contents

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List of abbreviations

ABCP	Asset-Backed Commercial Paper
ABS	Asset-Backed Securities
ADF	Augmented Dickey-Fuller
AIG	American International Group
AMLF	Asset Backed Commercial Paper Money Market Mutual Fund Liquidity Facility
ASF	Available Stable Funding
BBVA	Banco Bilbao Vizcaya Argentaria
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BOJ	Bank of Japan
CAPM	Capital Asset Pricing Model
CD	Certificate of Deposits
CDO	Collateralized Debt Obligation
CDS	Credit Default Swaps
CLO	Collateralized Loan Obligation
CP	Commercial Paper
CPFF	Commercial Paper Funding Facility
CRM	Comprehensive Risk Measure
DIC	Deposit Insurance Corporation
EWS	Early Warning System
FDIC	Federal Deposit Insurance Corporation
FSAB	Financial Accounting Standards Board
FSA	Financial Services Authority
FSB	Financial Stability Board

GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GLS	Generalized Least Square
G-SIBs	Global Systemically Important Banks
GSE	Government-Sponsored Enterprise
KPSS	Kwiatkowski-Philips-Scmidt-Shin
IRC	Incremental Risk Charge
LCR	Liquidity Coverage Ratio
ROC	Receiver Operating Characteristic
TARP	Troubled Asset Relief Program
TRM	Trait Recognition Model
MAG	Macroeconomic Assessments Group
MDA	Multivariate Discriminant Analysis
MTN	Medium Term Notes
MOF	Ministry of Finance (Japan)
MMMF	Money Market Mutual Fund
MBS	Mortgage Backed Securities
NSFR	Net Stable Funding Ratio
OFS	Office of Thrift Supervision
OLS	Ordinary Least Square
PDCF	Primarily Dealer Credit Facility
PP	Philip-Perron
REPO	Repurchase Agreement
ROC	Receiver Operating Characteristic
ROE	Return on Equity
RSF	Required Stable Funding
RWA	Risk Weighted Assets
SIV	Special Investment Vehicle
SNA	System of National Accounts
SPE	Special Purpose Entity

SPV	Special Purpose Vehicle
TIRAL	Temporary Interest Rate Adjustment Law
VaR	Value at Risk
WACC	Weighted Average Cost of Capital

Chapter 1. Introduction

1.1 Introduction and motivation

Conventional theory on banks regulation suggests that the more capital a bank holds, the easier it is to absorb any potential losses and therefore the more likely it is to survive a drain on its liquidity. Despite the efforts of the Basel Committee in setting up an international 'minimum' capital requirement, a safe and sound banking system is far from being achieved. The recent financial crisis that has caused the worst economic downfall the world has witnessed since the Great Depression, is perhaps the most immediate source of such evidence. In the aftermath of this crisis, on December 2009 the Basel Committee on Banking Supervision (BCBS) proposed new set of measures to improve the resilience of the financial system.

The new set of measurements dubbed 'Basel III' attempts to impose higher capital requirement aiming to promote a safer and sound financial system. However, prior to the 2007-2009 financial crises banks not only faced no difficulties in achieving their regulatory standards but they were also able to hold capital in excess to the regulatory requirement. Lehman Brothers Holdings, the fourth largest investment bank on Wall Street that failed during the crises, two weeks before its collapse announced that it had a Tier one capital ratio of 11 percent that is nearly twice what the US now considers is needed for a well-capitalised bank (The Economist 2010).

The Swiss bank UBS in June 2008 had a Tier one capital ratio of 11.6 percent -considered one of the highest in the industry- but needed government bailout to survive later on that year (Gow 2008). Washington Mutual Inc had a Tier one capital ratio of 8.44 percent prior to its demise 10 days after Lehman Brothers filed for bankruptcy (Ellis 2008). The same pattern can be observed in the case of Japan. Three major banks that collapsed during the Japanese banking crisis in the 1990s, Hokkaido Takushoku, Long-term Credit Bank of Japan and Nippon Credit Bank, had published capital ratios well above the 8 percent standard just prior to their collapse with 9.3 percent, 10.4 percent and 8.2 percent respectively (Rixtel et al., 2003).

If banks were considered to be well-capitalised, in the sense that most banks held capital ratios above the minimum standards, why did they fail? This question casts doubts over the effectiveness of the proposal of tightening capital requirements. The historical precedent is not encouraging. The decision to increase capital adequacy requirements in Japan during the 1990s, intended to overcome problems in the banking system, not only failed but also has been blamed for bringing on a 'capital crunch[1]'. The response of Japanese banks to higher regulation was reflected in a reduction of aggregate lending. Despite the zero rate interest rate policy, the Japanese economy has remained stagnant throughout most of the subsequent decade. Therefore the question of how capital adequacy requirements affect the real economy is crucial for understanding the effectiveness of such regulation.

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[1] Defined as a reduction in bank lending in response to tighter regulations on bank capital (Montgomery 2001).

Most of the discussion on bank capital requirements tend to ignore the effects of varying capital requirements on the way in which the system works as a whole, and, hence, on the way in which the economy generates the cash flows necessary for setting committed financial obligations. The exceptions are those theories based on the supposed effects of capital costs, which, however, ignore the cash flow consequences, and theories associated with Minsky, Steindl and Toporowski.

This thesis employs Toporowski's capital market inflation theory to investigate whether obliging banks to hold high capital makes the system less fragile, with reference to US and Japan. One possible explanation of this concern, given by the literature, is that when banks raise capital through the issue of equity the capital market will require greater profits in payment for additional capital. Pressured to meet capital requirements and investors demand for return on equity, banks are tempted to take on more risk. Besides this fundamental rationale in arguing against higher capital requirements this thesis employs the capital market inflation theory to examine the impact of such regulation on the probabilities of default of US and Japanese banks. Within such a framework is it possible to examine the impact of such regulation on banks, and the economy as a whole.

1.2 Thesis objectives and methodology

This thesis will provide an original analysis of the effectiveness of capital adequacy regulation in promoting the soundness and stability of the international banking system, focusing on two countries: US and Japan. The originality stems from the approach, a macro- economic theory-based approach, employed to examine such impact. The existing literature tends to ignore the effects of varying capital requirements on the way in which the system works as a whole. Thus the research of this thesis aims to contribute to the literature by using the capital market inflation theory to both empirically examine and highlight the effect of capital regulation on the banking sector and the rest of the economy.

Capital market inflation has profound implications on the financing structure of companies in modern capitalist economies. At the core of the theory is the proposition that inflation in the capital market induces financial fragility in the economy by encouraging equity finance, which leads to the overcapitalization of companies, and by limiting the role of banks as financial intermediaries. The overcapitalisation of the financial system, in particular banks, increases the riskiness of their assets. Furthermore, under conditions of inelastic equity capital supply, rising capital adequacy requirements force non-financial firms into debt. The higher the amount of capital held by banks, the lower the quantity available to nonfinancial intermediaries in the market. Therefore, they are left with no option other than to raise their needed capital through the issue of debt instruments. Therefore, the excess debt level being held by firm as a consequence of higher banks' capital regulation requirement reduces productive investment below what it would otherwise be. The reduced productive investment also reduces the cash flow of firms and their ability to service their debt.

In other words, the argument of the capital market inflation theory is that bank overcapitalisation makes the financial system in *general* more fragile, because of the crowding out effect. This fragility then appears as growing risky debt in the banking system. Nevertheless, that is not to say that overcapitalisation makes an individual bank more fragile. Actually, overcapitalisation may improve the position of an individual bank, but at the expense of banks in general. However the position cannot be improved if overcapitalisation is due to shadow banking. The relative probability of default of an individual bank could be explained by the shadow banking /overcapitalisation nexus. This way, this thesis not only shows how bank overcapitalisation, in general, increases the riskiness of their assets, as explained by the capital market inflation theory, but also incorporates shadow banking into the analysis as an explanation of how banks respond to the growing riskiness of their assets.

As a first step this thesis provides an empirical evaluation of the capital market inflation theory, by developing a simple asset-pricing model to estimate the US and Japanese stock price indexes, taking into account the inflows of institutional investors, such as pension funds and insurance companies, into the capital markets. This analysis is another original contribution that this thesis provides to the literature.

Within the framework of capital market inflation theory, using pooled cross-sectional data the analysis of this thesis estimates logit models to examine the impact of capital adequacy ratios on the probability of bank default, for both US and Japanese banks for the period 2007-2009 and 1998-2000, respectively. The time period chosen for the US analysis reflects the latest financial crisis associated with a large number of bank failures, despite most of the failed banks having high capital ratios. The analysis for Japan is applied to the period 1998-2000 not only because is it associated with a high number of bank failures but also in an attempt to capture the effect of introducing the capital requirements in a period when the country was already in economic distress following the crash of the stock market in late 1989.

Much research has been devoted in examining the Japanese crisis and more recently the topic has gained a lot more attention with particular focus on comparing the causes and consequences with that of the US in 2007-09. Amongst others, Lapavitsas (2008) identifies three similarities between the recent financial crises that erupted in the US and the one of Japan in the 1980s. The first one is that the crises in both economies are related to property bubbles. Secondly, is the fact the banks had accumulated bad debt over the years, reducing, therefore, their ability to expand their credit supply. And thirdly, both crises are marked by a decline of personal consumption. However, in the US consumption behaviour has drastically changed over the years, becoming more dependent on credit. This has not happened in Japan. Nevertheless Japan experienced a decline in personal consumption as the country entered in recession, something that happened in the US economy during the banking crises. Lapavitsas argues that Japan can act as a lesson for the US in terms of how to respond to banking crises.

As stated above, this thesis also integrates the shadow banking system into the analysis, as a cosmetic manicure for risk in balance sheet. The interaction between the traditional banks and the shadow banks might be a source for increasing the riskiness of banks as they attempt to shift their risky assets into the shadows by innovating financial products. If banks can vary the riskiness of their balance sheets by transferring assets off-balance sheet then the published risk-weightings capital ratios may be inefficient measures of risk. Goodhart's law argues that once a variable becomes a target of policy it no longer varies in the same relation to what it is supposed to be measuring. Put differently, once banks are forced to hold capital in relation to measured risk, as under the capital adequacy regime, an alternative strategy for banks is to transfer risky assets into the shadow banking system, so that the weighted-risk assets in their published balance sheet does not reflect their true risk. In turn this may suggest that the reliability of data on banks' balance sheet changed after 1988, when the Basel Accord was first introduced.

As argued above most banks prior to the crisis recorded capital ratios exceeding the Basel capital regulatory standards. Despite this, in the aftermath of the crisis that both the US and Japan experienced during the periods under consideration, banks faced major financial difficulties, leading to a large number of bank failures.

A study from The Economist (2010) shows that during the latest crises the average American bank consumed about 4 percent of risk-adjusted assets in losses. Some banks such as Citigroup, HBOS and Belgium's KBC lost 6-8 percent of risk-adjusted assets. In the extreme case Merrill Lynch lost 19 percent which suggests that it would have needed a core-capital ratio of 23 percent to avoiding falling through the 4 percent requirement ratio. Similarly, UBS lost 13 percent meaning that it would have required a ratio of 17 percent.

This evidence raises the question how much capital do banks actually need? There is a trade-off between safety and economic growth; a bank that took no risk at all would not be much use in providing credit in the economy. Getting this trade off is indeed difficult. As Minsky(1994) states in an unpublished paper the structure of regulation and supervision of banking might well be a 'never-ending struggle' because what is an appropriate structure at one time is not appropriate at another (Philips1997).

1.3 Thesis structure

This thesis is organised as follows. Chapter 2 reviews the literature whose main focus is the loan price implication of higher capital requirements. Different studies have used accounting principles to analyse the behaviour of banks when faced with tighter capital standards. For many bankers and researchers, equity is considered to be too expensive, relative to alternative funding, and as a consequence rising capital requirements will raise the price of credit, damaging the economy. But this contradicts the basic theorem of corporate finance set out by Modigliani and Miller (1958), that in the absence of taxes, bankruptcy costs, asymmetric information and agency costs i.e. in a perfect market, the value of the firm is unaffected by its choice of capital structure, so that any combination of capital and liabilities is as good as another. This might well be the case for firms. However, it does not apply to banks. This is because by their very nature some of their assets are funded by interbank deposits rather than by equity (The Economist 2009).

A century ago, banks had to hold a higher equity buffer than they do today, in order to reassure customers of their safety (The Economist 2009). In today's banking, deposits have become insured in government-backed schemes. Furthermore, deposits are priced in accordance with central banks' short-term interest rates. In addition, banks are now entitled to unlimited liquidity provision from governments. Along with the guarantees, the very-short-term nature of deposits and debt means that their cost for banks is extremely low when central banks' interest rates are low. In periods associated with low short-term interest rates, equity is indeed expensive**.** However, the havoc and expense of crises means it is worth paying the higher cost of capital to avoid them (ibid). Studies conducted by the Bank for International Settlements (BIS), the National Institute of Economic and Social Research as well as central banks, suggest that the benefits which are mirrored in a reduction in the probability of a banking crisis, exceed the cost of strengthening capital requirements in terms of their impact on output.

Thus many studies in the literature seem to presuppose that as banks increase their capital they have to pay more and more for capital, so this is supposed to increase the margin on what it charges on its loan. However, why should it be necessary increase the margin on loans? As stated above by their very nature some of banks assets are funded by deposits rather than equity. Furthermore, these deposits are priced relative to central banks' short term interest rates. If a bank raises more capital it does not need to rely so much on interbank deposits. So the effect on the lending margins depends on what is the cost of capital relative to interbank deposits. Another main argument here, arising from the capital market inflation ideas put forward by Toporowski (2000) is that in periods of capital market inflation people are willing to hold more capital not for the sake of income stream but for the appreciation of capital. With such inflation banks may pay less in dividends e.g. 2-3 percent, whereas the interbank deposits rate could well be 4- 5 percent. Furthermore the Modigliani and Miller assumptions are irrelevant to this analysis since that theorem presupposes that no further arbitrage is possible when in fact regulation forces banks to finance in a manner contrary to arbitrage. That is to say, in a situation of low interbank rate, vs. high cost of capital, regulation forces banks to issue more capital. With near zero interbank interest rates and the capital market weak, increasing capital would raise financing costs, in a way contrary to consideration of arbitrage. The argument whether or not higher capital ratios do indeed eliminate risk taking incentives of bank, is rather mixed. There are studies that advocate placing higher capital ratios than the standards proposed by the Basel Committee, whilst other studies argue that the market can be the best judge for bank capital. Another growing focus is given to the macroprudential regulation as a tool to make capital requirements countercyclical.

Following the crisis, there has been a growing interest in providing arguments in how to better regulate banks. However, none of these studies considers empirically the relationship between the probability of default and capital adequacy ratios. There are a few studies that have examined this relationship empirically prior to the crisis, however, they tend use different measures of capital ratios to serve as a proxy for the Basel definition of Tier I capital. Perhaps, most importantly the literature fails to provide an analysis of the effect of capital regulation within a framework that considers the system as a whole. In other words, there is no apparent theory that supports the examination of capital requirements on the financial system. The available studies are based on principles (perceived impact) that arise largely from the intuitions of individual bankers. In order to overcome this obstacle and to provide both an empirical examination and a better understanding on how these requirements might affect not only banks but also the economic system as a whole, this thesis employs Toporowski's capital market inflation theory.

Chapter 3 presents the capital market inflation theory, explaining its theoretical contribution in greater details. This thesis then examines the validity of the theory empirically. The theory is applied to both the US and Japanese capital market. Using data from the flow of funds account for the period 1964-2010 in the case of US, and 1980-2010 in the case of Japan, the analysis derives the demand and supply for equity capital. The supply of capital represents purchases of corporate equity from households, institutional investors and rest of the world. Demand is derived from combining non-financial sector issues of corporate equity with those of the financial sector. The regression results for the US capital market supports the capital market inflation theory, that the price level of securities is determined by the inflow of funds into capital markets in a non-linear positive relationship. However, when applied to the Japanese capital market the results provide no evidence that supports the theory. It is argued that various factors associated with the structure of the Japanese capital market could be important in explaining why the capital market inflation theory may not hold for Japan.

This thesis also looks at the overcapitalisation of banks that has occurred since the end of the 1980s. It identifies two processes linked to such overcapitalisation. The first process is capital market inflation, which is a generalized phenomenon picked up from the flow of funds accounts, shown in chapter 3, implying that the overcapitalisation of the financial institutions or banks, in general increases the riskiness of their assets. The second process suggests a different mechanism in that overcapitalisation of a given bank is also achieved by removing its bad assets off balance sheet and their replacement by superior assets. Such assets may have become available through the general overcapitalisation of the financial system (more particularly banks). One way by which banks were able to remove toxic assets off their balance sheet was to transfer such assets into the shadow banking system.

Chapter 4 looks at the shadow banking system and the different financial products innovated by banks in order to remove risk off balance sheet. The premise in this chapter is that banks are reporting overcapitalisation rather than being actually over-capitalised. This also adds to the fragility of the financial system because regulators and participants in banking markets are deceived by a façade of sound balance sheets.

Chapter 5 fills in the gap found in the literature by focusing on the capital adequacy as forerunner of banking crisis, using an Early Warning System model, by providing empirical evidence on the relationship between capital adequacy ratios and the probability of banks default, applied to the US. This research employs a logit model to estimate the probability of bank default on a pooled cross sectional data for US, over the period 2007-2009. Two models are estimated; a simple logit model using Tier 1 capital ratios, and the size of banks dummy as explanatory variables to predict the probability of bank failure and a multivariate logit model adding four additional financial variables as proxies for profitability, asset quality and liquidity and simple unweighted capital ratio. Both models yield results that suggest that the higher Tier 1 capital ratio the higher the probability of bank default. However, when taking into account the unweighted capital ratios the results imply that the higher this ratio the lower the probability of default. It is argued that the positive coefficient of Tier 1 capital ratio is the effect of crowding out in the capital market whereas the negative coefficient associated with unweighted capital ratio is the effect of illiquidity in the market for relatively risk-free assets. The findings indicate that the current regulatory capital requirements only take into account the risk of insolvency ignoring the risk of illiquidity in the capital market.

Using the same methodology, Chapter 6, estimates the probability of banks default on a pooled cross sectional data for Japan, over the period 1998-2000. Due to data limitation only one model is estimated using Tier I capital ratios as a sole predictor of the probability of default. The results again indicate that the higher the capital ratios held by banks, the higher the probability of default. The results in both chapters are not only in accordance with the assumptions of the capital market inflation theory but also reflect the well documents fact that some of largest banks, such as Lehman Brothers in US and Long-Term Credit Bank in Japan, had published high capital ratios prior to their failure.

Chapter 7 draws out the main conclusion from the analysis. The main argument of this thesis is that unless regulators pin down the real threats to stability, their efforts could simply move risk around. Shifting risk into unregulated or differently regulated sectors will not make the banking system more secure. Theory needs to move beyond an unsophisticated model of a single bank balance sheet to a more complex view of how bank balance sheet are integrated with other balance sheets in the economy. Chapter 7 also provides recommendations as possible tools in better regulating the banking sector. The recommendation tools derive from a combination of the ideas given by Toporowski and Minsky. Whilst they both emphasise the importance of recognising bank heterogeneity as an important aspect when applying capital standards, this research also advocates the Minsky's idea of a cash-flow balance sheet examination process, as a step toward better regulation.

Chapter 2. Literature Review

This chapter presents a detailed review of the literature on capital adequacy regulation, which will serve as the ground for employing an alternative approach presented in chapter 3. It will become apparent that very few studies have empirically examined the impact of capital adequacy on the probability of banks default. Furthermore, the literature largely fails to address the issue of such regulation on the system as a whole. The first section of this chapter provides background information of the Basel Accords together with the motivations and aims of establishing international capital requirements. This section also provides a detailed discussion on the changing frameworks set out in Basel I, II and III. Section 2 presents the different available studies that address the issue of bank capital regulation.

2.1 Capital adequacy regulation

Capital adequacy is seen by advocates of the Basel Accords as a means of maintaining a solvent banking system, and a secure banking system is necessary for a healthy and active economy. Adequate bank capital is therefore a necessary condition for a stable economy (Tarbert 2000). The world’s economy is incredibly complex and dependent on credit. Banks as intermediaries pump money into the economy and allow it to grow by providing credit to consumers and businesses. They are the single largest source of credit for consumers. Banks lending adds leeway to the economy by supporting the financial needs of individuals and business. Without such funds, businesses would fail as soon as their outgoings exceeded their income. Perhaps the most important role of all, of banks credit, is that of providing funds to new and existing investments, the single most important determinant of aggregate demand. Therefore, banks do not just act as intermediaries between savers and borrowers but also create credit, that fuels investment. Keynes (1930), stresses the importance of the banking system in the level of economic activity. He notes ‘by the scale and the terms on which it is prepared to grant loans, the banking system is in a position…to determine-broadly speaking- the rate of investment by the business world’(1930, Vol.1 pp.138 and pp. 163-165, quoted in Dymski 1988). For Keynes banks perform a dual activity, credit creation and liquidity provision (Dymski 1988). Kalecki also highlights the important role of banks in determining the level of investment. Even though, for Kalecki, investment is the main driver of aggregate demand, he argues that the willingness of banks to expand the money supply and extend credit enables the level of investment to increase (Harcourt and Riach 2005).

In an attempt to prevent banks insolvency, the governments’ main weapon in recent years has been to force banks to hold bigger equity buffers. Philips (1997) notes the fundamental rationale for bank regulation that some aspects of banks activities are a public good. Pilbeam (2010) argues that the banking sector is more heavily regulated, in comparison to other parts of the financial sector, for both historical reasons and because the most severe financial crisis have been linked to problems in the banking sector. Capital is generally perceived to act as a financial cushion that absorbs losses and thus protects depositors from loss as well as the financial system. Many economists state that adequate capital can cushion the most significant shocks to the banking system as well as preventing systematic failure (Tarbert 2000).

Banks are financial institutions whose liabilities are mainly short-term deposits (or obligations to pay savers on a predetermined date or upon demand) and whose assets are usually longer term loans to business and consumers. On a balance sheet a loan is classified as an asset because the bank is entitled to receive an amount of money plus regular interest payment on a given date from a borrower. The amount of net assets-total assets minus total liabilities- represents the banks' capital. When the value of their liabilities exceeds the value of their assets, banks are insolvent. The resulting banking crisis may cause a reduction in credit available to households and businesses, hence decreasing both the level of consumption and investment in the economy (Demirguc-Kunt and Detragiache 1998).

However providing funds to borrowers is easier than getting it back. This is why banks are prone to crises. When they run short of funds (money), they stop lending and call in loans. This in turn causes a downturn to the real economy. Also, bank maturity transformation creates a risk of a bank run following adverse shocks. Typically banks finance longer term lending with short term deposits, making banks vulnerable to deposit withdrawals (runs). The interbank market plays an important role in liability- management around the banking system. Interbank markets play a key role in providing short-term liquidity to banks. Hence, a shortage of liquidity in this market could affect the intermediary process from banks to households and corporations.

Capital adequacy is not only vital to banks, but also to firms in any other business. However, the non-financial sector, however, is not subject to capital regulatory requirements. Firms hold adequate capital through self-imposed, prudent management. If a firm misjudges risk and has low capital, it may become insolvent or earn a reputation for not paying its debts. This in turn, will either lower its business interactions with others or force it to pay additional rents for the transactions to compensate for the increased risk. Therefore, imprudent firms are disciplined by market forces and not by government as in the case of banks (Tarbert 2000) .

The important yet delicate role of banks as financial intermediaries is the main reason that banks are more regulated than any other part of the financial system. Heffernan (2005) points to the role of banks in the financial system, which has dramatically changed since the 1970s. Prior to this period banks were relatively stable and subject to strict regulation that limited their risk exposure. Cartel-like behaviour ensured minimum competition, with returns being to some extent steady, with little or no incentive to innovate. However, during the 1980s was the start of deregulation of the banking sector, which increased competition and also marked the start of financial innovation. Nevertheless, even though the risks bank faced prior to these changes seem relatively straightforward to manage compare to what they face now, bank failure has been a phenomenon in almost every decade (Heffernan 2005). Banking crises are endemic, and have been so in the last century.

The 1970s witnessed the failure of Franklin National Bank and Bankhaus Herstatt. In the UK, in 1973-74, the Bank of England organised rescues of a number of banks, which experienced financial distress due to the problems associated with the property market. In the 1980s, over 2000 US banks were in series financial trouble, with some failing and others surviving as a results of merging with healthy banks.

The 1990s was a decade that witnessed a large number of bank failures throughout the world. In early 1990s it was the failure of Bank of Credit and Commerce International, followed by the collapse of Barings Bank. By the end of decade much of the Japanese banking system was in series trouble, resulting in a number of bank collapses (see chapter 6). These events were followed by the banking crisis Germany experienced in the early 2000s (Heffernan 2005). The credit crunch that started in 2007 showed that banking collapses could occur on a massive scale once again, with a number of banks becoming dependent on state funded bailouts to stay in the business. These failures clearly showed that regulation had failed to achieve the aim of avoiding bank failure. BCBS(2010d) suggests that from a historical perspective banking crisis occur one every 20 to 25 years. The study argues that banking crisis cause a substantial decline in output ‘relative to trend’ and these costs have long lasting effect on real economic activity. One possible explanation given is that banking crisis amplifies the severity of recessions, leaving deeper scars than typical recessions (BCBS 2010d). In an attempt to alleviate the concerns that linked banks with the recent financial crises the Basel Committee proposed new regulatory measures arguing that the new capital standards will reduce the likelihood of the crises, and reduce the severity of crises.

In the US bank capital adequacy has been a regulatory objective since the implementation of the Banking Act of 1933. However, it was only in 1982 that these requirements became an enforced regulatory tool. Prior to 1982, regulators would compare an individual bank's capital to asset ratio to other banks that shared common characteristics, such as asset size. If a bank was found to have a lower capital to asset ratio than the average of the group of the banks compared, then regulators would advise it to raise capital ratios (Gorton 2012). In Japan on the other hand, capital requirements were implemented in May 1986. The timing of these requirements being put in place is believed to have acted as a preparation tool for competition from foreign banks following the liberalization of Japanese financial sector (Allen 2003).

The proliferation of bank failures during the 1980s, following the Third World Debt crisis and the US savings and loan crises, resulted in the formation of a standing committee of bank supervisory authorities, from the G-10 countries[2] based at the Bank for International Settlements (BIS) in Basel.

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[2] The Basel Committee on Banking Supervision consists of representatives of the central banks and supervisory authorities of the following countries: Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, United States and Luxembourg. Basel I agreement was signed by all 12 member countries

The main purpose of the Basel Committee is to eliminate regulatory arbitrage in the international banking system namely the tendency of banks to hold their risky assets in offshore subsidiaries. Wagster (1996) argues than an implicit aim of the Basel Accord was in response to the competition inequality between Japanese banks and other international banks during the 1980s. At the time Japanese banks were amongst the largest in the world, a position achieved, according to Wagster (1996), by underpricing their competitors. This allowed Japanese banks to capture some 38 percent of all international lending, including 12 percent and 23 percent of the US and UK banking market, respectively.

In the original paper published in 1988, the Basel Committee stated that the main two objectives for the proposed capital regulatory framework were, '…firstly… to strengthen the soundness and stability of the international banking system; and secondly that the framework should be in fair and have a high degree of consistency in its application to banks in different countries with a view to diminishing an existing source of competitive inequality among international banks' (BCBS 1988, pg. 1).

Capital adequacy regulation is influenced by the desire to maintain confidence and stability in the financial system. It prevents excessive risk taking by forcing banks to hold capital reserves based on the riskiness of their portfolios so that the risk and the impact of the failure of any bank on the system would be reduced. It is supposed to provide common standards of regulation, avoiding regulatory arbitrage. It is worth noting here that the Basel requirements and guidelines are not, as Getter (2014) notes, ‘treaties’. Each country can modify these standards in accordance to their needs and objectives when implementing national capital requirements (Getter 2014).

2.1.1 Basel I

Capital regulation under Basel I came into effect in December 1992, after being introduced and development since 1988. A minimum ratio of 4 percent for Tier 1 capital- defined as the value of all its outstanding shares less goodwill which is the market’s estimate of how solid a bank is- to risk-weighted assets and 8 percent for Tier 1 and Tier 2 capital or supplementary capital. Tier I or core capital consists of equity capital, reserves and retained earnings. Tier 2, which is the additional capital above Tier 1 capital, consists of loan-loss reserves, certain preferred stock, perpetual debt, undisclosed reserves and revaluation reserves. Basel I provided risk weights to different classes of assets. The more risky an asset is perceived the greater the weight attached to it. The framework established five category credit risks weighting between 0 percent and 100 percent. The latter represented the riskiest assets such as corporate loans and claims on governments outside the OECD. 50 percent risk was attached to residential mortgages; 20 percent -bonds issued by agencies of OECD governments; 10 percent risk were considered claims on domestic public-sector entities; whereas 0 percent risk were attached to assets such as cash and bonds issued by OECD governments. Basel I required at least 50 percent of the required capital (that is 4 percent of risk-weighted assets), to consists of equity capital and retained earnings (Tier I), whereas 2 percent of risk-weighted assets to be in common equity (Hull 2012).

However, these requirements were criticised for being too simple. Much of the criticism concerned the inability of Basel I to differentiate between levels of risk, which resulted in regulatory arbitrage. According to Pilbeam(2010), capital adequacy in the UK, USA and Germany rose well above the 8 percent requirements between 1992-2003, as a results of banks selling off assets that required too high capital requirements under the Basel system and retaining assets on which they considered capital adequacy ratios were too low relative to their own assessment of the risk. Another example of capital regulatory arbitrage made possible by Basel I is the fixed capital requirements within asset categories. That implies that a loan to a company associated with low default risks is assigned the same level of risk as a higher yielding loan to a company with high default risk. This in turn gives banks an incentive to shift away from low-risk borrowers and move toward high-risk borrowers, and not make any adjustment to regulatory capital. However, the consequence of such switch is higher risk for banks (Emmons et al 2005).

2.1.2 Basel II

In response to criticism of the original regulatory framework, a revised framework for dealing with regulatory arbitrage, known as Basel II, was introduced in June 2004.

The aim of the Basel II was to better assist regulators to better align the capital requirements with risk. It also recognised that the safety and the soundness of the financial sector could be better achieved only by the combination of effective bank-level management, market discipline, and supervision (BIS 2001).
Contrary to the Basel I, which provided only one option for measuring the adequate capital of banks, the new accord recognised that the best way to measure, manage and mitigate risks vary from bank to bank. Therefore the new framework introduced three mutually reinforcing 'pillars'. Pillar 1 of the Basel II system defined minimum capital standards to buffer unforeseen losses. Total risk-weighted assets were based on a complex procedure that took into account 'credit', 'market' and 'operational' risk. In calculating the minimum regulatory capital, this accord covers operational risk and market risk as well as the credit risk which is essentially the same as Basel I. The operational risk was defined as 'the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events' (BIS 2001, pg. 27). Adding some flexibility the Committee allowed banks to choose between two approaches for computing their capital requirements for credit risk. The first methodology was the standardised approach, which group exposures into a series of risk classifications. Loans to sovereigns, corporates and banks are assigned risks taking into account by external credit ratings. For example companies with AAA rating would be associated with lower risk weighting that BBB rated companies.

The second was the internal rating approach, where banks are able to use their internal estimates to determine the riskiness of their portfolios and thus the level of capital they would need to protect themselves against potential looses. The second pillar was concerned with the supervisory review process which requires supervisors to ensure that '…each bank has sound internal processes in place to assess the adequacy of its capital based on a thorough evaluation of its risks' (BIS 2001, pg 3). Banks need to demonstrate that they are well protected against adverse economic and market conditions. Supervisors are responsible for evaluating how well banks are measuring their capital adequacy needs in accordance to their risk profile (BIS 2001).

The third pillar of Basel II aimed to reinforce market discipline through enhanced disclosure on capital and risk levels by banks. The aim of such report is to ensure that market participants can be better informed on banks' risk profiles and on the adequacy of their capital levels, thus market reaction will act as a means of discipline on banks (BIS 2001).

Basel II was implemented in stages by the end of 2006 with a year extension for the US banks (Pilbeam 2010). The US federal banking regulatory agencies initially limited the application of Basel II to the country's 19 largest banks- those with consolidated total assets of at least $250 billion or at least of $10 billion of foreign exposure (Getter 2014). After the publication of the final rule to implement Basel II, in December 2007, it became effective on April 1, 2008. However it was quickly overtaken by the events of the credit crunch which started in the summer of 2007. Some argue that Basel II worsened the problems of the crises by obliging banks to cut lending and rise capital when the global economy was in recession (Pilbeam 2010).

In response to the financial crisis in 2009 the Basel Committee introduced a revised market risk framework, known as Basel II.5, as an amendment of Basel II. Basel II.5 addresses the issues associated with risk on the trading books of banks. The trading book is an accounting term that refers to trading securities, that is securities that are not held to maturity, as opposed to banking books, that refer to assets held to maturity. Another major difference between the trading and banking books is the accounting rules that are applied to securities held in each book. For example, securities in trading books are accounted for at the current market value whereas in the banking books they are accounted at the original book value. Responding to the losses and excessive leverage in the trading books of banks, revealed by the 2007-09 crisis, the BCBS introduced higher capital charges for the credit risk in their trading portfolios. Basel II.5 imposes an incremental risk capital charge to better capture trading book losses with reference to default and migration risk for unsecuritized products (BCBS 2009a). The incremental risk charge (IRC) is estimated based over a year capital horizon and 99 percent confidence level, as opposed to the 10-day standard regulatory value at risk model[3]. The measure assumes a constant risk level and takes into account liquidity horizon of individual positions as well as sets of positions. The constant risk assumption indicates that banks rebalance their portfolios, thus mitigating default risk. Banks are required to estimate liquidity horizons in order to establish the effective holding period of each instrument subject

[3] The market risk framework set prior to the introduction of Basel II.5 assumed that trading book position were liquid, implying that banks could sell or hedge these positions over a 10 day period (BCBS 2012).

to the IRC. The liquidity horizons represent the time that would be required to sell positions (reduce exposure) or hedge all material risks in a stressed market environment. The Committee also specifies a minimum 3 months liquidity horizon (BCBS 2009b).

Higher capital charges also apply to securitized products in the banking books, excluding certain correlation trading activities[4]. For the latter category, the comprehensive risk capital charge is applied as opposed to the standardised approach for securitized products. The comprehensive risk measure (CRM) has two separate components. One is the specific risk component of each security, for which an 8 percent capital surcharge is applied for both long and short correlation trading positions, and the general market risk (interest rate risk in the portfolio) component. The following table summarizes the standardized approach to calculating the comprehensive risk capital measure for correlation trading activities, in which higher capital charges apply to resecuritization exposures:

Table 1-1 Specific risk capital charges under the standardized approach based on external rating (banking book)

External Credit Assessment	AAA to AA-	A+ to A-	BBB+ to BB-	BB+ to BB-	Below BB- or Unrated
Securitizations exposures	1.6 %	4 %	8 %	28 %	Deduction[5] from regulatory capital

[4] Correlation trading activities refer to portfolio-based tranche products, such as bespoke credit default collateral debt obligation (CDO) and asset backed securities (ABS) , and their hedges (Citigroup 2013).

[5] The principal amount subtracted from capital, which 50 percent must be taken from Tier I and 50 percent from Tier II, making it equivalent to 100 percent total capital charge.

Resecuritization exposures	3.2 %	8 %	18 %	52 %	Deduction from regulatory capital
Source: BCBS(2009a)					

For unrated positions banks are allowed to use their internal models in order to calculate the CRM. However their models need to get approval from banks supervisors, so that risk is measured accurately. More specifically the CRM models must capture the cumulative risk impact from multiple defaults, credit spread risk, volatility of implied correlation, basis risk between an index and its single-name components, basis risk between the implied correlation of an index and that of bespoke portfolios, recovery rate volatility, the risk of hedge slippage and the potential costs of rebalancing those hedges. Banks are also subject to conduct rigorous stress tests (BCBS 2009a).

The market risk framework of Basel II allowed banks to calculate capital charge based on a 10-day horizon, calibrated to a 99 percent confidence interval. Calculating the value at risk regulatory measure assumes normal market conditions. In order to calculate the regulatory VaR banks use the so-called historical simulation procedure. To better capture potential losses under conditions of more volatile markets Basle II.5 requires banks to calculate the stressed VaR on their portfolios. The stressed VaR have the same confidence level and holding period, as the standardized regulatory VaR models, but must use historical data from a continuous 1-year period that reflects significant financial stress, relevant to banks current portfolios (BCBS 2009a).

2.1.3 Basel III

Financial regulation, especially the Basel capital requirements have received much criticism over the latest financial global crisis. One of the most frequent arguments has been the need to make banks more capitalized as well as having a weak framework to account for off-balance sheet activities. In December 2009 the BIS proposed a new set of measures dubbed Basel III. These rules reinforce the view that the greater the risk to which a bank is exposed, the greater the amount of capital it needs to hold to protect its soundness and overall economic stability. The new framework also attempts to deal with procyclicality of capital requirement as well complementing microprudentail with macroprudential in order to better deal with credit cycles (D'Hulster 2009).

Under Basel III banks are required to maintain a least 4.5 percent of risk-weighted assets in common equity Tier I at all times. Tier I capital must be at least 6 percent of risk-weighted assets. Total capital, that is both Tier I and Tier II, remains the same at 8 percent of total risk-weighted assets. Basel III also tightens the definition of common equity and additional Tier I and Tier II capital. This Accord places a strong emphasis on the elements that should be included in the definition of Tier I, which must mainly consist of common equity and retained earnings.

In addition to the minimum capital requirements Basel III established a new conservation buffer consisting of common Tier I set at 2.5 percent of the total risk-weighted assets. The purpose of the conservation buffer aims to protect banks from potential losses during periods of financial and economic distress. While banks can draw on the buffer during such periods of stress, the closer their regulatory capital ratios approach the minimum requirements, the higher the limitations on earnings and distribution i.e. such banks are expected to lower dividend payments to shareholders, or share buy- backs until they have improved their balance sheets. The capital conservation buffer will be implemented in stages by January 2019. Banks are required to hold a minimum of 0.625 percent of risk-weighted assets starting on January 2016, and then increase it each year by 0.625 percent rising until 2.5 percent in January 2019.

With the aim to mitigate procyclicality Basel III has introduced capital countercyclical capital buffer measures as a complementary to the conservation buffer capital. The procyclicality of bank capital regulation is related to the interaction between capital requirements and economic fluctuations. During good times, when the economy is booming, bank capital should increase, and when the economy enters into recession bank capital should fall. As evident in the latest crisis, bank excessive lending in periods of economic expansion, can result in huge amount of losses for banks when the economy takes a downturn. These losses can weaken the banking sector, which could amplify economic recessions (BCBS 2010a). The idea of countercyclical buffer capital measures therefore is for banks to hold higher buffer in good economic times and decrease during recessions. Taking into account the macro environment in which banks operate, this measure is a macroprudential tool in achieving financial stability by means by controlling credit growth in good times and putting banks in a better financial position to withstand losses during downturns (Jimenez et al 2012, Getter 2014). The logic behind this measure is that whilst requiring banks to maintain higher capital ratios in good times increases their capacity to withstand any unexpected losses, it could also lead to higher lending rates charged by banks, thereby reducing the demand for credit.

In a forward looking approach accounting for the procyclicality, that the credit cycle introduces into the real economy, is not a new regulatory tool. Even though it is the first time that the Basel Committee proposes such measure, Spanish banks have been subject to countercyclical buffer capital measures since 2000. Despite this measure being in place, Spain experienced a property bubble, fuelled by excessive credit, causing severe distress in the banking sector (Getter 2014). Nevertheless, the Basel Committee introduced countercyclical buffer requirements that would vary between zero and 2.5 percent of common equity Tier I or other fully loss absorbing capital, to total risk weighted assets. The size of the buffer will be set by national regulatory authority, depending on their judgement on credit conditions that could be a hazard to financial stability.

For the first time the Basel Committee introduced a non-risk based leverage ratio as a additional measure to risk based capital requirements. The focus on the leverage ratio derives from the latest global financial crisis in which banks had built up excessive leverage, which in turn is believed to have exacerbated the crisis (D'Hulster 2009). The newly introduced standard also acts as a countercyclical instrument. Intuitively higher capital means lower leverage and vice versa[6]. This is because in good economic times when asset prices are rising, bank equity as a proportion of total assets increases. In contrast, during economic downturns, asset price fall and as bank capital decreases, leverage is likely to increase. However, it is often argued that leverage is procyclical with the credit cycle. As evident in the crisis the market imposed pressure on banks to reduce its leverage, which contributes to falling asset prices, contributing to greater losses, lower bank capital and decline of credit (BCBS 2010a).

D'Hulster (2009) explains the procyclicality of leverage by highlighting banks' activities during the credit cycle activities used to manage their leverage, which are collateralized borrowing, and lending. Under expansionary monetary policy banks balance sheets grow, and subsequently liquidity supply increases. By contrast when monetary policy is tight, banks balance sheets shrink, thus the supply of liquidity decreases. The introduction of a minimum leverage ratio by the Basel Committee, aims to limit the amount of banks' debt relative to their equity capital and reinforce the risk-weighted capital requirements. Currently, the BCBS is testing a minimum Tier I leverage ratio of 3 percent, and plan to fully implement it by January 2018. However, the US regulators in 2013 announced the decision to implement a higher

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[6] The leverage ratio is the ratio of total assets to capital, or Tier I capital.

leverage ratio than that proposed by Basel III. The country's largest bank holding companies are required to hold a minimum leverage ratio of 5 percent, whereas their insured depository institutions subsidiaries must hold a minimum leverage ratio of 6 percent, in order to be considered well-capitalized (Federal Reserve 2014).

Basel III also introduces new liquidity standards in an attempt to avoid a reoccurrence of a liquidity crisis. The latest financial crisis revealed that despite many banks being well capitalised, liquidity problems are a major source of financial instability. A series of papers published by the BCBS, recognizes that capital adequacy regulation is not enough to prevent a liquidity crisis[7] (BCBS 2010b, BCBS 2009a). Therefore, the Committee proposed a new liquidity framework creating two regulatory liquidity measures: The Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR).

The LCR aims to promote short-term resilience of banks' liquidity ensuring that it has enough high quality liquid assets to survive any sudden disruptions in liquidity lasting 30 days. The numerator of the LCR consists of stock of high quality liquid assets, such as government securities and cash, and the denominator is comprised of cash outflows minus cash inflows over a 30 day period. Therefore the stock of liquid assets held should be equal or greater than the net cash outflows.

[7] The paper notes that […many banks –despite adequate capital levels-still experienced difficulties because they did not manage their liquidity in a prudent manner] BCBS(2010b, pg. 1).

The NSFR aims to promote long-term resilience by encouraging banks to rely upon stable sources, such as medium and long term funding, to fund their activities. The NSFR measures the amount of available stable funding (ASF) relative to the amount required stable funding (RSF). The ratio is intended to measure the minimum amount of funding that is expected to be stable over a one-year period taking into account the liquidity characteristics of a bank's assets as well its off-balance sheet activities. The amount of ASF is the sum of an institution's liabilities and capital using available stable funding assigning different weights (ASF factors) (Getter 2014). In such, banks capital is assigned 100 percent ASF weight. Consumer deposit liabilities, such as retail and small and medium enterprises that are considered stable receive a 95 percent ASF factor, whereas those deposits that are considered 'less stable' receive a 90 percent ASF weight. Corporate deposit liabilities and public sector lending with maturities les than one year, as well as other lending with maturities of more than six months but less than one year, receive a 50 percent ASF weight. Any other liabilities and net derivatives receivables are assigned 0 percent ASF factor. Thus, higher weights are given to those stable funding sources that have longer maturities than those with shorter maturities (Getter 2014). The denominator of the NSFR is calculated as the sum of the value of assets and funded by the institution assigning different RSF factors. Assets that are more liquid, in that they can be converted quickly into cash without any losses, receive lower RSF weights than assets that are less liquid and require more stable funding receive higher RSF weights. For example cash assets, don't require funding hence receive 0 percent RSF weight. Unencumbered marketable securities with maturities more than a year receive 5 percent RSF weight, whilst unencumbered corporate bonds rated at least AA with maturity one year or more, would be assigned a 20 percent RSF factor. Gold, unencumbered equity securities and corporate bonds rate AA- to A-, with one or more year to maturity, as well loans to non-financial corporations with maturity less than a year receive a 50 percent RSF factor. Residential mortgages of any maturity and other unencumbered loans with maturity of one year or more, that receives 35 percent or less risk weight under Basel II standardized approach for credit risk, would receive 65 percent RSF factor. Loans to retail clients are subject to 85 percent RSF factor and any other assets receive 100 percent weight (BCBS 2010c). The NSFR must be greater than 1. So in order to maintain the NSFR equal to or greater than 100 percent banks could increase their capital when funding longer-term loans with a sequence of shorter-term loans or diversity the maturity of their own short-term debts (Getter 2014). The NSFR also assigns different RSF weights to various off-balance sheet activates in order to determine the amount of stable funds an institutions should hold relative to its off balance sheet exposure that may be need funding over one year period. The LCR will be introduced in January 2015, whereas the NSFR will be implemented in January 2018.

To sum up, the ratio of minimum total capital banks will be required to hold by 2019 is set at 13 percent, adding the 2.5 percent conservation buffer and 2.5 percent countercyclical buffer capital to the 8 percent minimum total capital. These requirements apply to all globally active banks. However, for larger banks, relative to the asset size, the so-called globally systemically important banks (G-SIBs) Basel III has introduced additional loss absorbency or capital requirements. The rationale behind applying higher capital standard to these banks is based on the impact that their distress or failure would have on global financial activities. Hence the health of these banks is perceived to contribute significantly to global financial stability. The Committee has proposed an assessment methodology in identifying those financial institutions that would fit in the category of G-SIBs, using an indicator-based measurement approach.

This approach uses both qualitative and quantitative indicators to determine the systematic importance of globally significant financial institutions. The identified G-SIBs would then be grouped into different categories of systemic importance in accordance to the scores produced by the indicator-based approach, and would be allocated into different "buckets", based in their scores of systemic importance, assigning varying additional capital requirements. These requirements, to be met with common equity, would range from 0 percent to 2.5 percent of the total risk-weighted assets (BCBS 2011). For example banks allocated in bucket 1 are required to hold a minimum of 1 percent additional loss absorbency, banks in bucket 2 should hold 1.5 percent, banks in bucket 3 are required to hold 2 percent and banks in bucket 4 are required to hold 2.5 percent additional capital. The additional loss absorbency requirements will be implemented in stages and become fully effective in January 2019. In 2011 the Financial Stability Board (FSB) published the first official list of identified G-SIBs. The list is expected to be updated yearly by the FSA. The latest updated official list was published in November 2013, and an additional bank to the G-SIBs. This brings the total number of identified G-SIBs to 29, (FSB 2013a).

The 27 member jurisdictions and 44 central banks and supervisory authorities agreed on Basel III proposals for capital and liquidity requirements, together with the proposed implementation schedules, in September 2010 (Getter 2014). In relation to US banks, some of the new rules clash with the Dodd-Frank Wall Street Reform and Consumer Protection Act signed into law in 2010 (the Dodd-Frank Act). The Act is considered the largest financial regulation overhaul of the US financial sector since the Great Depression. Amongst other reforms, it addresses capital requirements and the definition of Tier I capital for the US banking institutions, which differ from what Basel III and Basel II.5 proposes. For example, the Dodd-Frank Act removes the use of credit rating agencies. The newly Basel Accords, II.5 and III, both rely on credit rating agencies to assign risk to various securities, and hence determining the amount of capital a banks needs to hold. However, given the blame the credit agencies received in the 2007-09 financial crisis, the Dodd-Frank Act forbids their use. Instead, the US authorities have had to come up with new standards to determine the risk of various assets held by banks and apply bank capital requirements accordingly. The new risk-weighted methodologies implemented by US regulatory authorities take into account factors such as different loan categories, issuers and the underwriting requirements of borrowers (Getter 2012). The risk weights would then be multiplied to all bank assets, and the sum of the risk-weighted assets is then multiplied by a minimum capital percentage in order to assess how much capital a bank needs to hold (ibid).

Furthermore, section 171 of the Dodd Frank Act, the Collins Amendment, established minimum risk-based capital and leverage requirements for all insured depository institutions, their holding companies and systemically important non-bank financial companies. The Collins Amendments imposes equal risk capital requirements and leverage capital requirements to bank holding companies and significant nonbank financial institutions and insured depository institutions. This is the first ‘floor’ to which the capital and leverage requirements are subject, established by the Office of the Comptroller of the Currency, Treasury; Board of Governors of the Federal Reserve System; and the FDIC (collectively known as the agencies). The second floor requires the minimum requirements not to be quantitatively lower than the requirements that were in effect when the Dodd-Frank Act was enacted, in 2010. The Collin Amendments also eliminates trust preferred securities as an element of Tier I capital for large bank holdings and systemically important financial institutions. The exclusion of trust preferred stock from the definition of Tier I capital for insured depository institutions became effective at the time of the enactment of Dodd-Frank Act, whereas the Collin Amendment places this requirement to bank holding companies with consolidated assets of $15 billion or more. The phase time given to US banks to adjust to these requirements is three years, beginning on January 1, 2013.

Under Basel III trust preferred stock are no longer eligible for Tier I capital treatment. However, the phase in period under Basel III is 10 years, beginning on January 1, 2013, unlike the shorter phase in schedule outlined under the Collin Amendment. Despite the difference between the requirements set by the Dodd-Frank Act in US and the Basel III requirements, these regulatory measures attempt to impose higher capital requirements in an attempt to promote a safer and sound financial system.

2.2 Related Literature

The literature on capital adequacy requirements falls naturally into three parts. In the first place there are the proponents of capital adequacy adducing various arguments as to how capital adequacy may reduce risk in banking. In a second, much smaller, category are those banking experts who argue that capital adequacy is not effective in decreasing banking risk, and may even increase it. Finally, there is the very small number of studies that have examined this question empirically. In the first category are various studies coming principally from the Bank for International Settlements (BIS).

While the literature on capital adequacy is vast, until recently very little empirical evidence was available on the relationship of probability of banks default and capital adequacy. As surprising as this seems, the lack of literature on this topic is also confirmed in Barrell et.al. (2009) in which the authors attempt to estimate the benefits of capital adequacy in reducing banking crises.   Furthermore, King et al (2005) states that even though since the 1990s the banking system has undergone fundamental changes, research into the causes of distress has significantly slowed.

A large body of literature examines the role of capital requirements on risk taking. One of the arguments for imposing capital regulations is that it will provide banks with the incentives to take less risk. Repullo (2002) suggests that higher capital ratios mean that banks shareholders would incur higher capital losses in the event of default, and thus they reduce banks incentives for risk taking. His analysis makes use of a dynamic model of imperfect competition in which banks are assumed to have two investment strategies; invest in prudent assets or gambling assets. He argues that capital regulation ensures the existence of a prudent equilibrium, because capital requirements do not affect banks' charter value and restrains gambling investment by imposing higher equity losses to the bank shareholders in the event of default (Repullo 2002).

Furlong and Keeley (1989) and Keeley and Furlong (1990) also examine the impact of capital requirement from a risk incentive perspective. They employ a state-preference model in which the option value of deposit insurance is taken into consideration. This approach was first used by Merton (1977), in a study in which he derived a formula used in the option pricing model, showing that deposit insurance can be viewed as a put option of the value on bank assets with an exercise price equal to the face value at maturity of banks debt i.e. bank deposits (Santos 2000). Merton's study also concerned the impact of deposit insurance and risk-taking incentives, and suggests that regulators need to supervise both the risk of assets and leverage of insured value-maximising banks (Keeley and Furlong 1989). The importance of the studies conducted over the effect of deposit insurance and risk-taking can be thought of as the logic behind the decision of regulators to impose capital requirements. As Keeley and Furlong (1989) state ' Concern over the risk exposure of the federal deposit insurance system has been a major factor behind the increase in capital standards in banking in the 1980s' (Keeley and Furlong 1989, pp. 883). In response to the risk-incentives behaviour that deposit insurance brought about in banks, studies such as Merton (1977) called in the need for bank regulation, as explained above. This led to many studies focusing on the effect of capital requirements on bank risk-taking.

The theoretical and empirical evidence on whether increasing capital ratios lower risk taking is not conclusive. For example, the studies of Koehn and Santomero (1980), Kahane (1977), Kim and Santomero (1988) using a mean-variance model, argue that higher capital ratios could in fact increase the risk of utility maximising banks. However, Keeley and Furlong (1989) argue that once the option value of deposit insurance is taken into consideration, higher capital standards lowers bank risk incentives. They argue that this is because, the value of marginal value of deposit insurance option in relation to increasing asset risk declines as leverage declines. Therefore, restricting the leverage on banks should decrease risk incentives. Sheldon (1996), also used the Black-Scholes formula to examine the risk effect of capital adequacy regulation for several G-10 countries. He examines 219 banks from a variety of countries over the period 1987 to 1994 to study the risk effect of the Basel I Accord. With reference to the US his findings suggest that bank asset volatility increased as banks raised their capital ratios. The positive relationship between asset risk and capital ratios was found in banks for the period 1990-1992, reflecting the Basel Accord regulatory implementation. However, examining the period before the implementation of the capital requirements Sheldon's findings are similar to the post-regulation period. That is to say that bank asset volatility increased for both bank groups, those that raised capital ratios as subject to Basel regulation and those that didn't prior to the capital regulation being in place. However, in Japan he finds that the asset volatility and default probability of Japanese banks over the sample period fell, even though most banks increased their capital ratios.

Montgomery (2005) also studies the risk incentive behaviour of Japanese banks for the period between 1982-1999. The analysis looks at how the impact of risk-based capital ratios affect portfolio risk adjustment for both domestic and international banks. Similarly, to Sheldon (1996), the effects of capital requirements on banks portfolio decision is conducted by examining banks' risk incentives,- as measured by the sensitivity of four different assets such as total assets, loans, corporate bonds and governments bonds- prior to the Basel requirements and post- Basel requirements. The study concludes that the low capitalized international banks in the period post-Basel requirements greatly shifted towards holding less risky assets. More specifically these banks shifted their asset portfolio from the risk-weighted assets such as loans and corporate bonds to riskless assets such as government bonds. This behaviour is found only in the post-Basel period. In terms of the domestic banks this effect is not found, so that the Basel capital requirements did not affect their asset portfolio.

In contrast to these views Blum (1999) argues that capital requirements increase bank risk taking. He employs a discrete time model to study the intertemporal effect that the capital adequacy rules have on the behaviour of banks. He argues that one of the effects of the capital requirements is a reduction in the expected profits, which reduces bank losses if it defaults. He argues that under binding capital requirements raising equity is excessively costly, and in a dynamic model the value of equity for a bank is more valuable tomorrow than today. In what follows, the only option left for banks to increase the amount of equity tomorrow would be to increase risk today. This way he argues the effect of capital requirements is opposite to what is perceived. Similarly, Gale (2010) argues that higher capital requirements will not necessary reduce the level of risk taking in the banking industry. This conclusion is reached when the impact of capital requirements is analysed within a general equilibrium framework. He argues that in a banking environment, which he calls it a 'casino banking', that is driven by target return on equity, rising capital requirements induce bank managers to take on additional risk to achieve their desired rate of return.

Other studies, such as the one of Alfon et al (2004), are concerned with the impact that capital requirements has on the amount of capital a bank decides to hold. The analysis looks at UK banks over the period of 1998-2003, and states that banks do hold buffer capital in addition to what is required. The authors identify risk management, market discipline and the regulatory environment as the main factors that influence the amount of capital held by banks. However, the regulatory requirements are the largest determinant affecting capital adequacy as opposed to the other considerations. These findings are similar to Ediz et al (1998) which study looks at the impact of capital requirements on the internal decisions of banks capital. The empirical evidence there suggests that the requirements strongly affect the amount of capital a bank would like to hold. In addition the paper states that banks adjust their capital ratios through the issue of equity rather than adjustment in balance sheet compositions. These results, suggest that capital regulation can significantly influence bank decision making on equity issue rather than risk management.

Some argue that the introduction of capital requirements was to blame for bringing on a credit crunch in countries like the US and Japan. Furfine(2000), examines the impact of changes to capital requirements on US banks. The analyses examine the role the Basel Accord played on the credit crunch the US experienced in the 1990s. Banks responded to the risk based capital regulation by shifting their portfolios into government securities.   Banks reduced their commercial and industrial lending, and increased their investment in government securities. This precipitated the credit crunch (Furfine 2000). During the same period the US also experienced a recession, suggesting that the decreased credit supply was the cause of the negative shock in the economy. However, a graphical representation of banks portfolio changes shows that the decreased supply was evident well before the start of the recession and well after the following US expansion had begun. Supporting these findings, the author also points to the previous recession that the US had experienced and states that the shift in bank portfolios was the reverse of that in the recession of the 1990's. In previous, economic contractions, commercial lending rose and investment in government securities either fell or remained fairly unchanged. Taking into account the marginal costs banks incur as a result of regulation, the study examined the impact of implementing capital requirements on lending growth and capital ratios over the period of 1989-1997. The estimated results show that capital requirements played a role in explaining the decline in loan growth and the rise in capital ratios in the US.

Similarly, many researchers have attributed to the credit crunch in the Japanese banking system to the introduction of capital adequacy regulations. Montgomery (2001) takes the analysis further by investigating the relationship between risk-based capital ratios and lending, and how the credit supply might have had had an impact in the real economy. Therefore, the research is based on both at macro and micro level. Calculating the capital adequacy ratios from individual banks and using an instrumental variable estimation method the author provides evidence on the micro level of Japanese banks over the period of 1982-1999. The study takes into account the different requirements standards between international banks, which under the Basel Accord are subject to an 8 percent capital ratio requirements, and domestic banks which are required to maintain a 4 percent MOF(Ministry Of Finance) ratio requirement. There is some sort of agreement, in the Japanese banking system literature, that the new standards limited bank activity at an international level. A number of banks were forced to close their international branches so that they were under the MOF regulation framework. The analysis shows that stricter capital adequacy requirements greatly reduced bank lending in Japan in the early 1990's most significantly in the case of international banks. Evidence suggests that domestic banks that were under less strict capital requirements, responded rather less to the increased requirements in terms of credit supply. The macroeconomic analyses, suggest that the reduction in credit supply contributed negatively to the real economy resulting in the 'lost decade' the Japan has experienced.

Martin's (1977) econometric study testing for the determinants of banks failure is one of few that used a measure of capital to risk-weighted assets. The Basel 1 ratio requirement did not take effect until 1993, making it too early for it to be tested in his study. But even the ratio of capital to assets, unweighted for risk, appears significant: as capital adequacy rises, the probability of failure declines. He constructs an early warning signal model estimating the probability of future bank failure as a function of variables taken from the current period's balance sheet and income statement during a seven- year period during the 1970s.

The approach, as termed by him- ex post empirical- in which a sample of failed banks were compared with those banks that did not fail. The dependent variable, a dummy variable, is the occurrence of bank failure. The independent variables are drawn from a set of 25 financial ratios which he classified them into four groups; (1) asset risk (2) liquidity; (3) capital adequacy; and (4) earnings. In what became a standard approach he ran several different specifications in which variables are dropped or added to the model one at a time based on their individual significance and their contribution to the overall fit of the model. He finds that capital ratios- gross capital/risk asset ratio- liquidity measures and profitability were the most significant determinants of failure during that period. However, he states that the level of significance differs among periods. The overall quality of the equations was “best” in the later periods i.e. in 1974 reflecting the development of the banking system after 1970. Because in the earlier period bank failure was infrequent, and the overall loan losses suggested that earnings and capital adequacy levels played a minor importance to the bank’s ability to survive. Bank failures were often associated with fraud and local economic trends which are difficult to obtain by examining bank financial statements whereas the recession-related asset problems are well reflected and were important in the later years. In reference to the level of loan losses, prior to 1973, such losses were at a minimum. However they greatly increased after that and badly affected the entire banking system. Therefore, he emphasised that the soundness criteria of banks varies over the business cycle. He concludes by stating that these findings are at variance with the literature on bank failure during the 1930s, which suggests that capital adequacy is little or not related to banks failure even under conditions of significant stress in the banking sector.

The Basel Committee on Bank Supervision, along with the staff at the BIS engage in the research and study of international banking. In August 2010 they published a paper which assesses the long-term economic and costs of strengthening capital and liquidity requirements, in terms of their impact on output. The analysis is based on the assumption that banks have completed their transition phase to the new levels of capital and liquidity. Reducing the frequency of the banking crises has substantial benefits. The analysis reports that a 1 percent point reduction in the probability of crises will gain around 0.2 percent of GDP per year, whereas when crises have long-lasting effect, it will generate a benefit between 0.6 percent and 1.6 percent of GDP per year. It is estimated that increasing capital ratios from 7 percent to 8 percent, with no change in liquid assets, reduces the probability of banking crises by one third (e.g. from 4.6 percent to 3.0 percent). The overall message conveyed is that benefits exceed the costs in the long run and 'there is considerable room to tighten capital and liquidity requirements while still yielding positive benefits, measured in terms of output' (BCBS, 2010d, pg. 28)

Around the same period, the Macroeconomic Assessments Group (MAG) at the BIS presented a paper concerned with the need to phase in the new regulation in a manner that relates well to the ongoing economic recovery. Higher capital standards affect the economy as banks increase their capital levels by increasing the cost of borrowing and reducing the supply of new loans. The MAG group used a two-step approach, in which the first step is to estimate the effect of higher capital standards on lending spreads and lending volumes using both statistical and accounting-based analyses. These estimates then, serve as inputs to the macroeconomic forecasting models which are used to assess the effect of changes to lending spreads and volumes on macroeconomic variables. Banks behaviour when faced with tighter capital and liquidity standards depends also on the length of the period during which the requirements are phased in. When banks are allowed time to adjust to new requirements, they may respond differently, in that they have additional time to employ different strategies of capital raising such as retaining earnings, issuing equity, shifting liability composition, hence mitigating any adverse effect on aggregate activity. Also the estimated impact transmitted from increased capital ratio could be offset by other benefits associated with the new requirements. Because banks become more robust, they face lower debt funding cost and required ROE target. This in turn should reduce the need to either raise lending rates or limit the quantity of new loans. Also other available sources of finance such as capital markets and retained earnings for non-financial corporations are likely to lessen the impact of changes in credit growth on economic activity (MAG 2010).

Barrell et al (2009) employs a multivariate logit model to relate the probability of bank default to a vector of explanatory variables. Their approach consists of pooled data on a number of crises from 14 OECD countries and focuses on capital adequacy as an indicator of banking crises. The authors then trace the impact of banking crises on the economy focusing on the user cost of capital. The dependent variable is defined in terms of observable stresses to a country's banking system. Using a general to specific approach, the crisis prediction model reveals that unweighted capital adequacy and the liquidity ratio alongside real house price growth are the most important determinants of the probability of financial crises in the OECD countries. Using data for the period of 1970-2007, they predict that, given the levels of capital and liquidity in 2006, the probability of crises could have been reduced by more than

6 percentage points, if the level of capital and liquidity were increased by one percentage point (Barrell et al. 2009).

King(2010), from the monetary and economic department of the BIS, examines the loan pricing implication of higher capital requirements. While banks adjust to new requirements in various ways this paper is concerned with the possibility that banks seek to pass on the additional costs by raising the interest rates on loans to their borrowers. Calculating a representative bank's balance sheet and income statement using data for 6,844 banks from 13 OECD countries between 1993 - 2007, the study maps how changes in a bank's capital structure, the composition of its assets and the measurement of risk-weighted assets(RWA), affect the different components of net income using accounting relationships. Measuring changes of a representative bank's net income and shareholders' equity associated with the new regulation standards, allows the author to calculate any increase in lending spreads required to realize a given return on equity (ROE). Bank lending spread here is defined as 'the spread between a bank's cost of liabilities and the average rate charged on its loan portfolio'. The assumption here is that banks price their loans in such manner that they cover the marginal cost associated with loan production. Also, assuming no change to other variables such as bank's ROE or cost of debt, a 1 percentage point increase in the capital ratio can be offset by increasing the lending spreads by 15 basis points. Whether banks will be able to pass on these additional costs to consumers, King argues, amongst others, depends on the elasticity of the demand for loans. However, if the ROE and cost of debt is allowed to decline by 10 basis points for each 1 percentage point increase in capital ratios, the increase in lending spreads is reduced to 13 basis points.

King (2010) also points to the work of Elliot (2010) which by applying the same accounting principles using data for the US banking system he examines the changes of interest rates charged on loans when banks are faced with tighter capital requirements. He assumes that the representative bank holds only loans, which are funded by equity, deposits and wholesale funding. Banks will charge an interest rates which ensures they receive their desired target ROE after taking care of other costs such as the cost of liabilities and other fixed costs. Elliot estimates that if the ratio of common equity required for a given loan is raised by 2 percent, assuming no other adjustments, then banks will increase lending spreads by 39 basis point in order to meet their target ROE of 15 percent. However he argues, that if banks were to reduce their ROE to 14.5 percent this would make the required increase to fall to 9 basis point together the cost of liabilities to decrease by 10 basis points. His proposition of a decline(not shown empirically) in ROE and the cost of liabilities are based on a modified Modigliani-Miller framework, which is based on the assumptions that the weighted average cost of capital (WACC) does not change for different capital structure choice. He concludes that banks could adjust to the new requirements by choosing a combination of actions that would mitigate the effects on pricing or availability of bank loans.

But these are studies of the impact of capital requirements in lending spreads and ROE, rather than on the likelihood of default, which the capital requirements are supposed to affect.

Toporowski provides a theoretical argument, in which he states that rising capital adequacy requirements under conditions of inelastic equity capital supply, has the effect of forcing non-financial firms into debt. Requiring banks to increase their capital reduces the amount of capital available to non-financial firms. When banks are faced with tighter capital regulation they have to adjust their capital accordingly. There are various ways in which banks adjust their required capital ratios. Either one of them will have a negative impact in the capital market. The higher the amount of capital held by banks, the lower the quantity available to nonfinancial firms seeking capital finance. Such firms are left with no option other than to raise their needed capital through the issue of debt instruments. Hence, firms are forced to borrow more than planned, which in turn reduces future fixed capital investment. Toporowski argues that 'enforced indebtedness' increases the financial fragility of the economy. Firms instead of reducing the amount of debt held, now have debt in excess of what they planned which can be accommodated in two ways. Firstly, companies can hold larger amounts of liquid assets. But this is not efficient since it means that the capital that firms have issued is being 'wasted' by being held as financial asset rather than being used to expand production or fixed capital. Alternatively, firms could reduce their future fixed capital investment in order to be able to have those liquid assets. Therefore, the excess debt level being held by firm as a consequence of higher banks' capital regulation requirement reduces productive investment below what it would otherwise be. The reduced productive investment then also reduces the cash flow of firms and their ability to service their debt. Therefore, higher capital requirement that aims to circumvent banks unsoundness, encourage firms to reduce their productive investment in fixed capital in response to their increased indebtedness. Toporowski, notes that such reduction in is the key determinant in causing the real economy to enter in recession. Furthermore, as history reveals the case of 1930s or Japan after 1992, excess debt can turn recession into economic stagnation and depression (Toporowski 2008, 2009).

A theoretical contribution on the topic is provided by Martinez-Miera (2009), in which he argues that higher capital standards reduce both banks leverage and, for given asset risk, the probability of bank default. The analysis assumes that entrepreneurs respond differently to changes in loan rates in the presence of moral hazard between banks and entrepreneurs. As a starting point, the paper emphasizes the benefits of having higher capital requirements, the capital buffer effect. When loan defaults are imperfectly correlated, the higher the capital requirements are, the higher is the ability of banks to absorb any losses that derive from non-performing loans, without undergoing failure. On the other hand, when the correlation is high a bank is unable to meet the demand of its depositors hence no buffer exists and the bank defaults. As banks face higher capital requirements, they tend to charge higher loan rates to compensate the higher cost of capital imposed by higher regulatory standards. This is the risk-shifting effect, as entrepreneurs now face higher costs and they shift their investment into riskier projects in a bid to have higher returns. As a consequence they are more prone to default on their loans and the bank is more likely to default as a higher fraction of its loans will default. A different point of view is given to the margin effect as capital requirements are increased. Assuming that loan rates are increased the bank earns higher rents on the non-defaulting loans. This provides the buffer capital that serves as a cushion to absorb losses. However if all projects default at the same time, that is when loan defaults are perfectly correlated, the probability of banks failure increases. By contrast, when the correlation is low, the effect of higher capital requirements is negative, that is the probability of default decreases. The overall conclusion of the paper is ambiguous. The author also provides a numerical solution, which shows that the relationship between capital requirements and the probability of banks default is non-monotonic (Martinez-Miera 2009).

A weakness in the current literature is the definition of capital adequacy. Although it is supposed to be an approximate for the Basel definition of Tier one capital, researchers have adopted different measurements of capital ratios in their analyses as an approximate for the Basel Accord capital requirement ratio. Barrell et al (2009), uses the unweighted capital- capital to loan ratio measures- in their analysis. Montgomery(2001), uses the book value of each banks' net worth as reported in the annual 'yukashoken hokokusho'[8] as a proxy for Tier 1 capital ratio. Capital adequacy is measured by various forms of the basic capital/asset ratio, with our without debt

[8] Annual Securities Report

capital in the numerator in Martin's (1977) study. The BIS studies refer to the broad definition such as Tier one or total capital as the target ratio of tangible of tangible common equity to risk weighted assets, including voluntary capital buffer and not the required minimum level set by regulators.

Estrella et al (2000), state that a good measure of capital adequacy should be strongly linked with bank failure. The study compares the effectiveness of different types of capital ratios in forecasting bank failure. As explained above, the calculations of bank's capital adequacy ratios are somewhat complex and guided by a formula that complies within the Basel standards framework. In contrast Estrella et al (2000) makes use of other accounting-based ratios, arguing that some of these '….ratios contain valuable information and virtually costless information, and therefore have a role in an overall framework for regulatory capital' (pg 34). The empirical results show that that simple ratios, such as the leverage ratio and the ratio of capital to gross revenue, perform just as well as risk-weighted ratio in predicting predict bank failure over one or two year time horizon. However, the risk-weighted capital ratio predicting ability, defined as the ratio of tier 1 capital to risk-weighted assets, improves beyond the one-or two-year horizon.

The above literature review suggests that bank risk is determined by the composition of a banks' balance sheet. By evaluating banks balance sheet and most importantly by measuring the weighted risk assets and setting up capital adequacy ratios in proportion to the riskiness of those assets, bank managers and regulators can reduce the level of riskiness, hence lower the probability of banks default or insolvency.

However, as its discussed below, the case of banking in Japan over the last two decades suggests that bank risk may be linked to developments in the economy at large in ways other than bank-risk taking impacting on the 'macroeconomy' in which banks operates. The banking crises of Japan show that risks may be in banks' balance sheet but the original source of bank risk comes from macroeconomic shocks. These facts reflect the credit cycle literature inspired by Keynes 1913, that a stable economy is a necessary condition for low risk and adequate bank capital. In "How Far are Bankers Responsible for the Alternations of Crisis and Depression" written in 1913, Keynes puts forward a simple model illustrating how banks can induce fluctuations in the economy. The fluctuations are as a result of over-investment during economic booms and under-investment during recessions (Toporowski 2005). The simple idea is that banks hold 'free resources' which represent savings 'of the community' which are held in current account deposits with banks. And it is these deposits that banks lend out for business investment. However, savings are also held in the form of other financial assets held by the public**.** When business investment has reached high levels, and most importantly when some of the investments undertaken by firms are not as profitable, banks realize that they need to arrange more credit to support investment projects. Recall that savings of the community represents current accounts held with banks and the purchases of financial asset by the public. And when banks try to arrange finance by means of selling financial assets, to the public, the community's savings will not be sufficient to sustain over-investment. Keynes states that it is then that banks realize that what they considered to be liquid assets have now become illiquid. He then argues that this is bound to lower the quality of assets banks hold (Kregel 1992). Naturally then banks respond to this by reducing lending and increasing interest rates. It is this process, Keynes argues, that causes banking difficulty and subsequently a crisis.

Taking macroeconomic conditions into perspective in the regulatory framework has been a growing concern of many observers in the wake of the latest financial crisis. A common consensus from a wide range of researchers is that the regulatory framework needs to shift away from the microprudential approach to macroprudential regulation (Kashyap et al 2010). However, Crockett 2000; Kashyap and Stein 2004, Borio 2003 and others have highlighted the need to focus more on a macroprudential regulation before the crisis erupted. More recently, Kashyap at al 2010, Borio 2011, and Tarullo 2014, have contributed to the literature in favour of macroprudential regulation. A microprudential approach is largely focused in preventing the failure of banks at the individual level. In contrast macroprudential regulation concerns the financial system as a whole. Kashyap et al (2010) state that microprudential regulation is based on partial-equilibrium conception whereas macroprudential ' recognizes the importance of general-equilibrium effects, and seeks to safeguard the financial system as a whole' (pg 1).

Tarrulo (2014) argues that macroprudential needs to be combined with the current capital and liquidity requirements, which are largely based on microeconomic foundations. He suggests four main propositions that should be incorporated in the regulatory framework for large financial institutions. He proposes that macroprudential regulations should dominate in the regulatory and supervisory framework for these firms. This is because large financial institutions are prone to common stresses because of their interconnections with each other and thus they cannot be considered in isolation from the rest of the financial system. The second proposition concerns resiliency, which should be the central in the macroprudential regulation. He claims that macroprudential capital requirements are just as important as the microprudential approach which requires individual banks to hold capital in able to increase its ability to withstand any losses. He refers to the stress test conducted over 19 largest bank holding companies as an important starting point towards macroprudential orientation. Stress tests can be used as a forward-looking assessment of future potential looses under stipulated adverse economic conditions. For example he suggests that these test should incorporate particular risk factors to the financial system, such as house prices, as well as adverse economic conditions, such unemployment. This approach is bound to lower the level of distress and the probability of failure for large financial institutions. The stress test was conducted in February 2010 on banks with assets worth more than $100 billion. The test aimed to evaluate the financial position of these banks, to ensure that they had adequate capital buffer to withstand any losses and to maintain lending even under more severe economic conditions. Each bank's capital was assessed using a two-year ahead hypothetical adverse scenario. The degree of stress for each bank was determined by assuming possible losses accruing on risky loans, assets and trades in the next two years. The level of stress was then used to determine the capital buffer position for each bank, i.e. whether a particular bank needs to increase the capital level or not.

As a third proposition, Farullo argues that time-varying measures will play a limited role at a macroprudential perspective. In the arguments of countercyclical regulatory tools, such as attempting to restrain any rapid credit extensions or asset prices and relax those restraints under weak economic conditions, he highlights some of the difficulties regulators might face in order for these tools to be effective at the international level. Some of the issues concern the question of having the right measure of excess or systematic risks, a suitable agency in taking macroprudential decisions, the speed of these measures to take effect after their implementation, and the right calibration of measures which would target any excesses without affecting the availability of credit in the economy.

The last point made by Farullo is related to the structural vulnerability that results from short-term wholesale funding. He states that large firms that substantially rely on short-term wholesale funding should be subject to higher capital and liquidity ratios.

Kashyap et al (2010) also advocate macroprudential regulation. Their study discusses the potential problems associated with the microprudential approach that could lead to more unnecessary problems that would harm the economy. For example, when a bank choses to adjust its regulatory capital ratios by means of changing the composition of the assets in the denominator[9], thereby shrinking the assets this could have implications for the economy if a large fraction of banks are in the same position. Therefore when banks simultaneously attempt to raise their capital ratios by reducing lending this is bound to harm the economy. To overcome the social costs related to excessive balance-sheet shrinkage they propose a set of macroprudential tools. Among others, time-varying capital requirements are proposed as a macroprudental tool in response to the balance-sheet shrinkage. They suggest that banks should be required to hold higher capital ratios in good time than in bad times. This way, in the event of unexpected or unpredicted shock banks could rely on their buffer capital without having to shrink their balance sheets significantly. They refer to a study conducted by Kashyap and Stein (2004), which show that time-varying capital requirements are the optimal scheme in a model where the objective of a social planner is to both protect the deposit insurance funds and maintain credit creations during economic downturns. A further point in Kashyap et al. (2010) is that in bad times, the market may play a more important role that capital requirements. That is because, when banks have a large proportion of risky assets in their balance sheet, and hence a shortage of capital, it is highly likely that the market would provide funds to these banks. Therefore, the capital regulatory ratios in good times must be significantly higher than the market-imposed standard in times when risks are believed to be more prevalent.

[9] Regulatory bodies are not concerned how an individual bank achieves its capital requirements standards, i.e. a bank could meet the capital regulatory standards by changes in the numerator or denominator.

Capie and Wood (2013), suggest that bank regulation is not necessary if governments do not underwrite banks. Based on the evidence that the UK banking history reveals they argue that banks should be left to choose their own capital ratios. They indicate that at the end of the 19th century capital ratios of UK banks averaged at around 10-12 percent amongst all banks, declining from the 15 percent level held in the mid 1870s. In the First World War period UK banks capital ratios fell to around 7 percent. This is argued to have been due to the high volume of government bonds banks held in their portfolios and therefore they adjusted their capital ratios in accordance to the riskiness of their assets. This was also evident during the Second World War period. As banks increased their holdings of gilts and their capital ratios fell to around 3 percent. The authors argue that if these capital ratios were to be converted in the requirements of the Basel Accord they would be subsequently higher so that they would reflect the quality of the assets banks held at the time. For example they argue that during the 1920, that is immediately after the First World War, risk-weighted assets as reflected the Basel rules, would indicate capital ratios of the order of 14 percent. The capital ratios of banks during the 1960s, which were around 4-5 percent, according to the Basel requirements should have been around 13 percent. The authors then argue against the current regulatory framework set by the Basel capital requirements as well as the Volker rule which separates investment banking activities from retail banking. The rationale behind this argument rests upon the evidence provided by the history of the British banking. In addition they argue that these rules that emphasise the importance of banks to avoid failure could be misleading. This is because banks should be left to fail in an orderly fashion. Once banks face the possibility of failure they would take responsibility for their actions, and thus they would be the best judges in deciding their needed capital ratios. In such a system banks would have to be sensible in choosing capital ratios to reflect the riskiness of their assets since failure in doing so would compromise their survival in the banking business.

Kuritzkes and Scott (2009) argue that capital regulation is not sufficient to prevent bank failures, and it needs to be complemented with more effective market discipline. They argue that the insufficiency of the minimum capital regulation to prevent bank failure was reflected in the high capital ratios banks held prior to the 2007-08 crisis. The evidence suggests that prior to the crisis of 2007-08 the top 20 US banks had capital ratios around 11.7 percent, well above of the minimum capital requirements. However, this was followed by the largest bank failures since the Great Depression. The article argues that when capital requirements and banks risk-taking are imperfectly correlated, the regulatory capital constraints could lead banks to seek higher returns on the additional capital. Also, higher capital requirements could push banks into the unregulated banking sector, a phenomenon that became evident in the crisis. They argue that market expectations would play a more important role than the Basel capital requirements.

Admati and Hellwig's latest book, 'The Bankers' New Clothes', argues that the best way to achieve a safer and healthier financial system is to require banks to hold much higher equity levels. The proposed equity levels are at least between 20-30 percent of their total assets. They argue that rising equity levels would not reduce lending as perceived by many. This is because listed banks can raise money by issuing new shares, and if the funds raised are used to make loans then higher equity levels would increase lending rather than curb it. For banks not listed on the stock exchange, the alternative option is to reinvest their earnings. Even though there would be a transition problem for this category of banks, after some time their lending would be the same as before.

The distinct feature of this proposition is that it its a clear departure from the Basel capital requirements. The later, with reference to Basel III capital requirements, require banks to hold at least 7 percent of their risk-weighted assets, whereas Admati and Hellwig proposed equity levels related to banks' total assets. They criticise the Basel approach and argue that this in turn has substantially reduced banks' equity to total assets. The main message of this book is that reducing banks reliance on borrowing, banks could become healthier by reinvesting their profits and raising equity in the capital markets, like any other company does. This would lead to a safer and healthier banking sector '..better able to support the economy' (Admati and Hellwig 2013, pg. xi). However, to claim that higher equity levels, achieved by issuing new shares do not impose any costs to the society could be misleading. As argued, one of the implications of forcing banks to hold higher capital ratios by the issue of new capital is the crowding out of capital issues by non-financial corporations. This would then reduce their productive investment, damaging the economy. This is the core message of the capital market inflation theory of Toporowski.

The other misleading message that the Admati and Hellwig analysis conveys is the claim that when banks hold more equity then shareholders will bear the risks rather than creditors and taxpayers, and thus ruling out any imposed-cost to the society as a result of increasing equity levels. Banks' shareholders are mainly pension funds, insurance companies and intermediaries holding society's long-term savings. Thus, to claim that when shareholder are left bearing the risks of the activities undertaken by banks, then no losses are transmitted to ordinary people is misleading since banks' shareholders are ordinary people of the society.

This argument is highlighted also by Coppola (2013), which contributes to the capital requirements literature by showing that there is no difference between equity and debt. She claims that both equity and debt are claims on a bank's assets, when it fails, or its income, when it is a going concern. When a bank fails the only real difference between a depositor, a bondholder and a shareholder is the seniority of their claims. She build a hypothetical scenario showing that if for example a bank's Tier I capital ratio, which comprises shareholders fund and retained earnings, is 3 percent, and if a bank suffers losses and it has to write down 3 percent of its assets then the shareholders funds are wiped out. If losses increase, junior bondholders are next in line. Once a bank declares that it is in financial distress or failed, junior bondholders are liable to have their bonds converted to equity, hence becoming ordinary shareholders. When and if the bank recovers then they can enjoy dividend payments. However, there is the possibility that their funds would be wiped out, as happened in the case of the Dutch bank SNS Reaal. As it turned out their investment was saved when the Dutch government took over their claims when rescuing the bank. Nevertheless, the point here is that if the government would have not rescued the bank, junior bondholders together with shareholders funds would have been wiped out. The next scenario is if losses are of a larger magnitude, thus affecting senior debt, which includes bondholders, wholesale lenders and depositors. All senior debt holders are ranked pari passu in the proportion to their claim. That said, secured debt is ranked senior to unsecured debt, so that when banks have issued debt or borrowed money using its asset as collateral, those creditors are ranked senior to depositors. When, however, the assets used as collateral turn out to be worthless, the debt is actually unsecured. Coppola argues that this hypothetical capital structure shows that when a bank is failing, whether the investment is in the form of equity or debt is in fact irrelevant. The seniority of the claim is what matters. In this respect she argues that losses incurred would be the same if the bank has 3 percent or 15 percent equity. Thus, higher equity levels do not reduce the likelihood of failure, instead it increases the likelihood that creditors will receive their money back. She concludes by noting that her argument does not necessarily advocates debt financing as oppose to equity, since heavy reliance on debt could be a potential threat not only for banks but for corporations too. But the focus of her analysis is to show that increasing equity level does not make banks safer.

Gorton (2012) similarly argues that, even though capital requirements do to have an important role in affecting banks insolvency, higher capital levels are not enough to prevent runs. ‘There is almost no evidence that links capital to bank failure’, Gorton writes. Looking at banks failure from a historical prospective, he argues that a cash shortage and the inability to sell assets, hence not able to convert them into cash, is the key source of triggering bank failures. He suggests that instead of focusing on capital requirements as the key solution to systemic events, liquidity should play a far more important role. That crisis is about cash is a view commonly understood by US bank regulatory bodies in the period between 1934 till the 1980s, which mainly focused on bank examination and not capital requirements, as exemplified in the writings of Tynan Smith and Raymond Hengren of the FDIC:

> ‘Capital is not the sole answer…..to the problem of keeping a bank’s doors open. Regardless of the size of a bank’s capital, it will continue to function as a going concern only so long as it has on hand or can obtain cash to meet the claims of depositors…..Whenever banks are faced with heavy withdraws of deposits, either because of general economic crisis or local or regional situation, the essential problem is one of liquidity rather than of capital. …..The equity ratio has relatively little bearing on the ability of a bank to obtain cash when it is needed ‘(1947, 557, quoted in Gordon 2012, pg 152)

Wray (2006) considers the then new approach of capital requirements set by Basel II and their ability to reduce banking risk. He argues that capital or risk-weighted capital are not good indicators of the probability of bank failure. Instead, second after the international macro environment in which banks operate, the return on assets or equity is a more important factor than the capital ratios advocated by regulators. This is because a bank, which yields higher returns on assets, is in a better position to withstand unforeseen losses. Furthermore, financial institutions that enjoy higher returns can easily issue more equity bringing capital to desirable levels. He refers to a study conducted by the Dolbeare and Barnd (1931)[10] of the Florida banks balance sheets for the period 1922-28 and concluded that banks that failed had higher capital ratios than those that did not (cf Wray 2006; Kregel 2007). Wray (2006) notes that the capital requirements imposed on banks not only do not help in preventing risk incentives but could actually increase it. Borrowing Minsky's (1986) argument, he states that in competitive markets well-capitalized banks will seek to finds way to achieve higher returns, in order to increase returns on equity. Any attempt for banks to seek higher returns would lead to more risk taking. Similarly, Tymoigne (2010) argues that in order to show that capital buffers are not sufficient to prevent financial fragility, it is necessary to analyse the return on equity. He argues that in good economic conditions, i.e. when the economy is expanding, the rate of return tends to fall, as equity extracts some of the profit and because the growth rate of profit has a tendency to fall in saturated markets. Therefore, to compensate for the declining return on equity, financial institutions are bound to find new ways to counter for such decline, by either increasing the leverage ratio or return on assets[11]. Tymoigne, notes that both these practices, increasing leverage and return on assets, are achieved by financial innovations. This way, any restraints placed on the leverage ratio and asset

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[10] Even though Wray (2006), refers to this study in relation to Kregel (2007) paper, in which he argues that from a historical perspective higher capital ratios do not show any evidence of providing better protection loss (cf Wray 2006). Kregel (2007) shows in more details the study conducted by Dolbeare and Barnd (1931).

[11] Tymoigne(2010), shows that both the leverage ratio, which is the ratio of assets to equity, and the rate of return on assets, which is the ratio of profits to assets, are two components of the return on equity, the ratio of profit to equity.

quality would be evaded, as banks and other financial institutions create new financial products in search for maintaining their return on equity. So unless financial innovations are regulated, capital and liquidity buffers will be useless to prevent financial stability.

Campbell and Minsky's (1987) study is focused on the then new regulatory standards associated with the Federal Savings and Loan Insurance Corporation during the 1980s, which were followed with the implementations of Basel I (see chapter 1). They argue that the proposed reforms of deposit insurance, such as capital requirements were likely to increase financial instability. The critical component of Basel I in their arguments is that it does not account for systematic risk. They write:

' All the proposed reforms raise operating expenses or reduce profits of banks that examiners find to be a higher risk class. Raising the operating costs of banks who, because of changes in systemic conditions, have become riskier will only make those institutions more vulnerable to failure. Risk-related premiums or risk-adjusted capital requirements would be pro-cyclical, worsening the conditions of banks just when other operating costs are rising and profits are being squeezed. If implemented at all, risk-related premiums should be adjusted downward for systemic conditions even as they are raised for the presumed riskier institutions' (pg. 258).

Therefore in this respect, increasing capital requirement contributes to financial fragility. For Minsky an important source of banking stability is the expected and actual cash flows. One major loophole in the regulatory framework Minsky argued was that instability of banks and other financial institutions was (and still is) commonly associated with runs and defaults. However, he argued that in order to better describe ' ….the instability of an "economy with banking"….' it is imperative to assess the root causes of the run and assess the structure of balance sheet, payment obligations and position-making activities of banks. These suggestions are also found in Minsky's earlier writings. Minsky has always emphasised the important role of liquidity in banks. As Gorton (2012) explains from the time the deposit insurance was introduced until the 1980s bank regulatory main weapon for stability was bank examination. And it is within this framework that Minsky (1967, 1975a) builds an argument and suggests a cash flow-oriented bank examination approach in order to assess the liquidity of a bank. His proposed framework is forward looking, by means of estimating the present value of cash flows of banks. He argues that the position making of banks is of dominant importance in evaluating their liquidity needs. To put it simply, Minsky states that 'banks generate cash and a need for cash' over a period of time. In order to determine whether a bank is liquid or not it is necessary to evaluate its position making activities. Therefore, the way by which a bank would obtain liquidity is mainly determined by the assets held on the balance sheet, which would be converted into cash, and the markets in which it would conduct such transactions. Therefore, banks' liquidity, and thus its viability and future profitability depend on the markets. Put simply it is the normal functioning of the financial markets that would determine the ability of banks to convert assets into cash. Therefore, for Minsky liquidity is a characteristic of markets rather than intrinsic to particular assets. As he states 'the liquidity of an institution cannot be measured by assigning universal predetermined liquidity quotients to assets and similar liquidity requirement factors to liabilities: the liquidity quotients and requirements are system-determined variables' *(*Minsky 1975a, pg.154*).* In this respect, a "point in time" balance sheet approaches, upon which the Basel Accords are based, can be considered ineffective in promoting financial stability.

Tymoigne (2010) also explains that the reason that the Basel capital requirements have not been successful in delivering what they are designed to do, that is to maintain financial stability by means of lowering risk incentives is not only because ' the mathematical models failed to recognize the economic risks, it is that the underlying economic principles also failed' (2010, pg. 3). He notes that Basel II Accord, together with other Acts associated with financial deregulation process in the US, are based on a free-market approach, in which risk management, self-regulation and market discipline became the core tools aiming to achieve financial stability.

Kashyap et al. (2010), illustrates the fundamental principles guiding the microprudential regulation. As already explained above in 1934 the FDIC provided deposit insurance, and hence these government-insured deposits are the main source of finance for banks. Within a Diamond and Dybvig(1983) framework, deposit insurance is presupposed to prevent banks runs. Diamond and Dybvig (1983) argue that one of main function of banks is to provide liquidity services. This on the other hand makes them prone to runs. This is because the liquidation value of banks' assets needs to be lower than the value of liquid liabilities, such as deposits, in order for a bank to be liquid (Santos 2000). The bank run model developed by Diamond and

Dybvig (1983) suggests that depositors' decision to withdraw their savings is also influenced by the expectations of what other depositors are doing. So if they expect other depositors to withdraw their funds they would quickly rush to the bank in order to secure what little liquidity it has. In this way, once a run starts it will bring down even a healthy bank. They argue that the most effective policy tool to prevent bank runs is government deposit insurance. However, deposit insurance is subject to moral hazard problems as well as places taxpayers' money at the disposal of such insurance. Therefore, capital requirements are seen as a way to mitigate both these problems.

2.3 Concluding remarks

This chapter has presented background information on the origin and development of the Basel Accords as well as the related literature. As evident, most of the discussion on bank capital requirements tends to ignore the effects of varying capital requirements on the way in which the system works as a whole and, hence, on the way in which the economy generates the cash flows necessary for setting committed financial obligations. The exceptions are those theories based on the supposed effects of capital costs, which, however, ignore the cash flow generation, which is central to the theories associated with Minsky and Toporowski.

The research in this thesis attempts to fill in the gap in the current literature by examining the role of capital adequacy regulation on the probability of default of banks using an economic theory-based approach. As stated, the underlying theory of this analysis is the capital market inflation theory, presented in the next chapter, which looks at the system as a whole and thus makes it possible to analyse the role of the Basel capital requirements on the real economy. This way, this thesis does not only provide an analysis of the impact that such regulation has on banks' probability of default but also looks at the effects on the functioning of the capital markets in providing funds to non-financial corporate sector.

Chapter 3. The Theory of Capital Market Inflation

This chapter provides empirical evidence on capital market inflation theory applied to both US and Japan. In the subsequent chapters of this thesis the probability of bank default for both countries under consideration will be analysed using the capital market inflation theoretical framework. As a first step to this analysis, this chapter empirically validates this theory. The chapter starts by giving a detailed explanation of the theoretical aspects of the capital market inflation theory. It then provides the methodological approach of the empirical work. Using data for the US capital market for the period 1964-2010, the results provide evidence supporting the capital market inflation theory, presented in section 3.2. By contrast, the regression results for the Japanese capital market, for the period 1980-2010, provide no evidence in support of this theory. However, taking into account various factors associated with the structure of the Japanese capital market and the government intervention in such market the results imply that government purchases offset private sector outflows of credit from the capital market. Thus, the capital market inflation theory may still be valid for this case.

3.1 Post Keynesian Approaches

A good economic model is said to make sharp and clear predictions that are consistent with reality. It is on the grounds of this statement that the capital market inflation theory stands in the current literature as a study of the capital market and unique in that the theory considers the issues of banks' capital requirements. While the literature on capital adequacy is vast, it is apparent that the literature largely fails to address the impact of these requirements on banks and the financial market as a whole. The available studies attempt to analyse and predict the relationship of banks and capital requirements, based on intuition and/or judgement on banks activity and behaviour. These intuitions are derived from a perfect foresight and representative agent perspective. This approach views the representative agent in isolation from other agents and the rest of the economy as a whole and because of this it falls into a fallacy of composition. The study of capital markets in the traditional theory of finance is conducted within a general equilibrium framework, in which the underlying assumptions are based on Walrasian general equilibrium in which savings and investment in the market for loanable funds are brought into equilibrium by the price of finance (a price mechanism). Thus, market equilibrium is achieved when the supply of finance (by rentiers) and the demand for securities intersect at a given price. In the event of market disequilibrium, the tatonnement process will establish a new general equilibrium by means of Walrasian auctioneers adjusting prices in accordance to the demand and supply conditions. This approach considers the functioning of capital market in isolation from the rest of the economy except where changes in a market affect other markets by means of establishing a new general equilibrium. By contrast, capital market inflation theory suggests that the demand and supply of capital are usually unequal and this has profound implications for the structure of the capital market, which in turn affects the rest of the economy.

The market disequilibrium is also reflected in other various theories, Keynesian theories, post-Keynesian theories, financialisation theories all of which try to look at the system as a whole, but none of them considers the issues of capital adequacy[12]. But Toporowski's capital market theory does.

The key element of Keynes' argument is that the market mechanism fails to restore equilibrium due to expectations under uncertainty. He acknowledged that the economy could be out of equilibrium for a significant time, since price mechanism, i.e. wages in the labor markets or interest rates in the money markets, could not reach an equilibrium in which supply is equal to demand. In contrast to the neoclassical economists, who presuppose that it is the price mechanism that brings about equilibrium, he argues that, because of uncertainty, investors form expectations about the future that could lead to excessive valuation of financial assets. He argued that it is the expectations that give a rise to stock prices that induce investment. This forms the basic argument of the nonequlibrium approach relating finance and investment that Keynes put forward in his writings. This approach could also be explained in terms of excessive borrowing, in accordance with the expectations of future stock prices, that is undertaken during a boom. However, when the boom ends, the need to

[12] Exceptions are Minsky, Kregel, Tymoigne and Wray, as explained in the previous chapter, who argue against capital regulation as sufficient and effective tool to promote financial stability. However, none of them provide a framework that analyse the impact of such regulation on the rest of the economy.

liquidate comes into the picture and this in turn reduces investments. In other words, Keynes provides a framework in which expectations lead to over indebtedness that make an economy unstable by reducing investment. The issue of indebtedness was not new in the literature when Keynes formed his theory. Fisher's view on indebtedness and the consequences it has on the economy were illustrated in a paper Fisher published in 1933, 'The Debt-Deflation Theory of Great Depressions'. Fisher's contribution to the literature in arguing that a capitalist economy is always out of equilibrium are perhaps best expressed in his own words in which he states ' it is absurd to assume that, for any long period of time, the variables in the economic organization, or any part of them, will "stay put", in perfect equilibrium, as to assume that the Atlantic Ocean can never be without a wave' (Fisher 1933, pp. 339). The central element to his argument is the level of debt in the economy is the main cause of disequlibrium as opposed to Keynes' emphasis on expectations.

The ideas put forward by Keynes have served as the basic foundation of other economic theories, most notably associated with post-Keynesian economists. For example Minksy' financial instability hypothesis (1975b,1986) "is an interpretation of the substance of Keynes's 'General Theory' "(Minsky 1992, pg.1). Toporowski (2005) states that ' Minsky may be said to have started where Keynes left off, with the flow of finance to investment. Thus Minsky developed a balance sheet approach to the relationship between the financial markets and business that extended Keynes's analysis' (2005, pg. 143). Minsky, like Keynes and Fisher, acknowledged that the economy might experience periods of disequilibrium. Indeed for him, a stabilizing economy was destabilizing. Behind such a short, yet powerful, statement rests the explanation of how a stable economy can be destabilizing. He identifies three types of financial positions in the financial structure of a capitalist economy that can lead to insolvent debt: hedge, speculative and Ponzi finance. Hedge financing refers to those positions in which cash flows can fulfil contractual payments obligations, i.e. interest and principal payments. Speculative finance is when cash flows can cover interest payments but not principal payments. Thus speculative financing may need to be rolled over in order to pay back the original debt i.e. the issue of new debt in order to repay the maturing debt (Minsky 1992). Ponzi finance refers to those financial postures in which cash flows cannot cover neither interest or principal payments. Borrowers need to borrow or sell the assets in order to meet interest payments. In this type of finance, borrowers are heavily dependent on rising asset prices which allows them to keep refinancing their debt (Knell 2012). It is the speculative and the ponzi financing which poses real threats to the economy. It is this way Minsky showed how the financial sector mattered in the functioning of the real economy, by inducing business cycles which are not exogenous shocks but a characteristic of it. In other words, he argued that in periods of economic prosperity, ‘capitalist economies tend to move from a financial structure dominated by hedge finance units to a structure in which there is a large weight to units engaged in speculative and Ponzi finance’ (Minsky 1992, pg. 8).

More recently there has been a growing literature on the financialisation theories in which the central element in the explaining market disequlibrium is the ever-expanding role of the financial markets in the economy (see below).

Minsky's theory does acknowledge the dynamic of an economy in which the financial sectors plays a pivotal role. But it is largely based on a bank credit model rather than a capital market model. Therefore Toporowski's theory provides a framework in which capital requirements are incorporated into the analysis, better suited to the purpose of this thesis.

This chapter empirically evaluates the capital market inflation theory applied to both the US and Japanese capital markets. The demand and supply for equity capital is derived using data from the flow of funds account for the period 1964-2010 in the case of US, and 1980-2010 in the case of Japan. The supply of capital represents purchases of corporate equity by households, institutional investors and rest of the world. Demand is derived from combining non-financial sector issues of corporate equity with those of the financial sector. The regression results for the US capital market supports the capital market inflation theory, that the price level of securities is determined by the inflow of funds into capital markets in non-linear positive relationship. However, when applied to the Japanese capital market the results provide no evidence that supports the theory. It is argued that various factors associated with the structure of the Japanese capital market could be important in explaining such results. Amongst other factors this thesis identifies government intervention, as a measure of stock purchases by the central bank, as an important factor in an attempt to empirically evaluate the validity of the theory of capital market inflation in Japan. For this purpose the impact of stock purchases of Japan's central bank on the Nikkei 225 stock price index, for the period between 2002-2011, is empirically evaluated. The results indicate that these purchases, or government intervention, do have an impact on stock prices. This implies that central bank stock purchases offset private sector outflows from the capital market. Therefore, the capital market inflation theory still holds.

3.2 The capital market inflation theory

The theory of capital market inflation brings an insight of how capital markets actually operate and identifies the critical effect that its activities have on the economy. The capital market brings together the supply and demand for equity capital: supply being from households and funds operating on behalf of households (pension schemes, mutual and investment funds) and demand represents the financial and non-financial businesses, which issue equity capital. The inflows in the capital markets will circulate around its participants, the initial money put into the market will be turned over more than once, until is taken out by government in forms such as issuing bonds, and corporations by means of them issuing stock. The balance is a net excess inflow, which will continue to circulate within the market until it is taken out by additional stock issue or investors' sale. If the initial transaction was a sale, the exchange will continue until the liquidity will be replaced by purchasing securities in the market.

The excess net inflow determines the value of turnover in stock and liquidity in the capital market. It also provides a margin of liquidity that allows the market to absorb to some degree the net sales by investors. In other words, when investors sell stock, the market is kept stable not by lowering prices to attract buyers, but using the past accumulation of net excess inflow to purchase the excess stock that investors have put on sale. The implication of this is that demand and supply of equity are not usually in equilibrium but are usually unequal and balanced by net inflows or outflows of credit into the capital market. Hence, stock markets crash not because they were not in equilibrium but because their disequilibrium has not been sufficient to accumulate enough inflow to accommodate the desired net level of stock sales.

The capital market inflation theory suggests that it is the net excess inflow that determines the price level of securities. In other words stock prices increase with the inflow of excess liquidity into the capital market. This contradicts the conventional finance theories, which are based on the belief that the price of securities reflects the estimated future stream of income derived from holding those securities. These theories, which analyse asset markets within a general equilibrium framework, presuppose that the law of demand and supply for financial assets holds in the same way as for other ordinary products. Evidence in support of this belief is practically non-existent even though theories, such as the market efficient hypothesis, have dominated the financial literature since the 1970s. Stiglitz (2000) identifies the difference between the financial and capital markets and other markets for goods and services and argues that the conventional neoclassical model fails to recognise this difference[13]. An article by the Economist also supports the argument against the presupposed belief of efficient markets arguing, ' Financial markets do not operate in the same way as those for other goods and products. When the price of a television set or software package goes up, demand for it generally falls. When the price of a financial asset rises, demand generally increases ' (The Economist 2012). And it is precisely this that Toporowski's theory predicts. When the inflow of funds increases and circulates around in the market for a lengthy time before is taken out by government issuing bonds or companies issuing stock, the price of securities rises. This describes the process of capital market inflation. When the price of securities rises, demand will increase even more, as investors are attracted by additional returns of capital gains. However, not all securities rise equally or proportionally. Short term securities and bonds, usually will have to be repaid at par value on their maturity date. Therefore, these securities are not likely to capture much capital gain, because the amount that the holder will receive on maturity is predetermined. In contrast, shares or common stock, have no guaranteed repayment value. Capital gains are therefore more likely to be sustained. This will increase investors' preference for equities, in prospect of capital gains (Toporowski 2000).

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[13] The argument Stiglitz raises is related to the capital market liberalization that is based on the neoclassical model, which do not address the difference between the financial market and the markets for other ordinary goods.

An increase in stock prices is supposed to reduce the yield on stock. But this reduction is offset by returns, additional to dividend and interest, of capital gain. An excess speculative demand for stock impacts most directly on the balance sheet operations of companies. Companies find that they can issue equity at lower earnings per share and at a lower cost because of capital gains, which is paid by buyers in the equity market. Therefore companies are inclined to issue equity to repay bank borrowing so that they substitute debt with equity finance. Because of this disintermediation, banks lose their best and safest borrowers; the borrowings of large corporations, and banks have been forced to lend to less financially secure borrowers, carrying greater risks.

Furthermore, as companies find issuing stock a cheaper and a more profitable activity, this will tend to discourage productive investment. If and when the possibilities of repaying debt have been exhausted, companies are inclined to search in other possible ventures to further increase their profits. And one way of achieving this, and what has been a characteristic of corporate finance since the 1980s, is by acquiring or merging with other companies. These can be held and sold later at a higher price if the market continues to inflate. In fact, lower levels of productive investment in most advanced economies such as the UK and US are now well documented and many scholars have attempted to address the reasons behind such outcome. In particular, financialisation theories argue that the decline in fixed capital investment, and thus the decline of economic activity, is a consequence of firm's management deviation from the principle 'retain and reinvest' to 'downsize and distribute'. In effect this is saying that firms' management main priority has become 'shareholder value maximisation' (Lazonick and O'Sullivan 2000). Similarly Hein (2011) argues that the decline in fixed capital formation is a result of increased dividends payout and buyback shares, in search for maintaining high stock prices, thus shareholder value. Hence, shareholder value was kept at the expense of having lower liquidity levels, which, on the other hand halted fixed capital investment. Financialisation is a recent term, which gained popularity in the aftermath of the 2007-08 financial crises. Even though there is no set definition for the term 'financialisation' it is generally understood to mean a rise in the activities of banking and financial markets that dominate capitalists economies in relation to production. For example Epstein (2005) refers to financialisation as ' the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies' (Epstein 2005 pg. 3).

Even though the financialisation theories and the capital market inflation theory share a common view that a rise in financial activities has undermined the productive investment of the non-financial corporations there are major differences in explaining the reasons of such phenomenon. As argued above, when capital markets are inflated the outcome is higher stock prices. Thus, it is the credit inflow into the capital market by its participants that contributes in maintaining shareholder value, without necessary draining out firms liquidity or value of the industry(Toporowski 2012). This is in contrast to the arguments raised by some of the financialisaton theories, which suggest that shareholder value is maintained at the expense of lower liquidity levels in firms.

Under conditions of capital market inflation, in which firms find equity issuance a cheaper and more profitable activity, firms tend to be overcapitalised- that is a situation in which firms issue equity in excess of what is needed to conduct their productive operations. Overcapitalisation then allows firms to use the excess capital to purchase short-term financial assets, thus increasing the liquidity of their balance sheet. Such assets could then be used as collateral for short-term borrowing, or balance sheet restructuring, such as merger and takeover activity. However, the latter activities could be profitable only if inflation in capital market is (and remains) an on-going process. Prior to the financial crisis many firms, such as General Electric through its subsidiary GE Capital, have used their financial assets in this way to sustain their profits growth rates, when it was not possible to do so from industrial activities .In addition, overcapitalisation allows firms to expand their commercial activities by increasing leverage. Therefore, firms are able to grow much quicker, especially in activities such as acquiring other companies, rather than by means of production (Toporowski 2012).

Actual overcapitalisation emerged in US with the rise of institutional investor: mainly pension funds and insurance companies. The concentration of savings in long-term financial institution led to the process of capital market inflation illustrated above. Pension funds and insurance companies dominate the capital market. Pilbeam (2010) notes that the dominance of institutional investors in stockmarkets in countries such as UK and US has imposed different demands from the traditional investors. So in effect this means that because of the rise of the institutional investor since the 1970s and 1980s the demand for stocks in the capital markets has increased. These suggestions provide the foundation on the assumption of the capital market inflation theory, which argues that it is the excess demand of institutional investors, i.e. pension funds, which, to some extent, radically change the balance sheet operations of corporations (as argued above). The important role that institutional investors play in the US capital markets is also documented by Mizuno (2010). He argues that since the 1970s their holding of corporate stock has steadily increased. For example, in 1987 US institutional investors held around 46.6 percent of the total stock of US largest 1000 corporations. By 2000, the proportion of their stock holdings reached 61.4 percent of total stock increasing to 76.4 percent by 2007 (Mizuno 2010). So it is the institutional investors' flow of funds of particular interest as it has a critical effect on the functioning of the market and the activates of businesses.

In the neo-classical theory of market equilibrium, a reduction in the price is supposed to increase demand for a commodity or asset. But if the capital market is deflating, lower prices will not evoke additional buying. High dividend yields on the one hand will be offset by prospective capital-losses, thus failing to elicit sufficient repurchases or redemptions of stock by companies to provide an inflow of funds that will balance the outflows. Toporowski argues that it is in this way that capital market inflation and deflation reinforce the inelastic demand and supply in the long-term stock market.

Thus the demand and supply of equity capital are not usually equal, and the price mechanism does not bring them into equilibrium as suggested in the general equilibrium models. The capital market enters a process of inflation or deflation, depending on whether there is excess demand or excess supply in the market. Companies' demand for finance is determined by the size and nature of business and circumstances. More precisely, in the case of pension funds, demand for equity will depend on its maturity, and in case of banks its determined to some extend on their capital requirements. Furthermore, under conditions of inelastic demand for equity capital by banks nonfinancial companies could be forced into debt thus discouraging their investments and limiting their cash flow. Pension funds do not need to issue capital. They will buy equity in proportion to the inflow of pension contributions and the maturity structure of their liabilities and the regulations affecting their business. Banks in the US and UK are not allowed to hold equity as assets, but issue equity to raise capital. Insurance companies also issue capital, but the demand for capital assets is also determined by the structure of their liabilities and regulation.

Requiring banks to increase their capital, therefore, reduces the amount of capital available to non-financial firms. When banks are faced with tighter capital regulation they have to adjust their capital accordingly. There are various ways in which banks adjust their required capital ratios. Either one of them will have a negative impact in the capital market. The first one is by issuing more equity capital reducing the amount of equity capital available to non-financial firms. The second one is by reducing their lending in relation to existing equity. The second reduces the amount of bank borrowing outstanding, and the size of bank balance sheet. In turn this reduces the amount of (bank) credit money in the economy, forcing companies to borrow from each other or issue debt securities.

The higher the amount of capital held by bank, the lower the quantity available to nonfinancial intermediaries in the market. Therefore, they are left with no option other than to raise their needed capital through the issue of debt instruments. Hence, firms maybe forced to borrow more than planned, which in turn reduces future fixed capital investment. Securitization is a way, which allows banks to raise capital ratios and shift balance sheet composition toward less risky asset. The sale of loan-backed bonds to other financial intermediaries reduces the amount of capital available to firms in the market. This is another way in which companies are forced into more debt. Toporowski argues that enforced indebtedness increases the financial fragility of the economy. Firms that planned to issue equity to reduce the amount of debt held, now have debt in excess of what they planned. This can be accommodated in two ways. Firstly, companies can hold larger amounts of liquid assets. But this is not efficient since it means that the capital that firms have issued is being 'wasted' by being held as financial asset rather than being used to expand production or fixed capital. Alternatively, firms could reduce their future fixed capital investment in order to be able to have those liquid assets. Therefore, the excess debt level being held by firms as a consequence of higher banks' capital regulation requirement reduces productive investment below what it would otherwise be. The reduced productive investment also reduces the cash flow of firms and their ability to service their debt. Therefore, higher capital requirement that aims to circumvent banks unsoundness, encourage firms to reduce their productive investment in fixed capital in response to their increased indebtedness. Toporowski notes that such reduction in fixed investment is the key determinant in causing the real economy to enter in recession. Furthermore, as history reveals the case of 1930s or Japan after 1992, excess debt can turn recession into economic stagnation and depression (Toporowski 2008, 2009).

3.3 Empirical analysis: the case of US

3.3.1 Methodology and results

As argued above, the general equilibrium systems have dominated the theory of finance. The efficient market hypothesis, associated with Eugene Fama, has perhaps been the most influential theory in finance since the 1970s. Under the efficient market hypothesis the demand and supply for financial assets is the same as for other goods and services in market for ordinary goods, and thus financial asset prices are set through the market mechanism. Stock price movements are examined under the assumption that they reflect all available information, thus markets are perfect. The assumption that asset prices incorporate all available information implies that they follow a random walk. This assumption is a property of the weak form market efficiency, which suggests that it is impossible to predict future prices using past historical asset prices. The simple asset-pricing model that Fama and other economists have used to test the market efficiency hypothesis is used (relies in the fundamentals) of within the no-arbitrage pricing model[14] framework. The simple asset pricing model implies that the price of a stock is equal to the expected present value of future cash flows i.e. dividends (Shabani and Toporowski 2014a).

Therefore, the efficient market hypothesis assumes that the value of a stock always reverts sooner or later to the net present value of future earning. This is contrast to the capital market inflation theory employed in this research. The distinction is that the capital market inflation theory suggests that the value of a stock is determined by the net inflows in the capital market. The two theories may not be incompatible if net inflows are determined by future expected earnings but the capital market inflation theory suggests that net inflows are predicated upon current liquidity requirements rather than expected future earnings.

In the efficient market hypothesis the assumption of no-arbitrage rules out the possibility of a 'bubble'. Within such framework Fama and other economists have conducted numerous studies in an attempt to examine the behaviour of stock returns. For example, in collaboration with Fisher, Jensen and Roll, Fama (1969) studied the adjustment of stock prices to new information, such as a stock split announcement. Using the 'market model[15]' approach-which is similar to the capital asset pricing

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[14] This assumption for the simple asset-pricing model is needed to ensure equilibrium. Therefore in a competitive market the return on two risk free assets must be the same.
[15] The so- called 'market model' associated with Sharpe (1964) suggests that a stock price movement is linear to the market movement. That is when the market increases

model (CAPM), they show that relevant news, in this case the stock split announcements, is fully incorporated into share prices, supporting the market efficiency hypothesis. Within this line of reasoning, when the announcement of the stock split reached the market, stock prices rose to a new fundamental value, in accordance with the news. However, after the announcement date stocks continued to trade at the new equilibrium price, therefore they did not exhibit any excess returns.

The CAPM[16] approach, which was independently developed by Sharpe (1964), Lintner (1965) and Mossin (1966), focuses on the relationship between the risk and return on a financial asset that is used to determine the price of that asset. The beta coefficient, which is a measure of volatility of an asset or portfolio in relation to the market as a whole, is key in determining the price of a security. For example, a security with a high beta is said to have a lower demand by investors, therefore the price for that security will be lower. Whereas a security with low beta, will command a higher price and subsequently this will push its rate of return to be lower than the average market rate of return (Pilbeam 2010).

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then stock prices will also increase. The model states that expected returns $E(R_i)$ are given by $E(R_i)=\alpha_i + \beta_i E(R_m)$, where $E(R_m)$ is the expected return on the market as a whole, α_i is a constant factor which varies across securities and β_i is the security's beta that captures the sensitivity of the return on security i to the market return (Pilbeam 2010).

[16] The major difference between the CAPM and the market model is that the former model imposes an additional restriction on the α coefficient, that is α is equal to $(1-\beta_i)$ times the return on the risky free asset (Economic Science Prize Committee of Royal Swedish Academy of Science 2013)

The literature has long used ideas derived from physics, such as random walk and Brownian motion models etc, to build statistical models used to analyse financial markets. In most recent years the kinetic models have also been employed to study the behaviour of stock prices. The use of this model is advantageous to researchers as it allows building a statistical system with many interacting particles (Maldarella and Pareschi 2010). Hsu and Lin (2002) refer to the connections between some of the laws of physic and stock markets as 'wonderful and astonishing'. Using these connections, they employ both the kinetic and kinematic theories to derive two equations-the motion and the work-energy equation- to analyse the behaviour of stock prices. Their work is based on the principles of dynamics in physics, i.e. the kinematic and kinetics, which focus on bodies in motion under the action of forces. In such the kinematics are concerned with mathematically describing the state of motion such velocity, position and acceleration. On the other hand kinetic theories are used to study the effects of forces on the motion of bodies. They argue that the relationship between external force and acceleration for bodies in the same as the relationship between excess demand and stock price changes. They refer to the conventional view that treats the supply and demand for financial assets the same way as for any other goods and services. This way, they argue that under condition of excess demand prices will go up and vice versa. This statement serves them as a foundation to study the behaviour of Taiwan Stock Exchange price index, for the period between 1989-1998, using both the ordinary least square (OLS) and generalized autoregressive conditional heteroskedasticity (GARCH) approach. They conclude that a unit increase in excess demand, calculated as units of buy orders minus units of sale orders, increases the TSE index by 0.00034 points. However they argue that these results do not violate the market efficiency hypothesis, as changes in excess demand are assumed to be deterministic. Also because the empirical results revealed some small predictable error for the equation of motion, which implies that stock prices are predictable, they argue this is due to the rather long time interval between the purchase and sale orders. They recommend a shorter period between these two transactions should be used to induce a fair market (Hsu and Lin 2002).

As argued the present value models rule out the presence of stock market bubbles in a no-arbitrage opportunity market. Behavioural economists are amongst others in criticizing this approach, providing empirical evidence against the simple asset pricing model and arguing in support of stock markets exhibiting repeated speculative bubbles. Amongst others the work of Robert Shiller[17] stands out in the literature in providing empirical evidence against the market efficiency hypothesis and in supporting the 'bubble' phenomena. His explanations of repeated speculative bubbles evident in the US stock market since the 1870s, comes from the assumption that investors are irrational, as opposed to rational as argued by the efficient market hypothesis. He links this irrationality with physiological human factors that influence the decision of investors to invest. He argues that when information of a particular investment i.e. investment in the stock market, is perceived profitable, and this information circulates around the market through word-of-mouth or the media,

[17] For which Shiller, along Eugene Fama and Lars Peter Hansen, was awarded the 2013 Nobel Prize of Economics(for more details see Shabani and Toporowski 2014a)

investor's demand of that particular investment, prices will increase. This in turn can again initiate further excitement for investment, increasing prices further more (Shabani and Toporowski 2014a). When this process is repeated for a number of times will lead to a speculative bubble which Shiller defines as ' an unsustainable increase in prices brought on by investors' buying behaviour rather than by genuine, fundamental information about value'(Shiller 2000 pg. 5).

Guided by the assumptions of the present value model researchers use the expected future cash flows and the discount rate as two main factor effecting stock prices. However many studies have also incorporated macroeconomic variables in analysing stock price behaviour. Kalyanaraman and Tuwajri (2014) argue that any macroeconomic variable that affect the two decisive variables of the present value model-the discount rate and the expected future dividends- also affect stock prices. Taulbee (2001) studies the impact of unemployment, real GDP and Fisher Effect on S&P 500 within the rational expectations hypothesis framework[18]. Using the generalized least square (GLS) method on monthly data for the period between January 1972 and August 1999, the results imply that real GDP and unemployment play a significant role in explaining changes in the S&P 500 index. Empirical evidence suggests that real GDP is strongly and positively related to S&P 500 index, whereas unemployment rate negatively influences the stock price index. On the other

[18] As stated above this approach has dominated the theory of finance, and this dominance is reflected in the statement of this author in which he notes 'Like other research on the stock market, this study will use the rational expectation hypothesis…'(Taulbee 2001, pg. 91)

hand the Fisher effect was not found to be significant for the period under consideration in this study (Taulbee 2001).

This thesis provides a new approach in estimating stock price movements, as represented by the S&P 500 stock index. Using the capital market inflation theory framework the independent variables are derived from the flow of funds accounts and no other independent variables are used, rather than those associated with the theory used to build the model to be estimated. However, that does not imply that this analysis rules out any impact of the macroeconomic variables on stock prices. In contrast it assumes that these effects, i.e. GDP and interest rates are captured in the data that represents the inflows and outflows of the capital market. Whereas the equilibrium theories are concerned with determining equilibrium values for stock prices, the theory of capital market inflation explains not only the price level but also the financial flows in the market that bring about that price level.

The empirical analysis, therefore, uses the flow of funds accounts obtained form the Federal Reserve database, and S&P 500 composite from DataStream, for the period between 1964-2010.

The main purpose of this empirical analysis is to derive/calculate the supply and demand for capital in the market. The supply of funds for equity financing represents purchases of corporate equity from households, institutions and rest of the world. The calculations used the following categories of capital suppliers:

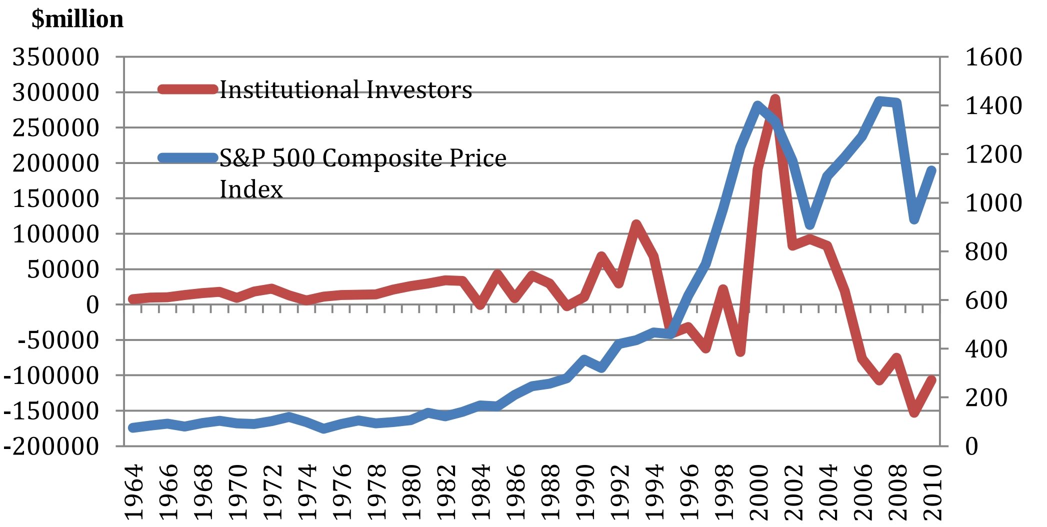
- Household purchases of corporate equity contain increases in holdings by mutual funds, closed-end funds, change-traded funds, broke and dealers and funding corporations.
- Institutional investors' represent purchases of corporate equity by property-casualty insurance companies, life insurance companies, private pension funds, state and local government retirement funds and federal government retirement funds.
- Rest of the world, is derived from subtracting net purchases of corporate equity from net issues to better determine its' flows in the market.

Demand for new equity is derived from combining non-financial sector issues of corporate equity with that of the financial sector.

As a first step in the analysis the inflow contributions of institutions in the capital market are analysed. The correlation between these contributions and the stock prices is calculated in order to establish their relationship (Figure 3.3.1-1 shows the increase in the purchases of corporate equity by US institutional investors and the S&P 500 composite price index). Data on S&P 500 composite, price index, is obtained for the period between 1964-2010, from DataStream. It is worth noting here, that this span period is chosen for the analyses, because the S&P 500 composite price index was only available from 1964 onward. The correlation between the S&P 500 stock price index and institutional investors purchases of corporate equity is -0.015. That is consistent with the view that the demand for securities in the capital market by institutions depends on their contributions or premiums minus current liabilities determined by the maturity structure of all liabilities.

Furthermore, the correlation between the non-financial sector issues and the financial sector issues reveals a negative correlation of -0.46. This inverse relationship between them, highlights the argument raised above that as banks raise more capital reduces the amount available for firms, hence they are forced to indebtedness.

Figure 3.3.1-1 S&P 500 Composite Index and US Institutional Investors



Source: Federal Reserve, Flow of Funds and Datastream

To analyse empirically the role of the net excess inflows in the capital market the following function is estimated:

$$\Delta p = f(S - D) \tag{3.1}$$

Where: Δp represents a change in stock prices; *S* is the supply of equity capital and *D* is the demand for equity capital, hence (*S*-*D*) represents the excess supply (or purchases) in the capital market.

Before estimating the above equation, it is useful to investigate the linear casual relationship between changes in stock prices and the excess supply of funds. In order to do so the Granger causality test is carried out. Granger's (1969) definition of causality is 'a variable Y_t is said to Granger-cause X_t, if X_t can be predicted with greater accuracy by using past values of the Y_t variable rather than rather than not using such past values' (Asteriou and Hall 2007). This means that the test uses past values of the depended variable and the independent variable to determine the causality relationship between them.

The test requires both variables to be stationary. In order to test for stationary the Augmented Dickey Fuller (ADF), KPSS and Philips-Perron (PP) tests are used to detect whether the log level price index and net inflows data are of a stationary form. The results(shown in Appendix 1, Tables A1-2, A1-3, and A1-4) indicate that the series is non-stationary so the difference-stationary procedure is used to remove the trend. The results for the first difference unit root test show that the series no longer contains a unit root. Hence, the first difference of log price index is stationary and the series used is said to be integrated of order 1, I (0). The same stationary tests are used for the net inflows data. As shown in Tables A1-5, A1-6 and A1-7, (shown in

Appendix 1), the ADF suggests that net inflow data is I(1) however PP and KPSS both indicate I(0). The weight of the evidence indicates that net inflows data are said to be I(0). Because both series are I(0), suggesting that they are not cointegrated, their short-term relationship is examined.

As in Tas and Togay (2011), the first-difference of logarithm of stock price index is used in the Granger causality test. The results, [19] shown in Table 3.1.1-1, indicate that the excess supply of funds does Granger-cause the change in the stock prices and not vice versa.

Table 3.3.1-1 Granger Causality

	Observations	F-Statistics	Probability	
Excess supply does not Granger Cause Prices	44	5.04214	0.01128*	Reject H_0
Prices does not Granger Cause Excess supply	44	0.02556	0.97478	Accept H_0

1) * Significant casual relationship at the 1% significance level
2) H_0 denotes the null hypothesis

The capital market inflation theory suggests that the demand for equity (or the supply of funds for equity capital) is relatively price inelastic. This means that in periods of market inflation, the price of long-term securities increases, and the subsequent capital gains attract speculative funds into the market. This in turn increases the demand for equity further (Toporowski 2010). This assumption indicates that the relationship between stock prices and excess supply may not be linear. In order to

[19] Different lag length was used for the pairwise Granger causality test and the results yield the same causality direction (See Table A1-8, A1-9, A1-10 in Appedix 1) .

determine whether their relationship is indeed linear or nonlinear the Ramsey reset test was used[20]. The test uses various powers of fitted values of the dependent variable as proxies for the squared independent variable, to capture any possible non-linear relationship. This suggests testing for functional form misspecification the following equation is estimated:

$$\Delta p = \beta_1 + \beta_2(S - D) + \delta_1 \hat{Y}^2 + \delta_2 \hat{Y}^3 + \varepsilon \qquad (3.2)$$

The result of the test are shown below:

Table 3.3.1-2 Ramsey Reset Test

Ramsey RESET Test:			
F-statistic	3.381462	Probability	**0.043486**
Log likelihood ratio	6.867831	Probability	0.032260

The p-value associated with the F-statistics, 0.04, is smaller than the 5 percent significance level; hence the null hypothesis of correct specification is rejected, concluding that the model is misspecified.

20 Even though the Ramsey Reset test is used to detect nonlinearity, it does not give any indication of the most appropriate nonlinear model that could be used.

To fully recognise the presence of the problem, the following quadratic model was estimated:

$$\Delta P_t = \beta_1 + \beta_2(S-D)_t + \beta_3(S-D)_t{}^2 + \mu_t \qquad (3.3)$$

In effect, what this regression implies is that the change in price depends on the excess supply of capital, but it does so in a quadratic fashion. This relationship supports the argument of the capital market inflation theory in that the demand for equity (or the supply of funds for equity capital) is relatively price inelastic. This means that in periods of market inflation, the price of long-term securities increases, and the subsequent capital gains attract speculative funds into the market. This in turn increases the demand for equity further (Toporowski 2010). In this way the market price becomes very responsive to changes in credit inflows into the market.

The results of the regression output are presented below:

Table 3.3.1-3 Regression Results for S&P 500

Variable	Coefficient	Standard Error	Prob. Value	Expected Sign
Constant	0.066081*	0.0240	0.0088	
SD	0.005255	0.0026	0.0543	Positive
SD^2	1.80E-05**	9.85E-06	0.0745	Positive
* Denotes significance at 5 percent level or better; ** Denotes significance at 10 percent				

level or better. Adjusted R-Square 0.045

The estimated equation[21] reveals a positive relationship between the two variables indicating an upward function. Because both, $(S-D)$ and $(S-D)^2$ have a positive sign, increases in excess supply always have a positive and increasing effect on stock price. The estimated coefficients are very small albeit significant. In order to calculate the increasing marginal effect of excess supply of capital on change in stock prices the following approximation is used:

$$\Delta\hat{p} = \left(\hat{\beta}_2 + 2\hat{\beta}_3\,(S-D)\right)\Delta(S-D),$$

$$so$$

$$\frac{\Delta\hat{p}}{\Delta(\widehat{S-D})} \approx \hat{\beta}_2 + 2\hat{\beta}_3(S-D) \qquad (3.4)$$

This approximation indicates that the slope and the relationship between excess supply of capital and stock price index depends on the value of the excess supply of capital. Thus, the first $1b of excess supply of capital, i.e. demand for new equity issues**,** increases stock price index by around 0.5255 percent. As the inflow of equity capital increases by a further $1b, stock index prices increases by about 0.00526+1.80E-05($1b)=0.5291%. Even though the effect is rather small, because of the upward function a bigger value of the excess supply will lead to a higher

[21] The tests carried out, confirmed that the model does not suffer from heteroskedasticy and autocorrelation. Furthermore, the residuals are normally distributed (See Appendix 1).

percentage change in stock prices. Taking the upper quartile value of highest value of excess inflow of £20.361b the increase of excess inflow to £21.361b increases price by around 0.6 percent.

Even though the results represent a small change in the price of stock, it is apparent that the higher the value of net inflows the higher the increase in stock prices, setting of an inflationary price dynamic as predicted by the capital market inflation theory.

3.4 Capital market Inflation theory applied to the Japanese capital market

Following the same methodology as above, this section applies the capital market inflation to the Japan capital market. Data is derived from the flow of funds accounts for the period of 1980-2010[22].
Data on the Nikkei 225 price index is obtained for the period between 1980-2010, from DataStream.

Before presenting the empirical analysis conducted over the Japanese stock market, it is necessary to provide an overview of the structure and regulation of the country's

[22] Due to changes in accounting standards in Japan's flow of funds, data is available from 1980 onwards. These changes, which took place in July 1999, included not only the changes in the base year, from 1968 System of National Accounts (SNA) to the 1993 SNA, but also restructuring of the economic sectors in the flow of funds accounts. For example in the flow of funds accounts using the 1968 SNA the household sector was included in the personal sector, which also combined health insurance cooperatives, mutual aid cooperatives and nonprofits organization. This makes it difficult to consolidate the data from the new accounting standards to the data using the old accounting standards.

capital market, which has been quite different from the US capital market, prior 1990s and to a certain extent still remains so. The characteristics of the structure and the regulatory framework of the Japanese equity market are also important as they could limit the ability of the model to fully explain the Japanese stock price movements within a capital market inflation theory framework.

As will be explained in Chapter 6 of this thesis, the Japanese finance sector is known to have been bank -centered, in which banks have had special relationship with their main customers. This contrasts with the US financial system which is market-orientated, and in which the capital markets play a vital role in providing finance.

Japanese capital markets have not always been underdeveloped, in the sense that banks dominated financing, despite having one of the largest equity markets in the worlds, based on total value. Prior to the 1930s the Japanese financial system shared similar characteristics to the postwar US financial system (Hoshi and Kashyap 2001). The shared feature was the role of the capital market, particularly equity financing, as opposed to bond and bank financing, in providing finance to industries. Even up until the 1940s equity financing remained an important source of finance. Allen (1996) states that during the period 1931-1940, equity issuance provided 31.70 percent of funds, with bonds and loans from private financial institution playing a smaller role in financing, providing 4.3 percent and 27.3 percent, respectively. However during this period retained earnings was the major source of funding providing 37 percent of funds (Allen 1996).

A more recent study conducted by Shabani and Toporowski (2014b), calculates the net sources of finance for Japanese corporate investment in the period between 1994-2012, using the flow of funds accounts[23]. Their analysis shows that internal funds have remained the most important source of finance for Japanese corporations during the period under consideration. On the other hand bank finance during the period was negative, implying that bank finance has experienced net repayments of debt rather than new funds for investments. Japanese corporations use of equity finance for physical investment was positive and increased steadily until 2005, but has since declined turning negative. This suggests that after 2005 the Japanese non-financial corporate sector has bought back shares and equity. Whereas the evidence on bond markets do not seem to have been a significant source in providing finance to Japanese corporations. The overall conclusion of this study could be taken to provide some evidence that Japan is no longer a bank-based system (Shabani and Toporowski 2014b)

Changes in the structure of the Japanese finance system have their roots in the financial crises that the country experienced during the 1920s. Japan experienced three crises during this decade, in 1920, 1923 and a more severe crisis in 1927. In response to the 1927 crisis a new banking law was implemented which marked the beginning of the heavily regulated financial system, that was in place until the Big

[23] The study employs the same methodology used by Corbett and Jenkinson (1994,1997) to calculate the sources of finance for physical investment.

Bang reforms in mid 1990s. During the 1930s the Japanese government became heavily involved in the financial system by means of controlling the allocation of resources, controlling which assets and liabilities should financial institutions write off, restricting shareholders' rights, etc (Allen 1996; Hoshi and Kashyap 2001). The changes in the regulatory and involvement of the governmental the financial system, which strengthened banks' power, led to the creation of the main bank system that has been in place since the early 1950s. In such system banks have special relationship with their clients, i.e. firms, in which banks not only are the main debt and equity holders but also intervene, by means of reducing interest rates, refinancing debt etc., when client firms are in financial distress (Allen 1996). The shape of the financial system in Japan took a different direction from the US. Like Japan, the US radically changed the regulatory framework of the financial system in the aftermath of the 1930's crisis. However, in contrast to Japan, the US authorities focused on promoting a market-oriented financial system. Banks became subject to tighter regulation in an attempt to prevent banking crisis, with less market intervention. In the US financial innovation, especially since the 1979s and 1980s, has been key in strengthening market orientation. But securitisation in Japan did not evolve as it did in the US. The value of total securitised assets in Japan, at its peak reached just below 2 percent of GDP, whereas in US in 2007 the value of securitised mortgages was nearly 25 percent of GDP (The Economist 2011c) (see Chapter 4 for a more detail discussion on the wide range of financial products innovation that has characterised the US financial system since the 1970s).

Apart from the main bank system that emerged in the 1950s, the so-called keiretsu[24], which are corporate groups organised around a main bank, is another unique feature that has characterised the Japanese industrial structure. The main Japanese keiretsu, known as horizontal[25] keiretsu, were Mitsubishi, Mitsui, Sumitomo, Fuyo, Dai-ichi Kangyo and Sanwa. Within such structures, member firms were closely linked to each other through cross-shareholding often anchored by commercial banks. Cross-shareholding is the practice by which firms hold each other's stock. It is worth noting here that cross-shareholding was not only conducted by firms belonging to the same industrial group but also between suppliers and costumers as well as between creditors and borrowers (Scher 2001). Perhaps the most important relationship for this research is the bank-corporations cross-shareholding, which is further analysed below.

The main shareholders of the Japanese banks prior to financial deregulation, that started in stages during 1980s and culminated in 1996 with the introduction of Big Bang which was fully implemented in 2001, were insurance companies and corporate borrowers. Both the double gearing process that had characterised the special relationship between banks and insurance companies, and the cross-shareholding system, that characterised the relationship between banks and corporations, could be

[24] Up until the 1960s, the business groups that characterized the Japanese economy were known as Zaibatsu. During the occupation period the zaibatsu groups were dissolved. However, with the occupation ending, some of the major former zaibatsu were reformed again into groups now called keiretsu.

[25] There are two types of keiretsu: horizontal keiretsu, and vertical keiretsu. The former is a group of enterprises whereas the latter refer to the supply chain dominated by a single company. A typical example of a vertical keiretsu is Toyota Corporation

contributing factors in explaining why the capital market inflation theory may not hold in Japan.

The double gearing process in simpler terms is best described as the process by which these two types of institution provide each other with capital (Fukao 2003). Japanese banks issued large amounts of subordinated debt to insurance companies, thus boosting their Tier II capital. On the other hand, the cash they raised from such issuance was then used to purchase subordinated debt that insurance companies issued. Furthermore the money raised by insurance companies was used to finance the purchase of subordinated debt that banks issued in the first place (Hoshi and Kashyap 2004). Even though the double gearing to some extent declined during 2000-2001, in the aftermath of the collapse of Chiyoda[26], Kyoei and Tokyo Life, in 2001 it still remained at significantly high levels. For example, as of March 2001, the amount of bank stocks of the seven Japanese insurance companies totalled to 5.4 trillion yen, and bank subordinated debt amounted to 5.1 trillion yen. On the other hand the amount of subordinated debts and the surplus notes of these seven insurance companies held by Japanese banks were, 1.2 trillion yen and trillion yen, respectively (Fukao 2003).

Cross-shareholding, a process in which banks and corporations hold each other stock, has also declined since the 1990s. Cross-shareholding between corporations and banks in Japan not only helped them maintain a strong long-term business relationship but also positively influenced stock prices (Nagayasu 2003). One reason

[26] Tokai Bank suffered 74 billion in losses as a consequence of the failure of Chiyoda Life in October 2000

for the decline in cross-shareholding during the 1990s was the deregulation of the financial market, which allowed corporations to access the capital market to raise finance, independently of their 'main' bank. However, Kanaya and Woo (2001), note that by 2001 Japanese corporate borrowers accounted for half of the total outstanding shares of banks.

In 1996, after the burst of the bubble in 1990, the Japanese government introduced the so-called Big Bang reforms as a major step towards financial deregulation. Even though now the country's financial and capital markets bear some comparison with the US, the banking system still accounts for the majority of the financial system assets. In 2010 Japanese investors holdings of financial assets amounted to a total of $27 trillion, second highest in the world after the US. However, only 10 percent of the total is invested in equities. Furthermore, Japanese households still prefer to hold their wealth in bank deposits. Some 80 percent of household wealth is kept in bank deposits, with government bonds accounting for 10 percent and investment trust and other, accounting for 6 percent (McKinsey & Company 2011).

3.4.1 Empirical Results-the case of Japan

As a first step in the analysis on the Japan the inflow contributions of institutions in the capital market are analysed. The correlation between these contributions and the stock prices is calculated in order to establish their relationship. As in the case of US, the data used in the empirical analysis are obtained from the flow of funds accounts available from the Bank of Japan. However, because of the difference in the flow of funds accounts between the two countries the following sectors were used to derive the demand and supply for equity capital in the Japanese capital market:

- Institutional investors' represent purchases of shares and other equity by insurance companies, including life non-life insurance and mutual aid insurance, and pension funds, including corporate pensions and other pensions
- Household purchases of shares and other equity include purchases of investment trusts and financial broker dealers
- Rest of the world represents only the net purchases of shares and other equity[27]

The correlation coefficient between institutional investors and Nikkei 225 stock price index is positive at 0.43. This rather strong positive correlation does not support the empirical predictions of the capital market inflation theory outlined above. The positive correlation between Japanese institutional investor and Nikkei 225 stock price index gives the first hint that the capital market inflation theory may not hold for the Japanese capital market. The structure and regulation of the Japanese capital and financial markets, explained above, may be factors that contribute to the empirical evidence not supporting the capital market inflation theory in Japan. There also various factors that could explain such inconsistences. For example, the Japanese

[27] Contrary to the flow of funds data used for the US, the Japanese flow of funds accounts does not provide data on the net issues of shares and other equities for the rest of the world sector. Therefore only their purchases are taken into account in constructing the database for analyzing the capital market inflation theory with reference to Japan.

pension fund managers such as trust banks and insurance companies until 1998, were subject to the 5:3:2 rule, which restricted stock holdings to 30 percent or less, 50 percent had to be invested in secured bonds or loans and 20 percent in the real estate market. One reason that these restrictions were in place was to make pension funds investment less risky as well to promote portfolio composition homogeneity (Weinstein 1997).

In order to test the capital market inflation theory applied to the Japanese capital market the same methodology as in the case of US is used. Hence, the Nikkei 225 stock price index is estimated as a function of excess supply for equity capital: $\Delta p=f(S-D)$.

As in the case of US, the causality relationship between net inflows and stock price changes is determined using the Granger causality test is used. As explained above, the causality test requires both variables to be stationary. The stationary tests conducted (ADF, PP, and KPSS shown in Appendix 2) revel that both variables are I(0). Table 3.4.1-1 shows the results of the Granger causality test of the first difference of logarithm of Nikkei 225 stock price index and excess supply. As evident the results of the test indicate that there is no causal relationship between these two variables[28].

[28] The pairwise Granger causality test was also conducted with 2 lags and 4 lags(see Appendix 2, Tables A2-11 and A2-12.

Table 3.4.1-1 Granger causality- Japanese net inflows and Nikkei 225 price index

	Observations	F-Statistics	Probability	
Excess supply does not Granger Cause Prices	28	0.38135	0.68717	Accept H_0
Prices does not Granger Cause Excess supply	28	1.95528	0.16435	Accept H_0

Given that both variables are integrated of order 0, I(0), their short-term relationship is examined and the following equation[29] was estimated using the OLS method:

$$\Delta P_t = \beta_1 + \beta_2(S - D) + \mu_t \qquad (3.5)$$

The results of the estimated regression are presented in Table 3.4.1-2

Table 3.4.1-2 Regression Results for Nikkei 225

Variable	Coefficient	Standard Error	Prob. Value	Expected Sign
Constant	0.021	0.0539	0.699	-
Excess Supply	-1.41E-08	7.58E-07	0.886	Positive

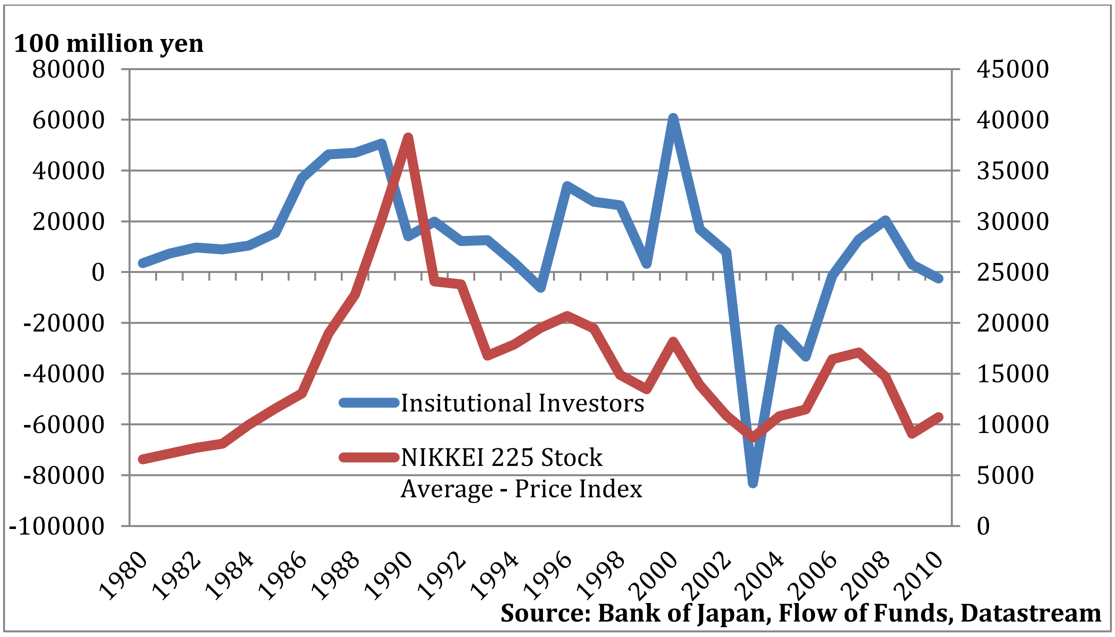
The sign of the coefficient of the excess supply of capital is negative but not statistically significant. This implies that the excess supply of capital does not have any statistical predictive power in determining Japanese stock prices. The results

[29] In contrast to the quadratic equation estimated for the US capital market here a linear regression is estimated. The results of the Ramsey Reset test indicate that the model is not misspecified therefore a lineal regression is estimated (See Appendix 2, Table A2-2).

provide no evidence that the data fits in well with the model. However as argued this could be for a variety of reasons associated with the characteristics of the Japanese capital market.

Another restriction in the capital markets, that could be an added factor in explaining the above empirical results, is concerned with public new equity issuance. An initially voluntary rule imposed by the large securities companies in 1973 became a formal rule for Japan Securities Dealers Association in 1992, and was abolished in 1996. Under this rule companies were subject to strict rules in relation to their first stock issuance to the public. In such they had to satisfy the following conditions: 1) the issuer company dividends had to be over 5 yen per stock in the previous year, 2) its ordinary profit had to be over 10 yen per stock in the previous year, and 3) its ordinary profits were expected to increase after the new stock issuance (Hirota 1999). The other potential factor that could be a great contributor in explaining the poor performance of the model to illustrate the capital market inflation theory in Japan is the so-called price keeping operations conducted by the Japanese government.

Figure 3.4.1-1 Nikkei 225 Stock Price Index and Japanese Institutional Investors



As will be discussed in more details in Chapter 6, the stock market crash in the early 1990s caused massive disruptions in the country's economy. The Japanese stock market reached its peak in 1989, with Nikkei 225 marking 39,915 (Figure 3.4.1-1), a massive increase from the lowest level of 1,020 in 1965. However, in 1990, with stock prices declining the Tokyo stock exchange lost 1 trillion yen. This year marked the burst of the so-called asset bubble. By 1992, the stock market had lost another 1 trillion yen as the Nikkei 225 dropped to below 20,000, thus falling nearly 50 percent from its peak in 1989 (Tabb 1995). With asset and land prices declining, the Japanese government took different measures to keep stock prices to a certain desirable level (Narita 2002). The so-called price keeping operations involved the purchases of equity by the Japanese government. These are believed to have started in 1992

(Nagayasu 2003). Estimates show that on November 19, 1992, the Japanese government purchased about 10 million stocks (Narita 2002). By early 1993, the amount of the purchases of stocks and bonds by the Japanese government amounted to one third of all purchases in the market (Tabb 1995). Furthermore, the Ministry of Finance (MOF), to a certain degree restricted stock selling, whilst encouraging state-controlled pension funds to spend large amount of money in purchasing stock in order to boost prices (Tabb 1995). Another informal measure undertaken by the MOF in an attempt to stop stock prices declining even further, was the request issued to the main brokers to provide the MOF with the names of the big sellers. Once the news of this request was spread in the market it is believed to have temporarily increased stock prices (Tabb 1995).

It is worth noting here that the term ‘price keeping operations’ was a term coined by the media and not only it was not used by the Japanese government officials but such operations have also been denied as a practice conducted by them. Therefore the date in which price keeping operations started or ended still remains unclear (Narita 2002). Nagayasu (2003) studies the Japanese stock market within the efficient market hypothesis. Amongst other reasons, the price keeping operations -that is the purchases of stocks by the Japanese government- is listed as one factor for limiting the significance of the efficient market hypothesis when applied to Japan. The analysis provides a graphical representation of the monthly Nikkei stock price movements and the government purchases of stocks for the period 1992-2002. The arguments provided in Narita (2002) regarding the uncertainty of when exactly did this operations started, are also supported in Nagayasu (2003). He states that ‘ it is generally believed that these operations were initiated in 1992 and were frequently conducted around the month of March when equity prices had declined earlier in the year’ (Nagayasu 2003, pg. 10). He argues that the results of the graphical representation of monthly Nikkei data are insufficient to reach a bold conclusion on whether price keeping operations could indeed explain stock price movements over this period. Nevertheless, he suggests that the data shows numerous occasions, especially in the early years, in which the direction or the rate of falling equity prices changed or slowed in March.

This thesis takes a further step in examining the impact of the price keeping operations on the Japanese stock market. Using time series data for the period between 2002-2011, the change in Nikkei 225 price index is estimated as a function of the government’s stock purchases and commercial banks purchases.
Data for the Nikkei 225 price index is obtained for Datastream, whereas the purchases of the government and commercial banks from the flow of funds account available from the Bank of Japan. Due to data limitation the following regression is run for the period 2002-2011[30]:

$$\Delta P_t = \beta_1 + \beta_2 purchases\ of\ commercial\ banks_{\ t} + \beta_3 purchases\ of\ central\ bank_{\ t} + \beta_4\, purchases\ of\ central\ bank_{t-1} + \mu_t \qquad (3.6)$$

[30] Data available for the Japanese central bank net purchases of shares and other equities (assets) is available only for the year 1994, 1996, 1998, 1999, 2002-2011.

The estimated output is presented below:

Table 3.4.1-3 Japanese central banks purchases of equities

Variable	Coefficient	Standard Error	Prob. Value
Constant	-0.093	0.088	0.340
Commercial Banks purchases	-1.90E-06	7.321E-06	0.805
Central Bank at time *t*	-8.869E-05**	2.51E-05	0.018
Central Bank purchases at time *t-1*	5.02E-05**	1.40E-05	0.016
*Denotes significance at the 1 percent level; ** Denotes significance at 5 percent level or better. Adjusted R-square 0.615			

The result of the regression reveal that the coefficient of central bank purchases of shares and other equities at *t-1* is positive and statistically significant at the 1 percent level. So that 100 million yen purchases of shares and equities from the Bank of Japan increases stock prices by 0.0005 percentage points. Whereas the coefficient associated with the purchases of shares and other equities of commercial banks is negative but not statistically significant. Similarly the purchases of central bank at time t also are also not statistically significant[31].

The results provide evidence that the government's intervention, as a measure of stock purchases by the central bank, do have an impact on the Japanese stock prices.

[31] The results and the tests carried out are shown in Appendix 2

Therefore, these findings provide an additional and important factor that could explain why the regression results obtained above show no support of the capital market inflation theory when applied to the Japanese capital market. Furthermore the empirical results of the relationship between government intervention and stock price movements suggests that these purchases offset private sector outflows of credit from the capital market. So that capital market inflation theory may still hold.

3.5 Concluding Remarks

This chapter has developed a simple model to illustrate the capital market inflation theory applied to both the US and Japan capital markets. The model is composed by deriving the demand and supply of capital in the market using flow of funds data for the period 1964-2010 in the case of US and 1980-2010 for Japan. Even though the same methodology is used in both countries the estimating regressions differ to reflect the data properties for each country. Therefore, the US capital market data indicates that the excess supply of capital has a non-linear relationship with stock prices, whereas in the case of Japan a liner model was estimated, as statistical tests provided no evidence, i.e. Ramsey Rest test, of a non-linear relationship. The estimating results also differ for both countries considered in this analysis. In the case of US, estimating a quadratic relationship, the results support the capital market inflation theory in that the price level of long-term securities depends on the inflow of equity capital into the market. In the case of Japan the model fails to provide any evidence supporting the theory. It has been argued that there are various factors associated with the structure and regulation of the Japanese capital market that could be contributing factors for such results. Furthermore, due to data limitations the time span for the Japanese capital market is rather short which could limit the ability of the model to explain stock price movement within a capital market inflation theory.

The empirical evidence on the US capital market is sufficient to validate the assumptions of the capital market inflation theory. The implications of this validation are of great importance not only because it provides a framework to better understand the functioning of the capital markets, but also it provides a basic foundation to conduct an examination of the impact of the capital adequacy regulation on banks probability of default.

As argued in Chapter 2 the literature on capital adequacy regulation provides no link between economic theory and regulatory framework. Capital adequacy regulation is rather based on intuitions and rule of thumb. Another implication of the empirical evidence provided in this thesis in supporting the capital market inflation theory is that it contributes to the asset pricing theory literature by taking into account market disequilibrium. This original contribution is in contrast to the conventional view of finance that fails to address the real functioning of the capital markets and the role it plays in the economy. And it is this linkage that further work in this thesis will attempt to examine, by using the capital market inflation theory to evaluate not only the effectiveness of the Basel capital requirements but also the impact that such regulation has on the business activities of the non-financial sector and thus on the rest of the economy.

3.6 Data Appendix

Table 3.6 –1 US Flow of Funds Data, used in Chapter 3

HH	Households
INS	Institutional Investors
ROW	Rest of the World
NFC	Non Financial Corporate sector
FS	Financial Sector
SD	Excess inflows (Supply-Demand)
S&P	S&P 500 Composite price Index

	HH	Inst	ROW	Supply	NFC	FS	Demand	S&P Price	SD
1964	-6142	7693	-503	1048	1145	7	1152	75.5	-104
1965	-9805	9593	-699	-911	-28	-706	-734	84.23	-177
1966	-8298	10169	-290	1581	1259	374	1633	92.26	-52
1967	-12611	13407	606	1402	2397	-765	1632	80.55	-230
1968	-17202	16223	1612	633	-159	1055	896	95.36	-263
1969	-14366	18114	1044	4792	3406	1632	5038	103.99	-246
1970	-4797	9310	495	5008	5694	-336	5358	93	-350
1971	-5125	18572	663	14110	11435	3146	14581	91.15	-471
1972	-12416	22519	2845	12948	10922	2652	13574	102.09	-626
1973	-3184	13162	3049	13027	7883	5568	13451	120.17	-424
1974	-495	5803	758	6066	4097	2177	6274	98.89	-208
1975	-6605	11238	3974	8607	9908	-1130	8778	70.71	-171
1976	-1560	13403	504	12347	10524	1921	12445	90.9	-98
1977	-10254	14049	916	4711	2727	2385	5112	105.7	-401
1978	-11754	14226	1671	4143	-101	4352	4251	93.52	-108
1979	-25664	21117	5	-4542	-7836	3246	-4590	98.58	48
1980	-15479	26085	1866	12472	10375	1549	11924	106.52	548
1981	-43898	29787	4616	-9495	-13450	3310	-10140	136.34	645
1982	-29241	33993	2287	7039	1900	4674	6574	122.74	465
1983	-11552	33393	1313	23154	20000	3472	23472	141.35	-318
1984	-67627	-652	-4303	-72582	-78975	6164	-72811	166.78	229
1985	-117602	42775	761	-74066	-84500	10452	-74048	163.68	-18
1986	-98142	8769	16745	-72628	-84975	14707	-70268	210.88	-2360
1987	-120623	40987	17155	-62481	-75500	14868	-60632	246.45	-1849
1988	-135363	29860	-3979	-109482	-129500	22906	-106594	255.94	-2888

1989	-111009	-2243	-8615	-121867	-124150	3613	-120537	279.43	-1330
1990	-39701	10812	-24140	-53029	-63000	6683	-56317	355.67	3288
1991	-1301	68098	-26889	39908	18250	22265	40515	321	-607
1992	86318	29773	-49857	66234	27000	40204	67204	419.35	-970
1993	8896	113142	-53002	69036	21300	51119	72419	435.38	-3383
1994	-41841	68013	-59575	-33403	-44900	9877	-35023	466.89	1620
1995	22867	-41351	-61958	-80442	-58330	-7216	-65546	460.71	-14896
1996	32551	-31688	-86319	-85456	-47325	-21250	-68575	617.69	-16881
1997	-56129.3	-62332	-4409	-122870.3	-77375	-27937.7	-105312.7	748.03	-17557.6
1998	-153445.1	21401	-73961	-206005.1	-215537	3536.4	-212000.6	975.04	5995.5
1999	-11440.6	-67050	-9835	-88325.6	-110368	1681.4	-108686.6	1228.1	20361
2000	-392275.3	191296	92993	-107986.3	-118204	17069.6	-101134.4	1399.42	-6851.9
2001	-331428.2	290570	25153	-15705.2	-48125	39872.8	-8252.2	1333.34	-7453
2002	-76771	82969	37481	43679	-16245	71536	55291	1172.51	-11612
2003	62426	92466	-112792	42100	-39599	66074	26475	908.59	15625
2004	-22192	83174	-59770	1212	-122683	118308	-4375	1108.48	5587
2005	-150149	19139	-129757	-260767	-341829	78469	-263360	1188.05	2593
2006	-380266	-76553	-41107	-497926	-565697	59484	-506213	1273.46	8287
2007	-573591	-107507	70694	-610404	-786825	178580	-608245	1418.34	-2159
2008	-43125	-75066	143682	25491	-335960	637594	301634	1411.63	-276143
2009	225296	-153096	129507	201707	-64568	314202	249634	931.8	-47927
2010	-40352.8	-106956.2	73763	-73546	-277956	190114	-87842	1132.99	14296

Figure 3.6-2 Japanese flow of funds

HH	Households
INS	Institutional Investors
ROW	Rest of the World
NFC	Non Financial Corporate sector
FS	Financial Sector
Nikkei 225	NIKKEI 225 stock price index
SD	Excess inflows (Supply-Demand)

	NFC	FS	Inst	HH	ROW	NIKKEI 225	Supply	Demand	SD
1980	28608	6819	3580	865	11007	6560.16	15452	35427	-19975
1981	36709	9333	7296	6910	418	7137.59	14624	46042	-31418
1982	52844	6898	9707	8242	4764	7697.6	22713	59742	-37029
1983	22657	7926	8958	-5516	6377	8120.51	9819	30583	-20764
1984	24983	7803	10453	1539	-14046	9961.25	-2054	32786	-34840
1985	74333	9773	15323	10196	-7095	11558.06	18424	84106	-65682
1986	32420	10011	37045	-9704	-44291	13053.79	-16950	42431	-59381
1987	83727	24387	46373	25407	-59734	18936.76	12046	108114	-96068
1988	131447	37262	46984	4492	2835	22790.5	54311	168709	-114398
1989	99657	50469	50619	2666	-37141	30209.54	16144	150126	-133982
1990	78400	13424	14053	21281	25911	38274.76	61245	91824	-30579
1991	71038	9669	19930	7333	44871	24069.18	72134	80707	-8573
1992	46216	7298	12207	8913	4412	23801.18	25532	53514	-27982
1993	69888	16807	12585	13088	42630	16782.88	68303	86695	-18392
1994	69487	19640	3799	13227	14395	17881.99	31421	89127	-57706
1995	53964	12250	-6178	2252	26279	19519.46	22353	66214	-43861
1996	61067	18018	33960	-862	34192	20669.03	67290	79085	-11795
1997	48437	33114	27763	10593	42926	19446	81282	81551	-269
1998	49492	96149	26356	16981	32111	14896.4	75448	145641	-70193
1999	86970	27458	3296	25235	119583	13468.46	148114	114428	33686
2000	67710	17936	60692	-16272	680	18168.27	45100	85646	-40546
2001	17332	119910	16857	-14652	10668	13867.61	12873	137242	-124369
2002	21456	120234	7896	-15	2263	10871.49	10144	141690	-131546
2003	15850	49517	-83181	-24358	148933	8713.33	41394	65367	-23973
2004	64560	-2517	-22495	12529	96170	10813.99	86204	62043	24161
2005	24598	5854	-33311	-19688	159862	11492.26	106863	30452	76411
2006	25998	-23592	-1355	-35178	82869	16428.21	46336	2406	43930
2007	85266	74979	12908	-4988	-5243	17091.59	2677	160245	-157568
2008	-22123	31638	20454	20671	-60085	14691.41	-18960	9515	-28475
2009	34258	60797	2979	-6574	86272	9080.84	82677	95055	-12378
2010	-3939	2732	-2572	1570	35208	10731.45	34206	-1207	35413

Figure3.6-3 Central bank purchases

CB Shares and other equities/Central Bank
Banks Shares and other equities/ Commercial Banks

	CB	Banks
1992	0	1754
1993	0	-2680
1994	200	25199
1995	0	13973
1996	2000	1983
1997	0	6251
1998	-200	3239
1999	-800	-30544
2000	0	-31443
2001	0	56243
2002	11680	15938
2003	7807	-24751
2004	738	-9908
2005	-255	-8284
2006	-4120	-1913
2007	-6247	8062
2008	-2092	-22114
2009	2741	-10094
2010	765	-95
2011	-548	-8015
2012	-1253	-8689

Chapter 4. Shadow Banking

The results presented in chapter 3 indicate that under conditions of capital market inflation firms may be overcapitalised. This has major implications for the functioning of the capital market. With respect to banks, overcapitalisation, arising from the imposed Basel capital requirements, increases the riskiness of their assets, as it crowds out available capital. This chapter argues that by creating a complex and opaque shadow banking system banks were able to achieve and maintain a reported overcapitalisation by means of shifting risky assets off balance sheet. The aim of integrating the shadow banking system in the analysis of capital adequacy regulation therefore is twofold: firstly, explaining the activities of shadow banks and the interconnections with traditional banks helps to illustrate the process by which banks were able to remove risk off balance sheet and report overcapitalisation; and, secondly, the creation of the shadow banking system not only serves as a cosmetic manicure for risk in balance sheet but also increases the vulnerability of banks, as revealed in the latest global financial crisis.

4.1 Overcapitalisation

The research in this thesis identifies mainly two processes associated with overcapitalisation of companies, that has been a rising phenomenon since the 1980s. The first process is the capital market inflation, which is a generalized phenomenon reflected in the flow of funds accounts, suggesting that overcapitalisation of the financial institution or banks, in general increases the riskiness of their assets.
The phenomenon of overcapitalisation is associated with the rise of institutional investors, such as pension funds and insurance companies, since the 1970s and 1980s. The accumulation of savings into financial institutions holding long-term financial assets led to the process of capital market inflation, explained in chapter 3, which provided higher capital gains from holding shares or common stock. The realised capital gains are obtained by stock buyers from the market rather the company that originally issued the stock. This process made equity finance a cheaper and alternative form of finance, which gave companies an incentive to overcapitalise.

Overcapitalisation is defined as ‘ the issue of equity or common stock in excess of what is required for the productive and commercial activities of a firm’ (Toporowski 2012). Overcapitalised companies use the excessive raised capital to purchase short-term liquid assets, thus, increasing the liquidity of their balance sheet. Such assets could then be used as collateral for short-term borrowing, or balance sheet restructuring, such as merger and takeover activity. However, the latter activities could be profitable only if inflation in capital market is (and remains) an on-going process (ibid).

Karwowski and Shabani (2013) analyse the financial operation of US major non-financial firms for the period between 1994-2012. Using the argument raised by Toporowski, the paper defines overcapitalisation ‘as a situation in which firms hold liquidity in excess of what would be needed for productive operations’ (Karwowski and Shabani 2013). Through a balance sheet examination the results indicate that a large proportion of the firms in the sample, which are a part of the Dow Jones Industrial Average, are indeed overcapitalised. Their study also provides evidence that the identified overcapitalized firms have increasingly engaged in financial investment.

The second process suggests a different mechanism in that overcapitalisation of a given bank is also achieved by removing its’ bad assets off balance sheet and their replacement by superior assets. Such assets may have become available through the general overcapitalisation of the financial system (more particularly banks). One way by which banks were able to remove toxic assets off their balance sheet was to transfer such assets into the shadow banking system. The argument here is that banks are reporting overcapitalisation rather than being actually over-capitalised. On this note it is important to stress the differences between absolute and reported overcapitalisation. The former refers to a situation in which a bank has far more capital than it needs to conduct it business, where as the latter refers to the process of reporting overcapitalisation because part of the balance sheet is hidden in the shadow banking system. This distinction between absolute and recorded overcapitalisation becomes evident in the discussion here on shadow banking system and its interconnections with the traditional banking system.

4.2 Creation of the Shadow Banking System

The term ‘shadow banking system’ is relatively new in the finance and banking vocabulary. The financial crisis that unfolded in the summer of 2007, has led many economists and researchers to look into the causes of such catastrophic event. Their findings shed some light on the shadow banking system. Even though such a system (or some of the activities such as securitization) was not newly created but rather had existed for some time prior to the crisis, the operations and interconnections with the traditional banking sector grew tremendously to a scale that was relatively unknown by many, including the regulatory bodies.

Paul McCulley was the first to coin the shadow banking system term in 2007.
He defined the shadow banking system as ‘ the whole alphabet soup of levered up non-bank investment conduits, vehicles, and structures’ (McCulley 2007). Since then, the literature provides different definition of the shadow banking system. The following are some examples:

- FSB (2013b)- ‘ credit intermediation involving entities and activities (fully or partially) outside the regular banking system’ .

- Adrian and Ashcraft (2012b) – ‘ a web of specialized financial institutions that channel funding from savers to investors through a range of securitization and secured funding techniques’
- Mehrling et al (2013)- ‘Money market funding of capital market lending-this may or may not include banks’
- Gorton (2010)- ‘ a combination of the repo market and the necessary collateral, including securitization debt’

This research does not aim to provide a set definition of shadow banking and does not aim to explain in depth the activities undertaken within the system, but instead will illustrate how the creation of it allowed banks to move some risky assets off their balance sheets.

Shadow banks conduct similar activities to traditional banks, by means of engaging in credit intermediation, maturity and liquidity transformation. However shadow banks are not subject to the same regulation as traditional banks. Therefore shadow banks do not have access to liquidity backstops or deposit insurance like traditional banks. In fact, a common reason given in the literature to explain the extensive engagement of banks in the shadow banking system is to escape regulation, in particular capital requirements (FSB 2012; Gorton 2010; Adrian and Ashcraft 2012a; Pilbeam 2010, etc).

In its simplest form the traditional banking approach has been the same since its beginnings. Banks accept deposits and use them to make loans. These loans previously were kept in the banks' balance sheet till maturity. This has been known as 'originate and hold' model. However, as the banking system has evolved in the last 30 years banks have move toward the 'originate to distribute' model (Pozsar et al 2012). This model is best described as a securitization- based credit intermediation process, explained below.

Over the years the market of the shadow banking system grew to become bigger than the tradition banking system. As of 2007 the liabilities of the U.S. shadow banking system amounted to $22 trillion whereas, the liabilities of the traditional banking system around $14 trillion (Pozsar et al 2010). Because the entities that form the shadow banking system are not regulated and hence are not required to report to regulators, it is difficult to have a precise estimate of its size. Given the lack of transparency of the activities and the opaqueness of the scale of the shadow banking, Tyson and Shabani (2013) employ a new methodology in an attempt to estimate the size of UK shadow banking system. The approach makes use of the equal compensation, which includes both salary and bonuses, to revenue ratio practice applied by investment banks in all global locations. The ratio disclosed in UK subsidiary financial statements is assumed to reflect true economic activity in the location. This assumption is based on the fact that the amount of bonuses given, calculated as a percentage of revenues, is obtained from internal management accounts, which use economically correct revenue figures. By contrast the revenue and assets figures disclosed in the financial statement are likely to be distorted by accounting, tax and regulatory arbitrage. The asset, revenues and bonuses ratios are calculated using the global accounts, and are then applied to the bonus figure for the UK' subsidiaries to imply total UK assets. The figures obtained from each individual bank included in the selected sample of banks used are summed to give an estimate of UK off-balance sheet assets of investment banks held in special purpose vehicles (SPVs). Using five- year average maturity, the level of off balance sheet assets is estimated to be around $546 billion or 26 percent of on-balance sheet assets. When combined with the estimated UK's hedge fund assets of £390 billion, (FSB 2011), the estimated assets of the UK shadow banking system amounts to over £900 billion (Tyson and Shabani 2013).

The creation of the shadow banking system comes in parallel with financial innovation. One the main innovations of the last few decades that has increased phenomenally and is recognised as a key activity within the shadow banking system is securitization. Adrian and Ashcraft (2012a) state that securitization as a financial process has been around since the 1920s but has proliferated in the last 30 years. Similarly, Pozsar et al (2010), postulate that the shadow banking system was born some 80 years ago and associate its' birth with the creation of the government-sponsored enterprises (GSE). Fannie Mae was the first GSE created by president Roosevelt as part of the New Deal program in response to the large number of mortgage defaults during the Great Depression. The main purpose of Fannie Mae was to provide sufficient and stable funds to mortgage banks in financing housing. In other words it was creating liquidity in the mortgage market, by means of purchasing banks' mortgage loans, thus providing banks funds to make new loans.

Fannie Mae was privatized in 1968, and another GSE, Freddie Mac was created in 1970. The two GSEs continued to perform the purpose of their design to buy from banks, or any other lender, mortgage loans, package them together as bonds, guarantee them against default, and sell these securities to investors. In its simplest form this process is known as securitization (CBO 2010).

Following in the footsteps of Freddie Mac and Fannie Mae, banks got involved in securitization. In a more detail form the process of securitization involves grouping a variety of assets that generate cash flows, and create a marketable security. The cash flows act as a guaranty for the security. In other words, securitization transforms illiquid assets such as loans and mortgages, into liquid assets, such as asset-backed security (ABS). However, loans and mortgages are just an example of the assets pooled by commercial banks. Other assets, include, credit cards receivables, automobile loans, students loans etc. But the common characteristic of all these assets is that they generate a cash flow, and these are the cash flows of ABS that investors purchase.

Securitization was taken a step further by financial institutions, by entering into another process known as re-securitization. In effect this means securitizing a security that has already been securitized before. These new securities are known as collateralized debt obligations (CDO). For example, banks would set up a special purpose vehicle (SPV) or special purpose entity (SPE) and sell them the cash flows of the pool of assets they have packed together. The SPV then slices the pool of cash flows of the assets into different tranches. These tranches have different risk and returns: the senior tranches are rated AAA, carry lower risk and thus pay the highest interest rates; the mezzanine tranches are rated AA to BB, and are risker than senior tranches; and equity tranches, which are no rated, carry the greatest risk and attract the highest yield. The process does not end there, but it continues in creating other securities that are backed by CDO tranches, known as CDO^2. The process continues in creating CDO^3 and so forth. Different securities are used as collateral in the creation of CDOs. When the CDO is formed from packaging loans, is known as collateralized loan obligation (CLO). Similarly a collateralized bond obligation (CBO) is created by pooling bonds. When the collateral of the CDO is ABS is known as ABS CDO.

The first CDO issuance was in 1987 by Drexel Burnham Lambert for the Imperial Savings Association (Adrian and Ashcraft 2012a) and grew to become one of the most important activities in modern banking. One of the main advantages of issuing CDOs by banks is freeing up capital that would have been required to hold if these loans were kept on their balance sheet (Pilbeam 2010).

Also by creating the SPVs banks were able to eliminate some financial risk. The SPV is a legal entity set up by another company (the sponsor), a bank in this case, that raise funds to purchase the assets by issuing securities to investors in the capital markets. The SPVs were created for no other purpose than to conduct these transactions and they do not to make any business decisions. The entity has no employees and no physical location and for these reasons is often known as a 'robotic entity'. The SPV has another important feature, in that the way it is created allows it to be bankruptcy remote. That means that in the event of insolvency of the sponsor bank the SPV will not be affected because its assets are in some way isolated from the sponsors' balance sheet. On the other hand in the event of write-downs of assets that were transferred from the sponsor bank, the SPV is liable to incur the losses. Therefore, this is a way reducing the financial risk of the sponsor bank (Pilbeam 2010).

According to data published by Lehman Brothers (as cited in Gorton 2010 pg 105), asset backed commercial paper conduits (ABCPs); special investment vehicles (SIVs) and SIV-Lites were amongst the main holders of the triple A CDOs tranches. ABCPs are a form of SPV that are created by large commercial banks, funded through the issuance of asset backed commercial paper (ABCP). These conduits were originally set up by banks to provide trade receivables financing to their customers. However, over the years, in additional to trade receivables, other assets were pooled and used as collateral, such as student loans, auto loans, credit cards and other various financial assets. Similarly, an SIV is an off-balance-sheet vehicle and like ABCPs is bankruptcy remote. SIV issue commercial paper (CP) and medium term notes (MTN) and ABCP, to fund the purchase of longer-term securities and structured product that earn a higher yield (such as ABS and CDO). The first SIV was designed by Citigroup in 1988, with the purpose to profit from the spread between short- term and long-term interest rates (Pilbeam 2010). So in effect an SIV aims to capture the spread between the lower costs used to fund their liabilities, and higher returns obtained from their asset portfolio. This way ABCPs and SIVs engaged and specialised in conducting liquidity and maturity transformation, just like a normal bank does, but as noted with different means of funding (unlike banks that are funded by deposits, shadow banks obtain funds through the wholesale money markets).

Even though both SIVs and ABCPs are a form of SPV, they have different structures. One of the main differences is the liquidity support available to them in the event of a liquidity crisis. The ABCPs has the advantage of receiving liquidity backstop provided from highly rated banks (sponsors) as well as some form of credit enhancement, as additional support. The liquidity support covers 100 percent of their outstanding ABCPso that sponsors provide funds when the ABCPs is unable to roll over maturing issues. This way ABCPs are linked to their sponsor banks. Because of this link, the credit rating that ABCPs receive on their issued commercial paper depends on the credit rating of the financial institution that provides the liquidity and credit support, whereas for an SIV the quality of its assets plays a major role on determining the credit rating it receives (Adrian and Ashcraft 2012a). SIVs did not enjoy the same liquidity support as ABCPs. The guaranteed liquidity provided by sponsor banks only covered a part, up to 20 percent of the outstanding ABCP (FDIC 2013). Another major difference between the conduits and SIV is that the former is funded only by means of issuing ABCP, whereas the latter is funded by means of issuing MTN and other short-term debt.

A shared similarity amongst these vehicles, such as SIVs, SIV-Lites and ABCPs, is that even though they are bankruptcy remote they are not robotic. They have a management team and assets are marked to market, unlike SPVs used in the process of securitization (Gorton 2010). An important point is that these special purpose vehicles were often not part of the banks that created them, nor were their activities displayed on their originating bank's balance sheet (Farhi et al 2009). In this way, banks were able to increase their balance sheet turnover and therefore extract the maximum value from their capital.

Another way by which banks were able to reduce their risk was by creating credit default swaps (CDS). CDSs were first created by JP Morgan and came to existence in the 1990s (Blinder 2013). A CDS is a credit derivative that has the same features as an insurance contract. So a contract is reached between two parties, where the seller party insures the buyer party against any losses arising from the default on a specific bond (Blinder 2013). In return the buyer party will make regular payments to the seller party. The CDS market grew significantly in the years preceding the crisis. In 2000 the amount of outstanding CDS was nearly $500 million, and by 2007 it amounted to nearly $62 trillion (Pilbeam 2010). CDS were an important way in which banks and shadow banking entities improved the apparent quality of their assets.

Gorton (2010) argues that the activities in the shadow banking system also involve repurchase agreements. A repurchase agreement (repo) refers to a transaction, which involves the sale of a security attached with the commitment of the seller to repurchase the security in the near future at a specified price. Effectively a repo is a short- term collateralized loan in which an investor[32], with a large sum of money, that wants to invest for a short period of time and earn interest, but is reluctant to deposit in his bank given the limited deposit insurance, lends to firms and other borrowers in the repo market and receives securities as collateral (Gorton 2010). The repo market is also a way in which holders of long-term securities can earn fee income by lending out their securities. As the repo market evolved, in addition to the usual Treasury securities, it came to accept a wide range of securities, and structured products such as ABS and CDOs as collateral. Gorton (2010) states that ' the shadow banking system, is, in fact, a real banking system' (Gorton 2010 pg. 45). He argues that collateral in the shadow banking system serves as a form of deposit insurance as opposed to the deposits in the traditional banking system[33] that are insured by the FDIC. Depositors are institutions with large holdings of cash that opt to invest short term and realize a return in the form of interest, and lenders are firms that require funds to finance their business operations. So lenders and borrowers enter in a transaction, which is in effect repo. A lender (for example a money market mutual fund (MMMF)) lends a large

[32] The term investor used here represents the main lenders in the repo market, such as institutional investors, pension funds, mutual funds, hedge funds, large corporations, etc.

[33] Insurance coverage by the FDIC prior to the crisis of up to $100, 000 per account has increased to $250,000 (FDIC 2010)

sum of money to the borrower (for example an investment bank) and receives some sort of security as collateral. The investment bank commits to repurchase the same (or similar) security at a later date for a specified price, and repays all the borrowed funds plus interest known as the repo rate.

There are mainly two distinguished features of a repo agreement namely: rehypothecation and haircuts. Rehypothecation is the practise, which gives the holder of the collateral the right to use it in another transaction. The process can be repeated, in which the third party that received the collateral can reuse it in another transaction and so on. The implication of the same collateral being used in number of contracts, say over the course of one day, is that 'the collateral has a money multiplier' (Gorton and Metric 2012). The other feature of a repo agreement is the degree of overcollateralization, the difference between the market value of the security used as collateral and the amount of the loan backed by that security, known as the haircut. So if borrowed funds amount to $395 million and the collateral has the value of $400 million, the haircut is 1.25 percent. As explained, collateral in repo serves as insurance and a haircut further protects the buyers (the lender) against default by the seller (borrower). It is worth noting here that the repo can either be used for borrowing and lending funds backed by collateral, or for borrowing and lending securities in exchange for cash. Repos are short-term, usually overnight but most of them are rolled over on a daily basis. The repo market grew substantially in the last three decades and even though its size still remains opaque it is estimated to have had size of the traditional banking system at around $10 trillion (Gorton 2010).

The above illustration of a repo transaction conducted directly between the buyer and the seller of the repo, is known as bilateral repo. Another form of a repo transaction is known as a tri-party repo and it refers to the use of a third party, a clearing bank, that handles settlements and managements issues, such as settling the collateral in its own balance sheet, verifying the quality of the collateral and allocating collateral in a manner that satisfies the requirement of the lender in respect to eligibility and risk limitations (Copeland et al 2012). In the US the clearing banks, that act as intermediaries in the tri-party repo transactions, are the Bank of New York Mellon and JP Morgan Chase (ibid).

The repo market is a major source of funding for primary dealers, in which they use repos to finance their inventories of securities. The normal operational practices in the tri-party repo market, involve the lender and borrower reaching a repo agreement at the start of the day (Federal Reserve Bank of New York 2010). Later on in the day, the clearing bank is notified and settles the agreement by simultaneously transferring cash to dealers (borrowers) and collateral to investors (lenders). The following morning, the clearing bank unwinds the transaction, whereby, the clearing bank returns back the securities to dealers and cash back to investors. The unwinding process is conducted each morning, even for non-maturing repos. By the end of the business day new repos must be settled, in a process known as ‘rewind’. Because dealers must finance the securities during the day, that is the time between the unwound and rewind process, the clearing bank provides financing to dealers, secured by a lien on dealers' securities. A study conducted by the Federal Reserve Bank of New York (Copeland et al 2012) , suggests that the exposure of a clearing bank to a single dealer can routinely be more than $100 billion.

Gorton (2010) and Gorton and Metric (2012) state that the repo market was the main source of funding for shadow banks or using their terminology ' securitized banking system'. Their definition of securitized banking is associated with the securitization process in which banks transform illiquid assets, such as mortgages, and any other loans, into marketable securities that serve as repo collateral. Gorton argues that a securitization bond, such as ABS and CDOs, that were created by banks and are used as collateral in the repo market provides a link between the traditional banking and the shadow banking.

The above introduction of the shadow banking system is just the 'tip of the iceberg' in explaining the complex financial products and the financial chain that was created by banks and shadow banks. However, it is sufficient to meet the purpose here in illustrating the ways by which banks were able to shift the risky assets off their balance sheet and still be overcapitalised. Also, the information provided suffices to build on an argument that even though bank created products and ways to eliminate risk off their balance sheet, they also created an opaque and complex system that played a disruptive role at the heart of the financial crisis.

4.3 Shadow Banking and the crisis

Since the onset of the financial crisis in 2007 much research and academic work is conducted in an attempt to pinpoint the roots of such crisis that had global implications. A common element in the resulting analysis is the shadow banking system. As the crisis unfolded in the summer of 2007, causing massive disruptions in the financial system, not only banks experienced runs (see Chapter 5) but also the vehicles that these banks created, such as ABCPs and SIVs. During the crisis the MMMF also experienced a run. The disruptions in the financial market halted securitization activity (Adrian and Ashcraft 2012b) and seized up the CP market and the repo market. Following these events the US government came to the rescue by providing various liquidity facilities, not only for banks but also for those institutions that are considered as ‘shadow banks’ which are not regulated and hence are not eligible to government liquidity backstops.

ABCPs and SIVs were the first to be hit at the onset of the crisis in 2007. As explained above these vehicles borrowed short term in the money market and used those funds to invest in long -term illiquid assets, such as ABSs and CDOs.
The collapse of the subprime mortgage market caused their assets to deteriorate in value. Subsequently, there was an investors run on both ABCPs and SIVs creating difficulties for shadow bank entities. By the end of 2007 the outstanding amount of ABCP had decreased by around 34 perccent from a peak earlier that year of approximately $1.2 trillion. Similarly, the SIVs industry, with assets worth $400

billion in mid 2007, contracted in size with SIVs outstanding dropping by $100 billion by December 2007 (Gorton 2010).
Sponsor banks which were liable to provide liquidity support to these vehicles, came to the recue. However, because SIVs received limited liquidity support from their sponsors, unlike ABCPs, they had to fund their maturing SIVs notes mainly by selling their assets. Given the deteriorated market conditions, the proceeds from such sales were not sufficient to refund investors in full (Bank of America 2011).

Faced with these difficulties most sponsor banks provided support to their SIVs, even though they had no contractual responsibility to do so. In December 2007, Citigroup announced the bailout of its seven SIVs, by consolidating $49 billion of assets onto its balance sheet. Other banks such as HSBC and WestLB AG also bailed-out out their SIVs (Harrington and Hester 2007). However, some SIVs were left to default, with investors being badly hurt by suffering massive losses. As the crisis erupted further in 2008 SIVs became unviable and by the end of the same year these entities ceased to exist. In October 2008, Sigma Finance Corp, worth $27 billion, was the last SIV standing to cease operations (Davis and Sakoui 2008).

Credit default swaps (CDS), which act as insurance against banks/companies defaults, had served banks well by making their investments look rather sound prior to the crisis. As investors used CDS to hedge against any potential losses, the banks' investment were considered safe. However, the use of CDS evolved beyond just hedging the risk on the purchased bonds. Their use become similar to 'gambling', in the sense that bets would be placed on the perceived likelihood of bonds default (Blinder 2013). But, the purchase of insurance required no ownership of bonds or loans. This gambling use of CDS is known as "naked CDS". The use of naked CDS accounted for nearly 80 percent of the total CDS outstanding in 2008. This is one way by which product creativity in the financial system created more risk rather than eliminate it (ibid).

When the crisis took off, it wiped out the value of securities that the insurers, such as American International Group (AIG), had guaranteed. AIG was the largest derivative insurer, with a market capitalisation of $95.8 billion as of 2008 (Pilbeam 2010). AIG offered insurance for a variety of products and in 1998 it offered credit protection in the form of CDS mainly on mortgage backed securities (MBS) and CDOs. However, the collapse of the subprime mortgage market caused a massive decline in the value of CDOs and MBS. Because AIG had a triple AAA credit rating it was not require to post collateral to its counterparties. This changed when the crisis unfolded: its CDS counterparties were demanding the firm to post collateral. This was the start of what became a storm that would bring down AIG. In September 2008 the insurance giant was downgraded by all three major rating agencies. Even though it managed to post some (billions of dollars) collateral with its counterparties, it was not enough to ensure its survival. Unable to raise sufficient funds to meet the further collateral calls from its counterparties the unregulated firm was nationalized, receiving a whopping $182 billion bailout money (Blinder 2013).

Lehman brother's collapse had some devastating effect on the financial sector bringing down with it other financial institutions. One of the financial institutions that followed suit was the oldest money market mutual fund (MMMF) the Reserve Primary Fund. The fund's holding of Lehman's CP, which amounted to $785 million in September 2008, became worthless following the failure of the investment bank. The first MMMF were created in 1971, by the Reserve Primary Fund, and had some special characteristic that made them relative safe. Their share price was always $1, which removed any speculation risk, as there are no possibilities of incurring capital gains, or looses. They normally invested in short-term instruments, such as Treasury bills, thus their investments were considered to be safe. Amongst these securities, MMMF started to include in their portfolios CP, given their perceived low riskiness. However, when Lehman collapsed the firm's CP, was practically worthless. This caused the Reserve to be the first fund and for the first time since 1994[34] to 'break the buck', meaning that the fund's share declined by 3 cents from their $1 historical fixed value. As a consequence the Reserve fund faced a large number of redemption requests from its' investors. The run followed suit on other money market mutual funds as investors confidence fell in the industry in the aftermath of the losses that Reserve suffered. Mutual funds stopped purchasing CP, causing the price of these securities to drop substantially (Blinder 2013).

[34] Community Bankers Mutual Fund was forced to break the buck, following the bankruptcy of Orange County California in 1994 (Gullapalli et al 2008) and (Condon 2008)

In response to a distressed CP market, on September 19, 2008, the Fed created the Asset Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF). The introduction of AMLF aimed to provide support to MMMF to meet their investors' requests for redemption as well as to provide liquidity in the ABCP market (Federal Reserve 2008). AMLF allowed the Fed to provide low rate nonrecourse loans[35] to banks and other financial institutions in order for them to purchase high quality ABCP from MMMF. However, money markets and ABCP markets needed further assistance to battle the severe disruptions as the financial crisis culminated. On October 2008, the Fed established the Commercial Paper Funding Facility (CPFF) to address the problems in the CP market that were causing major financing difficulties for US companies. The CP market is vital to US corporations since it provides the necessary funds to meet any short term mismatch that arise between payments and receivables. When the CP market dried up, as MMMF and other investors stopped buying CP and no longer wished to refinance maturing paper, some of the countries largest companies faced problems in meeting their financial obligations. In order to stabilize the market the Fed created a SPV, that was funded by the Federal Reserve Bank of New York, and used the funds to purchase CP from eligible issuers. The CPFF was closed on 1 February 2010 once the commercial market become stable (Federal Reserve 2010).

[35] Nonrecourse loans are loans that are secured by collateral. However in the event of default the lender is liable to seize only the collateral on the loans and cannot go after any other assets that the borrower may possess.

During the crisis, apart from the ABCP and MMMF markets, there was also a run on the repurchase agreement (repo) market. As explained in above lending in the repo market is conducted with collateral. Gorton (2010) argues that securities used as collateral in repo transactions before the crisis were ‘information insensitive’. That is, the value of these securities is known and is immune to adverse selection (Gorton and Metric 2009). However these perceived information insensitive securities quickly turned information sensitive as the crisis unfolded. The collateral serves as protection for lenders, in that in the event of the borrower defaulting the securities used as collateral can than be sold so that the lender gets his cash investment back. If market conditions are good then the investor will get back the full amount as reflected in the value of collateral. However, when market conditions have deteriorated the collateral might have lost value and hence the investor will not be able to get the full amount back. Hence he will make a loss. And this is how the debt issued by banks quickly became information sensitive as investors became nervous about the underlying value of the collateral as indicated by the increased haircuts. Prior to the crisis usually there were no haircuts involved in a repo transaction. But this changed during the crisis as haircuts substantially rose. Gorton (2010) documents this increase and refers to them as being analogous to withdrawals of deposits in the traditional banking system. He argues that these withdrawals would trigger a run on banks, as it did in the previous US banking crisis, prior to the creation of deposit insurance, and the increase in haircuts triggers a run on the repo market. Gorton’s extensive research on the topic suggests that it was the run on the repo market that triggered the financial crisis (see for example Gorton 2010, Gorton and Metric 2009, 2010, 2012).

In relation to the tri-party repo market the clearing banks are exposed to the same risks as the ones that investors face in the above illustration in the bilateral repo agreements. If dealers are to default than the clearing bank is left with the collateral in the books, and if the value of the collateral is wiped out or substantially reduced, than the clearing bank will suffer major losses. However, clearing banks are not under any contractual obligation to unwind the repo transaction. Lenders became aware of the fact that clearing banks could potentially decide not to unwind trades and hence they could be left holding the collateral that needs to be sold. However a quick sale would cause asset prices to crumble under liquidity pressure. This could potentially deepen the problems in the market.

In fact during the crisis lenders, worried about dealers financial health, decided not to roll over the repos, thus they withdrew financing from dealers, despite the collateral provided by them. In other cases lenders decided to increase haircuts on collateral to protect themselves against any potential losses arising from a lost value of the securities held as collateral.

The liquidity strains in the repo market caused a lot of financial distress for many dealers. For some the consequences were fatal, such as in the case of Lehman Brothers and Bear Sterns which both failed in 2008. Acknowledging the problems in the tri-party repo market which were growing rapidly, the Federal Reserve initiated the creation of the Primarily Dealer Credit Facility (PDCF), ‘to help restore the orderly functioning of the market and to prevent the spillover of distress to other financial firms' (Adrian et al 2009, pg 1). The PDCF was established on March 16, 2008, on the same day of the announcement that JP Morgan was to acquire Bear Sterns (Blinder 2013). Under PDCF, The Federal Reserve Bank of New York was able to provide funds to primary dealers in exchange for collateral through clearing banks. So, dealers notified the clearing banks of the overnight funding they needed, usually by the end of the business day. Once the collateral was received and verified by the clearing banks the Fed of New York was informed. Upon this notification, in regards to the loan amount requested and the collateral pledged, the Fed transferred the funds to the clearing banks to provide credit to dealers (Adrian et al 2009). In effect the Fed of New York was providing liquidity backstop to primary dealers, that were not eligible, prior to the creation of PDCF. On September 14, 2008, when Lehman Brothers was just hours away from bankruptcy, the Fed expanded the use of the PDCF by accepting a wider range of securities as collateral against the loans it provided. The expansion of the PDCF was in response to concerns that a possible collapse of Lehman Brothers could spread the risk to other financial institutions. Once the market conditions improved the PDCF funds were no longer used and the facility expired in February 2010[36].

4.4 Regulation of Shadow Banking

As explained in chapter 2, in response to the latest financial crisis regulation of the

[36] Federal Reserve of New York, http://www.newyorkfed.org/markets/pdcf.html

banking system has undergone major changes. Basel III introduced new regulatory measures for banks, which also address the activities in the shadow banking system. Under the Basel III reforms bans are subject to two liquidity standards: Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR). Also, in relation to the new capital requirements standards the credit conversion factor is increased from zero percent to 20 percent for commitments with an original maturity of one year or less that are unconditionally cancellable (FDIC 2012).

As argued above, banks were able to shift assets off balance sheet by means of creating an SPV, such as ABCP and SIVs. In terms of the capital regulation, the shifting of assets to the SPVs, were treated as sales by regulation and banks were required to hold risk-based capital only against their contractual exposure to SPVs (Tarullo 2013).

The crisis shed light on the loopholes in the regulatory framework that gave banks an incentive to transfer assets into the shadow banking system that allowed them to adjust their capital requirements at more favourable terms. In 2009 The Financial Accounting Standards Board (FASB), issued Financial Accounting Standards No. 166 and 167 to amend the accounting rules of certain structured finance transactions involving SPVs.

The new accounting standards apply to all companies, not just financial institutions, and it requires them to consolidate those SPVs in which it has control over the most significant activities of these entities as well as when the company has the right to receive benefits or the obligation to absorb losses from such legal entities (FASB 2009).

Prior to these changes, banks were required to consolidate the assets and liabilities of ABCP conduits[37], but were not required to hold risk based and leverage capital against these assets. Under the new accounting standards, banking agencies require banks not only to hold capital against the consolidated assets of their sponsored SPVs, but also as well as against consolidated securitization transactions (Adrian and Ashcraft 2012b). Therefore within this new regulatory framework banks ought to hold higher capital ratios than previously.

The problem in the tri-party repo market during the crisis shed light on the role that clearing banks play on this market. The difficulties of many dealers during the financial crisis revealed that clearing banks not only act as agent but are also the largest creditors in the tri-party repo market. Dealers were heavily dependent on clearing banks to provide intraday credit to fund their securities. In order to reduce such dependence the Federal Reserve has undertaken steps, and since 2013 the amount of intraday credit provided by clearing banks has reduced from 100 percent to 30 percent and it aims to further reduce it to 10 percent by the end of 2014 (Tarullo 2013). Furthermore, the daily unwind process has moved from 8:30 in the morning to

[37] Following the failure of Enron, which had sponsored over 3000 off-balance sheet SPVs (Gorton and Souleles 2006) , the asset and liabilities of ABCP conduits were required to be consolidated onto balance sheet.

3:30 in the afternoon. This reduces the hours of risk that clearing banks are exposed to, leaving cash investors to hold the risk of the trades during the day. Clearing banks still provide credit to dealer between the new time of unwinding 3.30 pm till the time when new trades are settled (Adrian and Ashcraft 2012 a).

However, it is argued that these changes are far from accounting for the systematic risks associated in the tri-party repo market. The fact that clearing banks still provide finance to dealers and are exposed to risks, and the use of structure products as collateral are amongst the most concerned issues raised in the literature (See for example Adrian and Ashcraft 2012a and Tarullo 2013). In respect to Basel III reforms, some argue that not only will it not help in stabilizing the financial markets but it could also increase the size of the shadow banking system. For example, Baur and Wackerbeck (2013), argue that Basel III has placed traditional banks under more tight regulation in comparison to shadow banks. This then could lead to financial institutions to engage more in shadow banking activities. This is likely to be more profitable for both investors and financial firms due to benefits arising from escaping the costs associated with the increased capital and liquidity regulatory measures. This argument goes hand-in-hand with the suggestions given by Gorton and Metric (2010), which argue that, amongst other reasons, the regulatory costs are a factor that induced banks to move their assets off balance sheet. They refer to the evidence provided by Keeley(1988) arguing that when the capital requirements were first imposed in the U.S., banks with low capital ratios grew relative slower than banks with high capital ratios. Gorton and Metric (2010), then suggests that if banks are obliged to hold capital ratios to meet the imposed regulatory requirements and when charter value is low, 'bank capital will exit the regulated bank industry' (Gorton 2010 pg 274). And off balance sheet securitization is a way to such exit.

4.5 Concluding remarks

The creation of the shadow banking system and its interconnections with the traditional banking system presented in this chapter illustrates neatly how banks were able to record overcapitalisation without necessary being well-capitalised. Also the discussion of this chapter shows clearly how the shadow banking system serves as a cosmetic manicure for risk in reported balance sheets, at the same time are concentrating risk in the shadow banking system.

The main purpose of the discussion on this chapter is to provide a reinforcing argument against capital requirements. The root of this argument stems from the common held view that one reason explaining the rapid growth of the shadow banking system is associated with capital regulation. Such a system allows banks to escape regulation, in particular capital requirements. The implication here is that imposing higher capital requirements on banks may induce complex risk taking, by means of creating opaque financial products and a complex shadow banking system. The consequences of such activities were revealed in the latest global financial crisis, by increasing the vulnerability of the banking system.

However the above argument can best be applied only to the US banking sector, as opposed to the Japanese banking sector, in which shadow banking has not been significant. In addition this thesis aims to provide an explicit argument, by empirically examining the impact of capital adequacy regulation on the probabilities of default of US and Japanese banks, which is presented in the following two chapters.

Chapter 5. Capital Adequacy Regulation and Probability of default of U.S. banks

Chapter 4 presented a detailed discussion of the creation of the shadow banking system, which served banks as way to shift toxic assets off balance sheet and record overcapitalisation. As argued, both the overcapitalisation of banks and the creation of shadow banks, together with the innovation of complex financial securities, can be attributed to the capital adequacy regulations set by the Basel Committee. Subsequently, banks' vulnerability increased, as evident in the 2007-2009 global financial crisis. This chapter further examines empirically the consequences of the Basel capital adequacy regulation on the probabilities of default of US banks, using the capital market inflation theory, presented in chapter 3. The chapter gives an overview of the US banking sector and a detailed discussion of the difficulties faced during the crisis. Section 5.3 explains the methodology used in estimating the probability of default of US banks for the period 2007-2009. The results, presented in section 5.4 imply that the higher the Tier I capital ratios the higher the probability of default, whereas the higher the unweighted risk capital ratio the lower the probability of default. It is argued that the current risk-weighted capital ratio requirements only take into account the risk of insolvency ignoring the risk of illiquidity in the capital market. Section 5.5 discusses the implications of these results on the system as a whole.

5.1 The probability of U.S. banks default

The significance of banking sector instability is now a well-documented phenomenon in the international financial crisis. Even though signs of an impeding perfect storm that was about to hit the world economy appeared in late 2006 and early 2007, it was the 7th August 2007 that marked the start of the crisis. The ensuing credit crunch caused the collapse of stock markets across the globe, the failure of some of the oldest and largest financial institutions that threatened the stability of foreign markets. Even though governments in the most advanced and wealthiest countries came to the rescue by bailing out banks and other financial institutions the scars that are embedded in the economy have yet to heal.

One of the warning signs that became apparent in the US banking sector as early as April 2007 was when New Century Financial filed for Chapter 11 bankruptcy protection. The company was reported to have been a victim of the deteriorated housing market conditions (Stempel 2007). Other signs followed when Bear Stearns' investors learned that their funds invested in two of the firm's hedge funds had little value, if any (BBC News 2009).

However, it was on August 7 that made governments around the world realize that the early signs of an imminent financial crisis were to become reality, and that it would wreak havoc on some of the biggest global banks. On that day, French bank BNP Paribas froze withdrawals out of the banks' three mortgage funds, since it was unable to value fairly some of their assets. Earlier that year, the Bank of England had refused to provide financial support to one the country's main savings institutions, Northern Rock. Following this, the bank experienced a run on its deposits, making it the first British bank run since 1866 (Blinder 2013). Government efforts to save the institution proved unsuccessful and on February 2008 it was nationalised. In the same year, the Swiss government had to refinance UBS bank, the largest in the country and one of the biggest financial institutions in the world. IndyMac bank was seized by Federal Deposit Insurance Corporation (FDIC) in June 2008, making it at the time one of the major collapses in US history. According to reports, the bank failed due to a run by depositors, which drained the liquidity of the Californian mortgage lender.

However, September 2008 was the time when the US witnessed some of the most catastrophic events in the country's financial system. AIG, the world largest insurer, had been bailed out by the US government along with Freddie Mac and Fannie Mae, America's two biggest mortgage lenders. Merrill Lynch was taken over by Bank of America. During the same period, Lehman Brothers became the first of the 'too big to fail' banks to file for Chapter 11 bankruptcy protection.

Following that, the giant mortgage lender, Washington Mutual was closed down by regulators and sold to JP Morgan Chase. Over in Europe, the insurance giant Fortis survived by becoming partly nationalised and Dexia was the second Belgium bank to be rescued by its government. The latter, considered to be the world's largest lender to local governments at the time, became insolvent as a consequence of its US operations losses. RBS, not only the biggest bank in the UK but also with the bigger loan book than any bank in the world with asset worth £1 trillion, had to be refinanced by the British government. The British mortgage lender Bradford & Bingley was nationalised in the same year. In May 2010, the Spanish central bank seized control over CajaSur, one of the biggest savings banks in the country making it the second Spanish bank failure since the start of the financial crisis.

The financial turmoil provides evidence that banking collapses could occur on a massive scale despite the fact that banks were deemed to be too big to fail, well regulated and well capitalized. Conventional wisdom holds that banks should have high capital ratios that can sustain unanticipated losses. However the facts provided above cast questions over the effectiveness of this theory. In a bid to establish the accuracy of this conventional theory as a remedy to these failures, this chapter provides empirical evidence on the relationship between banks capital adequacy ratios and the probability of default. The analysis in this section departs from the capital market inflation theory put forward in Chapter 3, arguing that rising bank capital requirements makes them more prone to failure. As previously explained, in conditions of capital market inflation firms tend to be overcapitalised. The implications of overcapitalisation provide a foundation to examine the consequences of bank overcapitalisation issues. Bank overcapitalisation is seen as a result of capital adequacy regulation set by the Basel Committee. The capital market inflation theory suggests that under conditions of inelastic equity capital supply, rising capital adequacy regulation is a way of forcing non-financial firms into debt. The higher the amount of capital held by banks, the lower the quantity available to nonfinancial intermediaries in the market. Therefore, they are left with no option other than to raise their needed capital through the issue of debt instruments. The excess debt levels being held by firms as a consequence of higher banks' capital regulation requirement reduces productive investment below what it would otherwise be. The reduced productive investment also reduces the cash flow of firms and their ability to service their debt. Therefore, higher capital requirements that aims to avoid banks unsoundness, encourage firms to reduce their productive investment in fixed capital in response to their increased indebtedness. Implicitly, excessive firms' indebtedness causes a decline in the quality of bank assets, thus increasing their probability of default.

This thesis employs a logit model to estimate the probability of bank default on a pooled cross sectional data for US, over the period 2007-2009. Two models are estimated: a simple logit model using Tier 1 capital ratios and the size of banks dummy as explanatory variables to predict the probability of bank failure and a multivariate logit model adding three additional financial variables as proxies for profitability, asset quality and liquidity. Both models yield results that are in accordance to the hypothesis of this research that the higher the capital ratios the higher the probability of default.

5.2 The financial crisis and the U.S. economy

During the first decade of the 21st century the US economy went from a period known as 'The Great Moderation' to a period dubbed 'The Great Recession'. The former refers to a substantial decline in macroeconomic volatility that characterised the US economy since the 1980s. The reduced volatility led to widespread perception that business cycles were a thing of the past. However, 2007 was the start of the worst financial crisis since the Great Depression in the 1930s. Following the burst of the housing bubble, the prices of mortgage related securities fell substantially, prompting huge losses for banks and other financial institutions. For some institutions the inability to withstand these losses ended their existence. Others survived due to massive government provision of new capital or were bought by other institutions. The crisis that unfolded in dimensions beyond what anyone had anticipated, also severely hit the non-financial corporate sectors. As credit markets froze, the stock market collapsed, numerous businesses closed down, and with rising unemployment, the US economy entered into deep recession.

The burst of the housing bubble is commonly considered to have triggered the financial crisis and the subsequent recession that started in December 2007. The property market started to show signs of vulnerability in 2006 and 2007, and the rates of default and late repayment by mortgage holders started to rise significantly (Murphy and Webel 2008). As a consequence the value of mortgage related securities asset started to fall, with some having no value at all. The ensuing bank losses had devastating effects on some of the biggest financial institutions and brought distress to the whole financial system.

Losses in the housing market placed Fannie Mae and Freddie Mac, the two U.S. biggest mortgage refinancing companies, under strain, threatening their survival. The government-sponsored enterprises, but owned by shareholders, were created in 1938 and 1970, respectively, to provide sufficient funds to mortgage banks in financing housing and to keep liquid the market on which mortgage loans could be traded. By 2008 their combined loans were a total of $5.5 trillion (Pilbeam 2010). In the aftermath of the financial crisis, the US government injected capital totalling $140 billion in an attempt to prevent their collapse. However, the bailout proved not to be enough to ensure their survival. In September 2008 the two mortgage giants were placed under government conservatorship.

The crisis culminated on September 15, 2008, when Lehman Brothers filed for Chapter 11 bankruptcy protection. One of oldest companies of Wall Street, which had survived the Civil War, the Panic of 1907, and the 1929 stock market crash, was unable to continue its operations in the aftermath of the financial crisis of 2008. After running into great financial difficulties, following its heavily exposure both mortgage-related securities and commercial real estate, the US government refused to rescue the 158 year old firm. Much that followed in the crisis is related to Lehman's collapse. The impact of its demise was so severe that for many it defines the start of the recession the US economy experienced. As will be explained below, after Lehman's collapse some of the biggest financial corporations nearly followed suit, but were however rescued by the government.

In response to the financial meltdown, the Emergency Stabilization Act was enacted on 3 October 2008. The legislation created the Troubled Asset Relief Program (TARP), which allowed the Department of Treasury to guarantee or purchase up to $700 billion of toxic assets from troubled financial institutions. On October 13, the Treasury secretary Hank Paulson gathered the main nine US banks and offered them each a share of the TARP funds. Banks participation seemed to have been non-negotiable at that point, in order to avoid exposure of some banks to the market. In other words, if all banks receive bailout funds, the market would not be able to distinguish bad banks from good banks. Therefore, it was decided that $25 billion would go to Citigroup, JP Morgan Chase; $15 billion for Bank of America; $10 billion for Merrill Lynch, Goldman Sachs and Morgan Stanley; $3 billion for Bank of New York Mellon and $2 billion for State Street Corporation. A further $45 billion of TARP money was provided to Citigroup and Bank of America in the months that followed (see below).

In the face of the severe financial distress that the US was experiencing, in February 2010 the US Treasury launched the so-called ‘stress test’ for the largest 19 US bank holding companies with assets worth more than $100 billion. The test aimed to evaluate the financial position of these banks, to ensure that they had adequate capital buffer to withstand any losses and to maintain lending even under more severe economic conditions. Each bank’s capital was assessed using a two-year ahead hypothetical adverse scenario. The degree of stress for each bank was determined by assuming possible losses accruing on risky loans, assets and trades in the next two years. The level of stress was then used to determine the capital buffer position for each bank, i.e. whether a particular bank needs to increase the capital level or not. The US Treasury offered capital infusions to those banks that could not raise capital by themselves, under the Capital Assistance Programme (Marshall 2009). The results of the stress test were published in May 2009, and revealed that 10 out of the 19 banks needed to raise a further $74.6 billion in capital in order to withstand any potential losses. In particular, the test indicated that Bank of America needed to raise as much as $39.9 billion in capital. The other banks with the most significant capital shortage were: Wells Fargo with $13.7 billion; Citigroup with $5.5 billion and Morgan Stanley with $1.8 billion. All banks announced plans that would adjust the capital level that would be in accordance to the stress test (Guha et al 2009).

There have been many suggested factors that caused the financial crisis. Whilst one factor alone cannot explain the devastating impact, it is commonly believed that the crisis had multiple causes. Bankers are often blamed for their reckless behaviour taking too much risk and innovating complex financial instruments but also credit agencies and regulators bare some responsibility too.

The repeal of Glass-Steagall Act in 1999 has received much attention as one of the main causes that led to the financial meltdown. The Act was enacted in 1933, in response to the large number of bank failure during the Great Depression. Preceding the 1929 stock market crash banks engaged in risky operations through underwriting securities. Their main source of funds used for speculative trading was consumers' deposits. When the stock market crashed, these deposits were wiped out. As a result the Glass-Steagall Act came into effect in 1933**,** separating the activities of deposit-taking banks from investment banks. The main purpose of this Act was to make depositors money safer by restricting any connection with the risky activities of investment banks and created the Federal Deposit Insurance Corporation (FDIC) to avoid future bank runs (Johnson and Kwak 2010). Commercial banks were under the protections of the government but subject to tight regulation. The Securities and Exchange Commission (SEC) was to become the regulatory body for investment banks.

The Banking Act also enacted regulation Q, which granted power to the Federal Reserve (Fed) to set interest rate ceilings on savings accounts of banks. During the 1960s the Act was amended to include also savings and loans (S&L) institutions in addition to commercial banks. However, the 1970s high inflation placed banks under major difficulties. High inflation leads to high interest rates and because bank loans were subject to Regulation Q, they were losing money on their fixed rate mortgage loans. Also, depositors shifted their funds from banks and savings and loans institutions towards money market funds and Treasury Bills that offered higher rates. As a consequence, in the early 1980s the saving and loan industry become insolvent. The impact was milder for banks as they were not exposed to mortgages like the savings and loans institutions.

In the aftermath of the problems faced by the savings and loan industry, the Depository Institutions Deregulation and Monetary Control Act of 1980 was enacted. This Act is viewed as the first step towards the deregulation of the US financial market. Amongst other changes in the regulatory structure for the banking sector and S&L industry, the Act removed the Fed's Regulation Q enabling banks to be competitive by providing higher interest rates on their deposits. Two years later in 1982, the Garn-St Germain Depository Institutions Act was implemented. The Acts allowed S&L institutions to engage in other risky lending activities rather than concentrating just on mortgage lending. The regulation changes were placed with the aim to circumvent problems in the S&L industry. But as it turned out these legislative actions did nothing but exacerbate the crisis (FDIC 1997). The S&L crisis, led to over 2000-bank failure between 1985 and 1992, and a further 534 failed in 1989.

In 1988, the Basel Accord introduced international capital requirements for commercial banks. Basel I was implemented in January 1993 and all US deposit taking banks became subject to the risk-based capital requirements. In order to meet the capital requirements banks had to adjust their loan portfolios. This resulted in reduced commercial lending and increased holdings of government securities. This adjustment was accompanied with the recession of 1990-91. Many suggested that the credit crunch the US was experiencing was due to the newly introduced capital requirements. Whilst others viewed the effect of capital requirements as temporary, ruling out any long-term effect (Furfine 2000).

In 2004, Basel II Accord was introduced. The required capital remained the same as Basel I but Basel II allowed some banks to use their own risk management models to calculate regulatory capital requirements. The Accord was implemented in stages in 2006 but the US authorities adopted the agreement in 2007 (Pilbeam 2010).

In a response to the financial crisis of 2007-2009, the Basel Committee on Banking Supervision introduced new regulation standards, known as Basel III, in 2010. Under the new framework banks are required to hold higher capital ratios in an attempt to achieve and maintain financial stability. However as stated in chapter 3 the regulatory framework for capital adequacy requirements set by the Basel Committee provides no justified economic model nor does it provide a set amount of capital that is sufficient to protect banks or the banking sector as a whole.

Kuritzkes and Scott (2009) state that before the crisis, the average capital ratios held by the top 20 US banks was 11.7 per cent. The last reported capital ratios of the five large US banks[38] that either failed or were government-force sold/merger during the crisis, ranged from 12.3 per cent to 16.1 per cent.

Wachovia's capital position showed no risk of an imminent failure, prior to its demise in 2008, as was that of Bear Sterns. Prior to Bear Sterns' collapse in March 2008, the chairman of the SEC, Christopher Cox, expressed no concerns about the capital levels of the firm, stating, "the firm had a capital cushion well above what is required to

[38] Bear Sterns, Washington Mutual, Lehman Brothers, Wachovia and Merill Lunch

meet supervisory standards" (Norris 2008). Bearn Stearns was known for its heavy exposure to mortgage-backed securities, and in early March, there were rumours circulating that the investment bank was struggling. As investors lost confidence, the firm, which relied heavily in short-term financing such as repos, was unable to raise funds in the market. The Fed came to the rescue by providing Bear Stearns a $13 billion loan through JP Morgan. However, the loan was not sufficient to ensure the firms' survival. Two days later, JP Morgan acquired Bear Stearns for $10 a share.

Following the announcement of the Basel III rules, the US government implemented the Dodd-Frank Wall Street Reform and Consumer Protection Act. One element of this Act is the Volcker Rule, which in effect brings back, to some extent, the Glass-Steagall Act of 1933. The Volcker Rule prohibits commercial banks from engaging in proprietary trading. That is trading undertaken by banks for their own profit rather than on behalf of their clients. Therefore commercial banks that are under the FDIC supervision are banned for proprietary trading, whereas those financial institutions that are allowed to, will not be liable to government rescue should they need to in the future. Even though some have argued that these rules are likely to secure a safe financial system, this dissertation does not address the Volcker Rule but rather focuses on the impact of the Basel III capital requirements.

5.3 Methodology

The most commonly used method for explaining and predicting financial crises are the early warning system models (EWS). In the empirical literature, there are essentially two main methodological approaches for constructing EWS models: the parametric approach and the non-parametric approach. The former approach is the probability model, such as logit or probit, using limited dependent variables estimation. The occurrence of a crisis, the dependent variable, is a binary variable, taking the value one or zero, is estimated as a function of one or more explanatory variables. The main difference between the logit and the probit model is that the latter model assumes the cumulative standard normal distribution whereas the logit model assumes the cumulative standard logistic distribution.

EWS are used not only by academics and private researchers but also by banking regulatory and supervisory authorities. In the US the evaluation of individual banks by the regulatory bodies is conducted by means of on-site examination and off-site surveillance systems (Cole and Gunther 1998). The findings of the on-site examination determine the rating assigned to banks, based on its financial soundness and other regulatory criteria. The composite rating, known as CAMELS, is based on six criteria: capital adequacy, asset quality, management quality, earning ability, liquidity position and sensitivity to market risk[39]. In addition to these annually exams to assess bank performance the regulatory bodies have used off-site monitoring systems, or early warning systems.

[39] Market risk component was added in 1996

The CAMELS financial ratios have been used in many empirical researches in predicting bank failure. Sinkey (1975), was the first to employ the statistical technique of Multivariate Discriminant Analysis (MDA) to study bank failure using various financial variables. His analysis examines 110 failed and 110 non-failed US commercial banks for the period between 1969-1972. His study uses a variety of financial ratios in order to derive characteristics that distinguish between failed and non-failed banks in the sample period. The findings suggest that ratios employed to evaluate bank performance, such as liquidity, capital adequacy and efficiency, are statistically significant different between the two groups (failed and non-failed banks) (Sinkey 1975). However, the ability of MDA approach to detect future bank failure is limited, since it only distinguishes between failed and non-failed banks. Sinkey (1975) argues that his analysis ‘ represent(s) a preliminary input to the final goal of developing an early-warning system’ that can enable the prediction of future bank failure. Martin (1977) was the first to employ a logit analysis to predict bank failures, and this method is the most commonly used in the literature in predicting bank failure (Aktas et al 2006).

For the non-parametric approach mainly two models are used to predict financial crisis: trait recognition model (TRM) and the signal approach. The latter approach, used to predict both banking and currency crisis involves monitoring the behaviour of a set of single indicators in periods proceeding and during the crisis. When the behaviour of a particular variable is assessed as unusual, relative to its normal behaviour, it is considered to be issuing a warning signal if it goes beyond a threshold value. This threshold value, which expresses an unusual behaviour in a quantitative manner, is then adjusted to obtain an outcome that balances Type I and Type II errors (Kaminsky and Reinhart 1999).

Davis and Karim (2008), compare the predictive efficiency of the multivariate logit model and the signal approach to predict banking crisis using a single dataset. The analysis estimates the likelihood of a banking crisis as a function of a set of macroeconomic, institutional and financial variables. Using 105 countries for the period 1979-2003, their findings favour the multivariate logit model in terms of in-sample predictive ability. However, the signal approach may be more appropriate when estimating the probability of a banking crisis for a specific country. This is because using a common threshold value in the signal approach may not be optimal since the relationship between the discrete variable (the threshold value) and the crisis probability is not smooth over the countries in the sample (Davis and Karim 2008).

The other non-parametric approach is the trait recognition model (TRM), a computer intensive method which aims to identify systematic patterns in the data. This methodology can detect any irregular performance of the independent variables included in the model prior to failure/crisis. It stands out from other econometric models because it does not make any assumptions about the distribution or independence of the predictor variables. Another unique aspect of the TRM is that this technique attempts to exploit information from the interaction of variables. The

TRM technique has gained popularity in the literature used in predicting bank failure (Jagtiani et al. 2000).

When TRM is employed there are five steps used in the process of its construction: 1) the selection of cutpoints for each variable 2) the allocation of binary codes to each variable 3) constructing a trait matrix for each observation in the sample 4) using this trait matrix to identify good and bad traits and 5) set classification rules for voting matrix (for more detail see Kolari et al 2002). The selections of the threshold value and the classification rules are subject to the judgment of the researcher. The results depend to a large extend on these decisions which on the other hand could be a source of bias in the estimation (Gaytan and Johnson 2002).

Kolari et al (2002) compare the predictive ability of the TRM and the logit model for large US commercial banks over the period between 1989-1992. The authors estimate the probability of bank failure using both models on a sample containing 100 large banks. Their predictive power was tested using the holdout sample consisting of 50 US commercial banks. Based on classification results the analysis shows that both models are able to accurately predict in-sample bank failures.

However, the TRM performs better using both one and two year information prior to collapse, in the holdout sample. Furthermore, the TRM allows the examination of interaction of different variables, which contain useful information not found on individual variables in predicting failures. The importance of including variable interactions when predicting bank failures is also highlighted by Jagtiani et al (2003). Their study tests the efficacy of EWS models in predicting inadequate capitalisation of US banks. Using the equity to capital ratio as the dependent variable they employ both logit and TRM analysis to predict incipient financial distress in US commercial banks as revealed in declining levels of capital ratios. Classifying banks as capital adequate or capital inadequate, they predict bank capital falling below a specified adequate level one period ahead. The analysis is based on the assumption that capital serves as a financial cushion to a financial institution to absorb any unanticipated losses. Therefore monitoring capital levels predicts the risk of a bank becoming insolvent and does not predict failure. The results indicate that both of the EWS models perform well in predicting incipient capital deficiencies a year ahead. Therefore they argue that both models could be used in the supervisory process in monitoring bank capital levels.

Inspired by the methodology used in studies conducted by Martin(1977) , Estrella et al (2000) and others, this research estimates the probability of banks default using a logit model on a pooled cross sectional data set for the US banks over the period 2007-2009. Two models are estimated in this chapter; a simple logit model using Tier 1 as the sole predictor for probability of default, and year dummies and bank size dummy variable and a multivariate logit model adding three other financial ratios as explanatory variables- net interest margin ratio; the ratio of liquid assets to deposits and short-term funding and the ratio of net charge-off to average gross loans.

Identifying that a particular bank has experienced a failure for which the dummy variable takes the value of one or zero otherwise. The probability that a failure will occur, P(Y_{it}=1), is assumed to be a function of a vector of n explanatory variables:

$$P(Y_{it} = 1) = F(\beta X_{it}) = \frac{\mathrm{e}(\beta X_{it})}{1+\mathrm{e}(\beta X_{it})} \tag{5.1}$$

where Y_{it} is the banking failure dummy variable for bank i at time t, β is the vector of coefficients, X_{it} is the vector of explanatory variables and $F(\beta X_{it})$ is the cumulative logistic distribution. When estimating limited dependent variable models the maximum likelihood method is vital . Therefore, to obtain the actual parameter estimates the following log likelihood function is used:

$$Log_e\, L = \sum_{i=0}^{n}\sum_{t=1}^{T}\left[\left(Y_{it}\ \log_{\mathrm{e}} F\ (\beta' X_{it})\right) + (1 - Y_{it}) log_e(1 - F(\beta' X_{it}))\right] \tag{5.2}$$

Because the probability curve of the logistic function has an S-shaped characteristic, the estimated coefficients do not indicate an increase in the probability of failure given a one-unit increase in one of the independent variables. Thus, the marginal effect of X_{it} on the failure probability is non-constant and is obtained by multiplying the probability of failure with the probability of non-failure and the coefficient β_{i} (Davis and Karim 2008). This means that the probability of failure depends on the initial values of the independent variables. Although the sign of the estimated coefficient is sufficient for determining an increase or decrease effect on the probability of failure the magnitude varies in relation to the slope of the cumulative distribution function at $\beta' X_{it}$ (Demirguc-Kunt and Detragiache 1998).

A key element in this model is the construction of the banking failure dummy variable, which is the dependent variable. To establish which banks enter the category as failed, information was obtained from various sources. The criteria that a bank is considered as failed would have had at least one of the four following conditions: 1) bank that failed for Chapter 11 bankruptcy protection; 2) was seized by the government or financial institutions; 3) merged with another bank; or 4) is still operating because of a government bailout which otherwise would not be. For bank regulatory target capital adequacy ratio the Tier 1 capital ratio is used, obtained from Bankscope database[40]. Other variables that are included in the multivariate logit model are various ratios that intend to determine banks soundness such as liquidity ratio, asset quality ratio and profitability ratio.

5.3.1 Sample summary

In the estimated logit models, pooled cross sectional data was used for a subsample of US major banks. All banks are subject to the regulatory capital ratios, which intend to evaluate banks' capital strength. Tier 1 capital was used as a measure of capital adequacy ratio. This is the ratio of a bank's core equity capital to its total risk-

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[40] Tier I capital ratio for Countrywide Financial Corporation for year 2007 is obtained from the company's annual report, SEC filings, Form 10-k.

weighted assets. This ratio is considered to be a more reliable measure of the financial strength than other numbers used to evaluate a bank.

According to the classification criteria outlined above, there were 18 bank failures out of 103 observations (see Table 5.3.1-1). The dummy variable takes the value of one for banks that have failed and the value zero if the bank has not failed. A bank is defined as failed in a particular year, when it meets one of the above criteria, and its last reported financial ratios were in the previous year.

Table 5.3.1-1: Banks used in the sample

Failed Banks		**Non-failed Banks**
1	Downing Savings	US Bancorp
2	Washington Mutual	Bank of New York Mellon
3	Indymac	Capital One
4	Wachovia Corp	BOKF NA
5	Netbank	BancWest Corporation
6	Bank United Financial Corporation	TD Bank Holding

7	National City Corporation	PNC Financial Services Group
8	LaSalle Bank	Suntrust
9	Guaranty Bank	Valley National Bank
10	Colonial Bancgroup, Inc	US Bank National Association
11	Countrywide	Branch Banking and Trust Company
12	PPF Bank and Trust	Key Bank
13	Citigroup	HSBC
14	United Commercial Bank	Regions Financial Corporation
15	Bank of America Corp	Fifth Third Bancorp
16	Chevy Chase Bank	Wells Fargo
17	Corus Bank	Compass Bank
18	AMTrust	Huntington
19		Morgan Stanley

20		JP Morgan Chase & Co

Banks that failed during the 2007-2009 period are included in this research. This period was chosen to reflect the large number of bank failures as well the massive government financial assistance that banks received to ensure their survival. According to the classification criteria, outlined above, there were 18 bank failures out of 103 observations, thus the frequency rate for bank failure is around 17 percent (Table 5.3.1-2). The dummy variable takes the value of one for banks that have failed and the value zero for banks that have not failed. A bank is defined as failed in a particular year, when it meets one of the above criteria, and its last reported Tier 1 capital ratio and other ratios were in the previous year. Due to data limitation, the model includes only 103 observations.

Data limitation when analysing bank failures is a recognised obstacle in the literature. Aktas et al. (2006) argue that because of data limitation, their analysis was conducted over a six year period, 1997-2002, containing 42 observations out of which 19 were classified as failed banks and 23 successful. Similarly, Foreman (2002), using a logit model to predict the probability of bankruptcy of US firms in the telecommunication industry, limited his analysis to 77 observations. This is mainly because not all firms disclosed the detailed financial information needed for analysis. The same problem arises in the analysis of this research, as data for some banks[41] that have failed during the period under consideration are not available from Bankscope database.

Table-5.3.1-2 Sample Summary

Year of failure/non-failure	Number of non-failed banks	Number of failed banks	% of banks that failed	Total number of banks
2007	36	2	0.05	38
2008	27	10	0.27	37
2009	22	6	0.21	28
Total	85	18	0.17	103

The dataset used in this study is a pooled cross-section between 2007 and 2009. An individual bank can appear as a separate observation in each sample year. Data contains 103 observations, which includes 38 individual banks. Table 5.3.1-2 provides the sample summary of the data used in the analysis.

As can be seen from Table 5.3.1-2, in 2007 only two banks are classified as failure; namely Netbank and LaSalle Bank. Netbank, which only operated as an online bank was closed by the Office of Thrift Supervision (OTS) in September 2007, and the Federal Deposit Insurance Corporation (FDIC) was appointed the receiver. The bank as of June 2007, had $2.5 billion in assets and $2.3 billion in total deposits. ING

[41] For example, there is no published data available for Tier I capital ratios for Lehman Brothers, Merrill Lynch, Sanderson State Bank, Goldman Sachs and other banks that failed during the period under consideration

Bank acquired $1.5 billion in deposits and $724 million of Netbank assets (FDIC 2007). On the same month, Bank of America Corp. announced its plans to acquire LaSalle Bank from ABN Amro North America Holding Co. LaSalle at the time was one of the biggest US bank holding companies, and had more than $113 billion total assets.

In 2008, 10 banks in the sample are identified as failures. They are the following: Washington Mutual, the third largest mortgage lender prior to the crisis, was seized by regulators on 26, September 2008. The mortgage bank reported losses that amounted to $6.3 billion in three successive quarters of 2008, due to deterioration of the housing market conditions. A few days prior to its demise, the bank's credit rating was downgraded from BBB to BB. Following the downgrade, Standard and Poor credit rating agency reported that ' the bank is operating with adequate capital positions from a regulatory perspective and has demonstrated funding resilience as the deposit franchise has remained stable' (Levy 2008). However, Washington Mutual was suffering from a run on its deposits, losing up to 9 percent as of September 25, 2008(Blinder 2013). On the very same day, the OTC and FDIC closed Washington Mutual and later sold it JP Morgan & Chase for $1.9 billion (FDIC 2008a).

The decision to close Washington Mutual was in principle governed by the fear that the run would spread to other banks. However, two days following its closure, the regulatory bodies of the US banking system faced yet another possible imminent bank collapse, that of Wachovia. The bank was the country's fourth largest bank at the time with assets worth more than $800 billion(Alvarez 2010). Similar to the fate of

Washington Mutual, Wachovia was facing a run on its deposits. However, Blinder (2013) states that the run was rather 'silent', meaning that withdraws were conducted through computers rather than lining up at bank branches. Nevertheless, Wachovia liquidity was drying up, its stock price was declining sharply and the value of the banks' 10-year bonds dropped by more than 60 percent.[42]

At this point the prospects of Wachovia failing were close to being realised, and thus the bank was put in the market for sale. Both Citigroup and Wells Fargo were interested in acquiring Wachovia, and submitted their proposals both requiring FDIC assistance, albeit different amounts. Citigroup proposed a deal to regulators in which it offered to purchase Wachovia, in exchange for $2.1 billion in the bank's stock. Citigroup was willing to cover the first $42 billion in losses from Wachovia's loans, which amounted to about £316 billion, leaving the FDIC to cover any additional losses. Wells Fargo on the other hand, initially, offered to cover the first £2 billion losses from a much smaller asset pool, of £ 127 billion. Based on these proposals, FDIC decided that Citigroup's proposal was a better deal for them, since its estimated cost were minimal, whereas, the estimated cost the FDIC would have incurred under the Wells Fargo's proposal were between £5.6 billion to $7.2 billion (Blinder 2013). Therefore, on 29 September 2008, the FDIC announced that Citigroup was to acquire the trouble Wachovia. However, in a twist of events, the deal with Citigroup broke. Wells Fargo made a different proposition to the Fed. This time the bid to acquire Wachovia did not require any federal assistance. On October 3, Wachovia's board

[42] Blinder (2013) reports that the price of Wachovia's 10-year bonds dropped form 73 cent on the dollar to 29 cents

decided to accept Wells Fargo deal because it offered $6 per share more than Citigroup's offer. FDIC announced the agreement on the same day, which resulted in Citigroup's stock dropping by 18 percent (Blinder 2013). The bank had already received $25 billion of TARP money in October but its financial position remained weak and needed further government assistance. On 23 November 2008, it was announced that the Fed, FDIC and the Treasury had decided to inject a further $20 billion into Citigroup. The bailout was arranged under the conditions that the government would purchase $27 billion of preferred stock on which Citigroup was liable to pay an 8 per cent dividend. Furthermore, Citigroup would absorb the first $29 billion in losses on the $306 billion portfolio, plus 10 per cent on any potential losses. The rest was left to the FDIC, the FED and the Treasury to absorb.

Another bank that was still struggling for survival even after receiving $25 billion TARP funds in October 2008 was Bank of America Corporation, the saviour of Merrill Lynch. In December 2008, the Fed and the Treasury were informed that Bank of America was in trouble due to the mounting losses of Merrill Lynch. In mid January 2009, the bank received a further $20 billion of TARP money, on nearly the same condition as the Citigroup's bailout. CNN Money reports that regulators agreed to inject capital in return for preferred stock carrying an 8 per cent dividend (Goldman et al 2009). However, the pool of toxic assets that were guaranteed by the government totalled $118 billion, a much smaller amount of Citigroup's pool of portfolio assets. Bank of America was liable to absorb the first $10 billion and a further 10 per cent on any additional losses, leaving the Treasury and the FDIC to absorb the rest.

The demise of IndyMac in 2008 was considered at the time the third largest bank failure in the US history[43]. In the summer of 2008, the weak financial position of the mortgage bank was pinpointed by Senator Charles Schumer. The senator expressed his worries over the troubled bank in a letter addressed to regulators. In the days that followed the bank experienced a run on its deposits. A total of £1.3 billion deposits were withdraws 11 days after the fears over its solvency were raised by the senator (Paletta and Enrich 2008). IndyMac was seized by federal regulation in July 2008. The FDIC temporarily ran the bank, under a new name, IndyMac Federal Bank, FSB, until it sold it to OneWest Bank, FSB in March 2009 (FDIC 2009a).

BankUnited Financial Corporation, the parent company of BankUnited FSB, the largest bank headquartered in Florida, raised fears of being on the verge of collapse, after failing to comply with the Securities and Exchange Commission (SEC) mandatory rules in disclosing their fiscal accounts for 2008. The company also received notification from Nasdaq Stock Market, indicating that the inability to file its accounts on time threatened its continued listing. BankUnited company was expected to have suffered losses of at least $327 million, in the last quarter of 2008 alone (Hielscher 2008). In March 2009 it filed for Chapter 11 bankruptcy (Gale 2009).

[43] The failure of Continental Illinois in 1984, with assets worth $40 billion was considered the largest failure in US history, followed by the collapse of the American Saving & Loan Association in 1988.

Because its last available accounts are in 2007, and because of the actual distress the bank experienced in 2008, its failure is recorded in 2008 in the sample data used in this research.

Downey Savings &Loan after suffering major losses in late 2007 and early 2008, failed on November of the same year. FDIC announced that U.S. Bank, National Association acquired all Downey Savings assets worth $12.8 billion as of September 30, 2008. In November 2008, U.S. National Association also purchased PFF Bank and Trust, which was closed by regulators on the same month (FDIC 2008b) .

Countrywide Financial Corporation the largest US mortgage lender at the time was rescued by the Bank of America in January 2008. The rescue came after the giant mortgage lender run into financial difficulties and lost substantial market value, as economic conditions in the mortgage market worsened. Bank of America agreed to purchase the company for around $4 billion (Mildenberg 2008)

National City Corporation sold First Franklin, one the country's main subprime lenders, to Merrill Lynch in 2006. Since then the bank experienced major financial difficulties and in 2008 applied for federal bailout funds but was rejected (Engel and McCoy 2011). In October of the same year National City Corporation was acquired by the PNC Financial Services Group.

Capital One Financial Corp. announced in December 2008 the purchase of Chevy Chase for $445 million in cash and $75 million in stock (Dealbook 2008).

In August 2009, the OFS closed Guaranty Bank, and its receiver FDIC immediately arranged its sale to Spanish bank BBVA Compass. As of June 2009, the bank had assets of around $13 billion out of which BBVA Compass purchased $12 billion, the remaining assets were held by FDIC (FDIC 2009b). On the same month, August 2009, Colonial BancGroup filed for bankruptcy Chapter 11 after its banking units was closed by the Alabama State Banking Department, naming the FDIC its' receiver. FDIC then quickly facilitated its sale to Branch Banking and trust (BB&T) (FDIC 2009c).

The 120th bank failure in 2009 was United Commercial Bank, which was seized by federal regulators in early November that year (Campbell 2009). FDIC announced later that East West Bancorp acquired all the United Commercial's deposits.

Corus Bank was seized by the government in September 2009, and was immediately sold to MB Financial Bank. In December of the same year, the OTS closed AMTrust bank, and was later sold to New York Community Bank (FDIC 2009d).

5.3.2 Descriptive Statistics

As in Bunn and Redwood[44] (2003) the explanatory variable, Tier I capital ratio, is obtained from bank reported accounts in the year preceding the year of non-failure

[44] Although they estimate a probit model to examine the determinant of failure of both individual public and private UK's companies, the same methodology can be applied to the logit model as the only difference between the two models is that the probit

/failure, since it is not always possible to obtain data for the year in which banks have defaulted. Table 5.3.2.1 presents summary statistics for the Tier I capital ratio variable for all banks. Banks included in the sample are divided into two groups, failed and non-failed, and the t-test of the mean is calculated.

Table 5.3.2-1: Tier I ratio variable mean used in the sample

	All banks	Failed	Non-Failed	Difference in Mean	T-test on the difference
Tier I capital ratio	9.034	9.934	8.842	-1.096	-1.667***
Size[45]	0.601	0.388	0.647	0.258	2.054**
Net interest margin ratio	3.093	2.748	3.166	0.418	1.860***
Asset quality ratio	0.008	1.585	0.629	-0.955	-3.356*
Liquidity ratio	15.66	15.321	15.741	0.419	0.087
Unweighted capital ratio	9.626	7.793	10.015	2.221	0.009*
*, **, *** Represents significant the 1%, 5% and 10 % level, respectively					

The mean Tier I capital ratio of banks that failed is 9.93 which is higher than 8.84 the mean of banks that survived. The t-test mean difference is significant at a 10 percent level, hence the null hypothesis of equal difference in mean is rejected. Put differently, the mean of Tier I capital ratio of failed banks is different from that of non-failed banks. The mean of big sized banks that failed is lower than the mean of

model uses the cumulative standard normal distribution whereas the logit model assumes the cumulative standard logistic distribution

[45] Because this is a dummy variable, its' mean is the proportion of big sized banks

big sized banks that did not fail. This implies that bigger banks are less likely to fail. Non-failed banks have a significant lower mean asset quality ratio and higher significant net interest margin ratio. The mean of the liquidity ratio of failed banks is slightly lower than the non-failed banks, but not statistically significant.

5.4 Results

5.4.1 The simple logit model

The simple logit model estimates the probability of bank failure as a function of Tier I capital ratio. Two year dummies are included in the model to allow the intercept to differ across years.[46] A further dummy variable is added to the model to account for different bank sizes in the data sample. Banks with assets over $100 billion are considered 'big' and the dummy variable takes the value of 1. Those banks with fewer assets than $100 billion are considered 'small-medium' sized and the dummy variable takes the value zero.

The results of the estimated logit regression[47] are presented below:

Table 5.4.1-1. Results of the Logit model

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[46] The year dummy variable is included to reflect that the population may be different for different years. 2007 was taken as the reference year.

[47] The Pearson X^2 goodness of fit test used reveals that the number of covariate patters is the same as the number of observations therefore the Hosmer and Lemeshow goodness of fit test with 10 groups is used. The Homser and Lemeshow goodness of fit, obtained by calculating the percentiles of the estimates probabilities, shows that the model fits the data reasonably well. The output of the test are as follows: X^2 (8)= 5.84, prob>X^2= 0.66 (See Appendix 3)

	Coefficient	Robust SE[48]	Marginal effect[49]
Tier I capital ratio	0.165**	0.084	0.018
Size (big)	-1.098**	0.536	-0.132
Year dummy: 2008	2.127**	0.944	0.296
Year dummy: 2009	1.840**	0.964	0.273
Constant	-4.044	1.381	
Number of observations=103; Wald $X^2(4)$= 11.71; p> X^2=0.019; pseudo R^2=0.153 ; log-likelihood= -40.3852 *, **, *** Correspond to the 1%, 5% and 10% significance level, respectively			

The sign of the capital adequacy ratio coefficient reveals a positive relationship between the probability of default and Tier I capital ratio. This relationship indicates that banks with higher Tier I capital ratio have a higher probability of default. This leads to the acceptance of the hypothesis of this research that the higher the Tier 1 capital ratio the higher the probability of default. As stated above, the sign of the coefficient in a logit model gives only the direction of the relationship between the Tier I capital ratio and the probability of banks default. Therefore to interpret the magnitude of the coefficient the marginal effect of the estimated Tier I capital ratio

[48] Because the data is pooled and some individual banks appear as a separate observation in each sample year, the analysis uses cluster standard errors at the bank level, in order to allow correlation between the error term of the same bank but not between banks.

[49] The marginal effects are calculated at the sample mean for each variable. The marginal effect for continuous variables measures the change in predicted probability given a small change in that explanatory variable. For dummy variables the marginal effect shows how the predicted probability of failure changes as the variable changes from zero to one, holding other variables at their means.

coefficient is calculated. As can be seen from Table 5.4.1-1, the marginal effect associated with the Tier I capital ratio implies that a one percentage increase in Tier I capital ratio increases the probability of a bank default in the next year by 1.8 percentage points. The coefficient associated with bank size is negative and significant at the 5 percent significance level. This implies that big banks are less likely to fail than the small-medium asset size banks. The year dummies are both significant at the 5 percent level. The coefficient of 2008-year dummy is significantly high at 0.29, implying that in this year the probability of bank default substantially higher than the year 2007. Similarly the coefficient associated with the 2009 dummy variable is positive and high. These results indicate that both these coefficient capture additional factors not explained by the explanatory variables in the estimated model.

As a measure of accuracy in the ability of the model to correctly predict the depended variable the estimated probability is compared with actual bank failures[50]. In other words this would show the degree to which predictions are in line with the data.
To define a particular bank as failure or non- failure one needs to define the threshold value or cutoff probability. Therefore, if the predicted probability of a particular bank is equal or exceeds the cuttoff point, the bank is classified as predicted to fail and thus the binary variable takes the value of one. In contrast, if the predicted probability is less than the cutoff point the bank is classified as non-failure. The most widely used threshold value is 0.5. However, Wooldridge (2009) argues that this classification

[50] Because real probabilities are unattainable the actual bank failures are used as a measure to compare it with the estimated probability

rule has been heavily criticised by researchers, because the observed proportion of an outcome may not always be 50 percent. As an alternative approach in choosing an appropriate cutoff point, the share of failures in the sample data can be used. For example in this study the fraction of non-failed banks is approximately 17 percent (see Table 5.3.1.2).

Another way to determine the optimal cutoff point is obtained by plotting sensitivity and specificity against the predicted probabilities. The point of intersection between the sensitivity and specificity is said to yield the optimal cutoff point that correctly classifies failed and non-failed banks. Applying this methodology in this paper, the graph shows that sensitivity and specificity intersect at around 0.17, which is the same as the fraction of bank failure in the sample (see Table 5.3.1-2). Therefore this value could be used as the optimal cut off point. This threshold point is used here because it yields better prediction results[51] that the traditional alternative method (the default cutoff point of 0.5) explained above. The results are presented in Table 5.4.1-2.

Table 5.4.1-2 Model predicting accuracy

Classified	Failed	Non-failed	Total
Failed	12	30	42
Non-failed	6	55	61
Total	18	85	103
Sensitivity	p(+failed)	66.67%	
Specificity	p(-non-failed)	64.71%	

[51] The overall classification of the model at a 0.5 cutoff point is approximately 83 percent with a sensitivity of 11.11 percent and specificity of 98.82 percent therefore increasing Type I error.

Correctly classified	65.05%

The results indicate that the model's overall accuracy of prediction is 65.05 percent. This means that it has correctly classified 65.05 percent of the observations. The model failed to accurately predict 6 of the 18 failed banks, a sensitivity[52] of 66.67 percent and mistakenly predicted 30 of the 85 sound banks as failure, a specificity[53] of 64.71 percent.

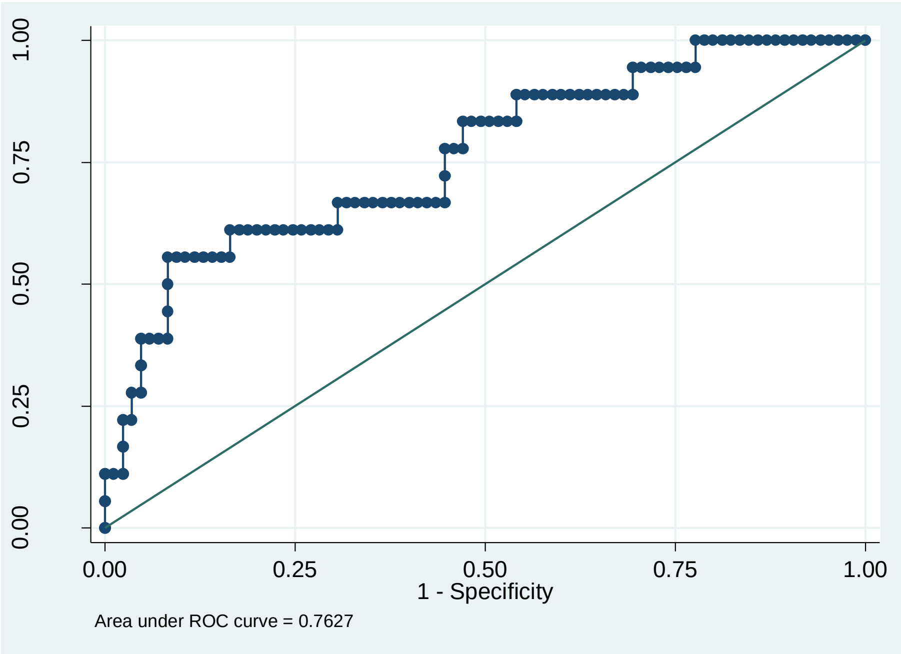
Another measure used in the literature to assess the accuracy of predictions is the area under the receiver operating characteristic (ROC) curve. The ROC curve plots the sensitivity against 1 minus specificity at different cutoff points. The 1 minus specificity is the proportion of banks misclassified as failure.

Applying the same reasoning as Peng and So (2002), the obtained ROC curve for the model developed in this thesis, suggests that in order for the logit model to correctly classify a large proportion of failed banks, for example 75 percent of banks, it has to misclassify nearly 25 percent of non failed banks as failed. Peng and So (2002) also argue that the trade off between a higher sensitivity and a lower 1 minus specificity is key in choosing the best model. The area under the ROC curve, which varies between 0.5 and 1, is of interest to researchers and it shows the overall measure of predictive

[52] Sensitivity refers to the share of banks that have failed that are correctly specified
[53] Specificity is the percentage of non-failed banks that are correctly classified.

power. So for a model to have some predictive power the area under the ROC curve has to be greater than 0.5.

Figure 5.4.1-1 Area under receiver ROC



For the logit model presented here, the area under the ROC curve for is 0.7627**,** shown in Figure 5.3.1-1. According to Lemeshow and Hosmer (2004) a value between 0.7 and 0.8 is considered acceptable level of discrimination between banks that have failed and have not failed.

5.4.2 Results for the multivariate logit model

Despite the evidence provided by Jagtiani et al (2003) and Estrella et all (2000), that a simple EWS model with Tier 1 as the sole explanatory variable, performs better than a complex EWS model using various financial variables to predict bank probability of default, the latter model is most commonly used by the literature. This paper estimates both a simple logit model presented above, and a multivariate logit model, in an attempt to find a model with the highest predictability accuracy. In such attempt, the analysis here adds three additional financial variables [54]to the previous model. Furthermore the unweighted capital ratio, equity to total assets, is included in the model.

The net interest margin ratio is used as a proxy for profitability. The relationship between this ratio and the probability of default is expected to be negative, so the higher the profitability ratio the lower the probability of bank default. The ratio of liquid assets to deposits and short-term funding is used as a proxy for liquidity ratio and it intends to gauge the ability of banks to meet customer deposits and short term funding in the event of sudden large withdrawals. The higher the ratio of liquid assets to customer deposits and short term funding the more liquid a bank is supposed to be, hence the lower the probability of default. As a measure of banks' asset quality the net charge-off and average gross loans ratio is used. The ratio intends to measure the percentage of bad loans that is not recoverable. The lower this ratio is the lower the probability of banks' defaults.

The results of the multivariate logit model are presented below:

Table 5.4.2-1 Results of the multivariate logit model

[54] The analysis has made use of all the financial ratios available from Bankscope database.

	Coefficient	Robust SE	Marginal effect
Tier I capital ratio	0.181**	0.095	0.015
Net Interest margin	-0.7833***	0.433	-0.068
Liquidity ratio	-0.036*	0.015	-0.003
Asset quality	1.174*	0.424	0.102
Unweighted capital ratio	-0.317*	0.123	-0.027
Year dummy: 2008	1.925**	1.012	0.218
Year dummy: 2009	-0.544	2.024	-0.064
Number of observations=101 ; Wald $X^2(6)$= 24.79; p> X^2=0.0008; pseudo R^2=0.328 ; log-likelihood= -31.801 *, **, *** Correspond to the 1%, 5% and 10% significance level, respectively			

The sign and marginal effect of the Tier 1 coefficient is similar to the simple logit model; positive and significant. The negative sign of the net margin interest ratio is as expected and significant at the 5 percent significance level. These results imply that an increase in net margin interest ratio reduces the probability of bank failure by 10 percent. Similarly, the higher the liquidity ratio the less likely a bank is to fail. An increase in the liquidity ratio reduces the probability of default in the following year by 0.3 percentage points. Whereas in relation to the asset quality ratio, the higher the net off-charge to average gross loan ratio the higher the probability of failure. A one percent increase in the asset quality ratio increases the probability of default by 12 percent. The coefficients associated with the year dummies are not statistically significant in this model. This indicates that after controlling for, Tier 1, liquidity, asset quality and net interest rate margin ratios, there are no additional factors that affect the probability of bank default. The coefficient associated with unweighted capital ratio is negative and significant. This implies that a one percentage point increase in unweighted capital ratio reduces the probability of default by 2.7 percentage points. The findings here are to some extent paradox. The two capital ratios, the risk-weighted and unweighted capital ratio, are both significant but have opposite signs. In other words the higher the risk-weighted capital ratio the higher the probability of default and the higher the unweighted capital ratio the lower the probability of default.

The above relationships can be best summarised as follows

$$PD_{it} = \alpha_1.(E/TA)_{it} + \alpha_2.(\text{Tier 1}/RWA)_{it} + \Omega\, X_{it} + u_{it}$$

Where:

PD is the probability of default
E is a bank's equity
Tier 1 is Tier 1 capital
TA is bank's total assets
RWA is risk weighted assets
Ω is a matrix coefficient
X is a vector of all other variables included in the multivariate model estimated above

Focusing only on the two coefficients associated with unweighted capital ratio and Tier 1 risk-weighted capital ratio, α_1 and α_2, the estimated results indicate that $\alpha_1 > 0$ and $\alpha_2 < 0$, respectively. This says that the coefficient associated with unweighted risk capital ratio is negative and hence smaller than 0. Whereas the coefficient associated with risk-weighted capital ratios is positive, and thus greater than 0. In an attempt to explain such paradox results the focus is given to the way the two capital ratios are constructed. Assuming the numerators to be the same in both ratios the denominators are further elaborated. This is because in effect Tier 1 capital and Equity can be taken to be common to both ratios. However the denominators are constructed differently. The difference between them consists in that TA contains all assets at book value and RWA is equal to TA minus risk-free assets, and a proportion of all other assets proportionate to the estimated risk in their asset class. A possible explanation is that true risk is in inverse to estimated risk. This on the other hand suggests that many experts have estimated risk wrongly and consistently.

A more likely explanation may be found by understanding the market process that would give rise to such paradox results. The conventional risk-weighting approach presumes that risk is intrinsic to particular asset categories distinct probability of default on payment to the bank holding them. Such 'risky' assets therefore have their liquidity permanently reduced (a bank holding them must set aside capital against the risk that is supposed to be inherent in the assets). The risk here is the risk of insolvency.

However this ignores the risk of illiquidity in the capital market.   The assets that would be more vulnerable to this kind of risk are more likely to be risk-free assets, which are traded more commonly in the capital market. They are therefore more vulnerable to a fall in the liquidity of the capital market. Such a fall would arise, according to the capital market inflation theory, if liquidity is taken out of the market, with outflows being greater than inflows into the capital market. The fall in liquidity would affect the value of 'risk-free' asset more than the value of risky assets, whose markets have less liquidity in any case. Consider the situation of a bank with a given amount of capital and a given amount of assets distributed in a given way across different risk categories. A shift of its asset portfolio towards more risky assets, shifting away from 'risk-free' assets, would reduce its Tier 1/ RWA ratio, but would also reduce the bank's vulnerability to illiquidity in the markets for safe assets. Whereas a shift of its asset portfolio towards 'risk-free' assets would increase its Tier 1 capital/RWA ratio but would also increase its vulnerability to illiquidity in the market for safe assets. Thus the results can be explained by the risk of illiquidity in the capital market, a risk that is not taken into account in the regulatory capital ratios.

Looking at the prediction accuracy of the multivariate logit model, it is evident that this model works better than the simple logit model (table 5.4.2-2).

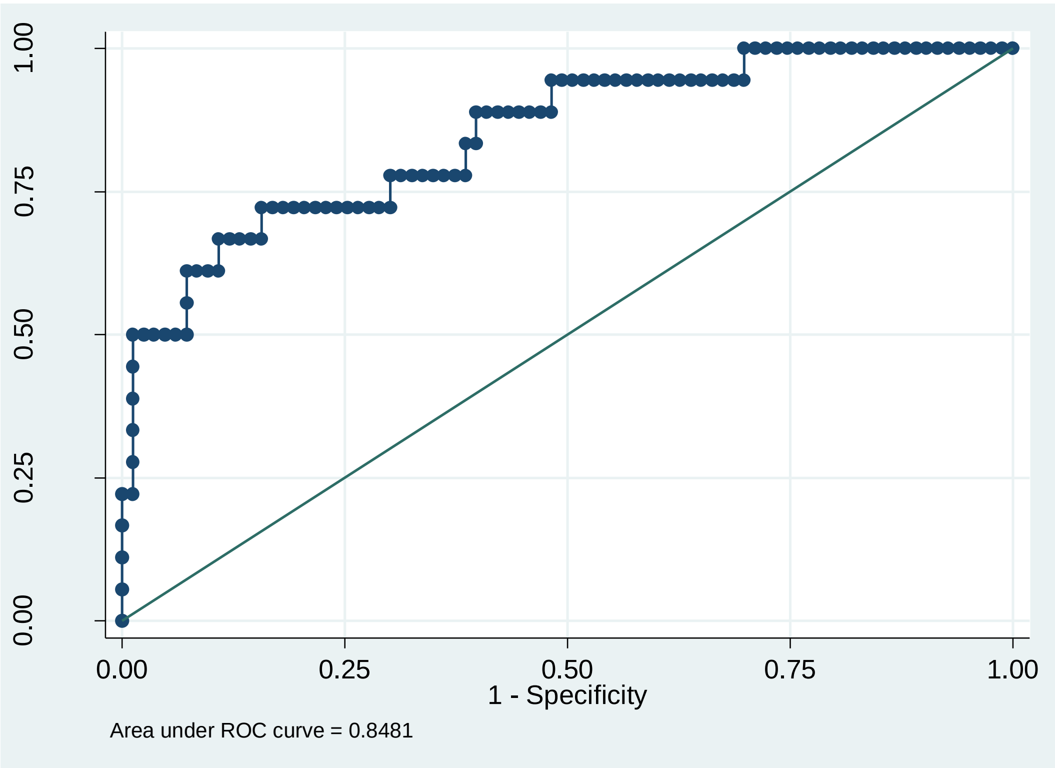
Table 5.4.2-2 Predictability accuracy of the multivariate logit model

Classified	Failed	Non-failed	Total
Failed	13	18	31
Non-failed	5	66	70
Total	18	83	101
Sensitivity	p(+failed)	78.31%	

Specificity	p(-non-failed)	72.22%
Correctly classified		77.23%

Using the same threshold value, 0.17, as previously, the model's accuracy of prediction is 76.24 percent. The multivariate model fails to predict 5 of the 18 failed banks and mistakenly predicts 18 of the 83 healthy banks.

Figure 5.2.1-2 Area under receiver ROC-multivariate logit model



The above graph (Figure 5.2.1-2) shows the area under the curve (AUC) for the multivariate model, which is 0.8481[55]. As discussed above, according to Lemeshow and Hosmer (2004) a level between 0.7 and 0.8 is considered acceptable

[55] See Appendix 4 for more details on the results and the tests carried out for the multivariate logit model

discrimination. However, in this case the AUC is slightly higher than 0.8, which makes it excellent discrimination. This provides evidence that in this analysis the multivariate logit model works better than the simple model in predicting bank failure.

5.5 Implications

The empirical results presented in this chapter imply that banks with higher Tier I capital ratios have a higher probability of default. The use of Tier I capital ratio as the main predictor of the probability of default was chosen to better capture the effect of such regulation on the capital markets, and thus on the rest of the economy. Even though the elements of Tier I capital ratios are mainly shareholder's equity and retained earnings, this analysis assumes that banks adjust to higher capital standards by means of issuing equity. The analysis has also incorporated other financial ratios as potential factors in determining the probability of defaults. All these variables are found to have significant power in determining the likelihood of banks' failure. However, the main variable of interest to the analysis has been the Tier I capital ratio which supports the assumptions of this thesis. The results not only validate the assumptions of the capital market inflation theory, but also implicitly stress the consequences of these requirements on the rest of the economy, which can be far-reaching. The point of the argument is that forcing banks to maintain higher risk-weighted capital ratios not only does not make them safer; on the contrary it increases their probability of default, crowds out private investment which further damages the economy and concentrates risk in the shadow banking system. Furthermore the findings of this chapter suggest that the higher the unweighed capital ratios the lower the probability of default. The implication of such paradox results is that the current risk-weighted capital requirements only account for risk of insolvency. There is however a more important risk that needs to be taken into accounts, that of liquidity in the capital market which explains the negative relationship between the simple unweighted capital ratios and the probability of banks default.

As explained above, most banks on the verge of collapse can be rescued by governments. Thus, even though bank failure, in itself, could indeed have major consequences for the functioning of the economy, governments to some extend lessen their negative impact by means of providing funds so they continue to operate and also by providing 100 percent insurance to their depositors. However, inadequate productive investment in the economy, conducted by non-financial corporations, proves to be a very hard disease to cure. The low levels of fixed capital formations have raised concerns over the last few years in the US. Smithers (2014) argues that US corporations' debt levels have increased whilst their capital investment remains very low in proportion to the cash flow. The implications of the reduced levels of productive investment by US non-financial corporations in the US could be a contributing factor in the slow recuperating process of a struggling economy. In fact, the importance and the role of productive investment by corporations have also been evident in the Japanese economy during the 1990s, that is further examined in the next chapter.

5.6 Data Appendix

Table 5.6 Data used to estimate the logit model(s) in Chapter 5

	Tier I	Banks	Asset quality	Interest margin	Liquidity ratio	Unweighted capital ratio (equity/total assets)
	17.6	Downey Savings	0.01	3.3	1.02	9.25
2007	8.96	Washington Mutual	0.34	3.02	4.6	9.34
2007	11.35	Indymac	0.08	2.33	7.52	6.88
2007	7.92	Netbank	0.39	2.56	22.96	6.62
2007	7.42	Wachovia	0.11	2.9	14.59	10.3
2007	9.93	Guaranty bank	0.1	2.73	3.84	6.74
2007	9.09	Colonial bancgroup	0.11	3.79	5.81	9.03
2007	11.6	Countrywide	0.15	1.79	44.46	7.16
2007	13.8	Bankunited financial corporation	0	2.13	0.93	5.55
2007	8.95	Wells Fargo	0.64	4.93	8.07	9.52
2007	8.59	Citigroup	1.16	2.59	52.81	6.36
2007	8.7	JP Morgan Chase & co	0.67	1.97	62.29	8.57
2007	8.64	Bank of America	0.71	2.98	30.26	9.27
2007	8.97	National City Corporation	0.4	3.7	5.39	10.4
2007	9.19	Chevy Chase bank	-0.05	3.73	4.99	6.77
2007	8.8	US Bancorp	0.38	3.72	5.69	9.67
2007	8.28	Bank of New York Mellon	0.12	1.79	37.94	10.32
2007	10.22	Capital One Financial corp	1.66	5.19	5.11	16.85
2007	8.58	BOFK	0.07	2.45	8.44	6.68
2007	4.19	Bancwest corp	0.17	3.34	6.7	10.93
2007	8.43	TD bank holding	0.18	4.6	10.88	20.8
2007	10.43	PNC financial	0.27	2.8	12.95	11.46
2007	7.72	Suntrust banks	0.19	2.93	5.76	10.3
2007	9.63	Valley national bank	0.12	3.61	4.28	8.57
2007	6.52	US bank	0.37	3.74	7.38	10.18

2007	9.21	Branch Banking and Trust	0.19	4.18	4.44	10.85
2007	6.87	Key bank	0.24	3.69	4.93	9.04
2007	8.38	HSBS USA bank	0.85	2.25	37.51	7.4
2007	8.07	Regions Financial corp	0.18	3.46	5.56	14.44
2007	8.39	Fifth Third bancorp	0.43	3.19	3.97	9.96
2007	9.38	Morgan Stanley		2.22	54.47	13.37
2007	7.87	Compass bank	0.34	3.85	3.22	8.92
2007	6.47	Huntington	0.31	3.34	5.98	7.34
2007	9.85	LaSalle bank	0.08	3.27	8.77	9.67
2007	10.4	AmTrust	0.09	2.98	0.98	7.25
2007	9.67	United commercial bank	0.16	3.24	6.34	9.71
2007	12.99	Corus bank	0.03	4.09	5.01	9.87
2007	10.25	PFF bank	0	4.18	2.02	8.72
2008	18.1	Downey Savings	0.58	3.04	0.85	10.72
2008	8.92	Washington Mutual	0.83	3.06	2.59	9.27
2008	9.56	Indymac	0.26	2.09	10.02	5.61
2008	7.35	Wachovia	0.21	2.83	13.92	10.25
2008	9.63	Guaranty bank	-0.03	2.7	2.94	6.69
2008	8.22	Colonial bancgroup	0.31	3.5	13.73	9.88
2008	11.8	Countrywide	0.64	1.67	40.23	6.92
2008	14.6	Bankunited financial corporation	0.08	2.33	7.09	5.4
2008	7.59	Wells Fargo	0.93	4.71	4.31	8.28
2008	7.12	Citigroup	1.43	2.59	58.58	5.19
2008	8.4	JP Morgan Chase & co	0.91	2.1	65.41	7.89
2008	6.87	Bank of America	0.8	2.58	28.41	8.56
2008	6.53	National City Corporation	0.58	3.46	3.18	8.92
2008	8.86	Chevy Chase bank	0.07	3.69	4.75	6.55
2008	8.3	US Bancorp	0.52	3.48	5.42	8.86
2008	8.24	Bank of New York Mellon	0.14	1.92	45.97	7.89
2008	10.13	Capital One Financial corp	1.88	5.36	5.48	16.13
2008	7.83	BOFK	0.19	2.42	11.89	6.28
2008	4.55	Bancwest corp	0.3	3.1	6.41	10.56
2008	12.19	TD bank holding	0.31	4.98	14.78	17.73
2008	6.79	PNC financial	0.32	2.93	12.33	11.88
2008	6.93	Suntrust banks	0.32	2.97	12.01	10.11
2008	9.28	Valley national bank	0.14	3.5	10.2	8.49
2008	6.48	US bank	0.5	3.52	7.65	9.77
2008	8.76	Branch Banking and Trust	0.24	3.49	3.05	10.73
2008	6.67	Key bank	0.38	3.49	5.85	8.82
2008	7.2	HSBS USA bank	1.09	2.22	43.33	6.26
2008	7.29	Regions Financial corp	0.28	3.73	5.51	14.06
2008	7.72	Fifth Third bancorp	0.58	3.28	3.38	8.26
2008	6.96	Morgan Stanley		1.98	60.54	8.97
2008	6.57	Compass bank	0.13	1.28	3.34	22.29

2008	6.64	Huntington	1.48	3.39	8.08	11.5
2008	9.77	LaSalle bank	-0.01	0.86	16.47	20.11
2008	11.27	AmTrust	0.59	2.48	0.83	7.66
2008	8.59	United commercial bank	0.13	3.37	5.41	10.58
2008	13.5	Corus bank	0.94	3.37	8.52	10.71
2008	10.5	PFF bank	1.3	3.63	1.83	8.64
2009	8.45	Guaranty bank	1.67	2.46	1.89	4.66
2009	8.58	Colonial bancgroup	3.77	2.89	18.04	6.35
2009	7.84	Wells Fargo	1.21	3.08	9.85	7.81
2009	11.92	Citigroup	2.58	2.97	54.89	7.31
2009	10.9	JP Morgan Chase & co	1.55	2.38	52.15	7.67
2009	9.15	Bank of America	1.73	3.04	22.8	9.74
2009	8.48	Chevy Chase bank	1.68	3.2	9.4	6.17
2009	10.6	US Bancorp	1.05	3.65	3.55	9.89
2009	11.26	Bank of New York Mellon	0.19	1.85	65.14	6.01
2009	13.76	Capital One Financial corp	3.42	5.62	6.55	16.04
2009	7.96	BOFK	0.89	3.05	11.23	5.37
2009	4.74	Bancwest corp	0.8	3.13	8.02	9.68
2009	-1.54	TD bank holding	0.69	4.01	15.15	9.45
2009	9.59	PNC financial	0.43	2.12	13.13	9.5
2009	10.87	Suntrust banks	1.19	2.91	13.11	11.89
2009	8.91	Valley national bank	0.21	3.55	5.66	8.53
2009	6.56	US bank	1.03	3.67	6.31	8.73
2009	10.8	Branch Banking and Trust	0.68	3.3	2.94	11.19
2009	7.83	Key bank	1.65	2.83	10.5	9.47
2009	7.5	HSBS USA bank	1.76	2.81	43.44	6.98
2009	10.38	Regions Financial corp	1.59	3.16	11.27	11.5
2009	10.59	Fifth Third bancorp	3.19	3.51	4.42	10.08
2009	12.92	Morgan Stanley	0.23	1.12	86.77	10.01
2009	7.41	Compass bank	0.92	4.4	3.52	20.39
2009	6.45	Huntington	1.17	3.42	3.61	10.91
2009	8.7	AmTrust	5.12	2.35	21.49	5.71
2009	11.93	United commercial bank	1.36	3.08	7.49	11.98
2009	10.99	Corus bank	8.44	1.43	29.31	8.08

Chapter 6. The Probability of Bank Default – The Case of Japan

This chapter provides empirical evidence on the impact of capital adequacy regulation on the probabilities of default of Japanese banks, using the same methodology as in chapter 5. However, contrary to the time period chosen for the US banking sector, that of 2007-2009 which is associated with Basel II Accord, for Japan the period between 1998-2000, during which Basel I capital requirements were in place, is chosen to empirically evaluate such impact on the Japanese banking sector. This time period is chosen to reflect the large number of bank failures associated with the Japanese banking sector at the time, discussed in detail in section 6.2 of this chapter. Section 6.3 discusses the empirical results which, as in the case of US, indicate that banks with a higher Tier I capital ratios have a higher probability of default. Section 6.4 concludes.

6.1 Probability of bank default- the case of Japan

The 2007-2008 US banking crisis serves as a warning that such a crisis can be inevitable even for a (perceived) healthy and sophisticated financial system. The

1990s Japanese banking crisis and its aftermath, however, serves as a lesson that the costs of having such crises can be so considerable as to cause the economy to remain stagnant for years, as in the case of Japan. Prior to the bubble burst, the Japanese economy was characterised by a period of high economic growth, dubbed 'miracle' economic growth in the period from mid 1953 to early 1973. After the occupation period ended, Japan's economy growth rate was at the average with the rest of the world, but it soon became one of the highest growth economies, averaging 10 percent growth per year. During the early 1970s its growth rated slowed, to an average of 4 percent per annum, but was still considered the highest amongst other advanced economies. In the late 1980s Japanese banks were considered to be among the strongest in the world. In 1988, seven Japanese banks were ranked among the world's top ten largest banks by assets (Hoshi 2001). However, in the aftermath of its stock market crash in 1989, the Japanese economy entered a prolong slump from which it has yet to fully recover. The slowdown in economic growth and the onset of asset price deflation had a significant negative impact on the health of Japanese banks and other financial institutions. In the years that followed the stock market crash, the soundness of the Japanese banking system weakened, culminating in 1997 with the spectacular failures of several highly important financial institutions. The large number of banks failures occurred despite the then newly introduced Basel I capital requirements. As explained earlier, Basel I was introduced in 1988 and was fully implemented in Japan in March 1993[56].

[56] The end of fiscal year 1992, in Japan

Judging just on the number of bank failures the country experienced during the 1990s and early 2000s one can easily reject the notion of the Basel capital requirements aiming to make banks more secure. Furthermore the research in this thesis provides empirical evidence that does not support the capital regulatory standards, arguing that under conditions of capital market deflation requiring banks to hold higher capital ratios makes them more prone to failure.

After more than a decade of repeated failures and poor performances Japanese banks now not only seem to have recovered but also are trying regain their position at the international level. The Economist in 2011 published an article about Japanese banks, titled 'Back from the dead', where it is argued that not only the country's three main banks are amongst top 30 largest banks in the world, by assets, but also how these banks used the crisis in their favour by expanding internationally in countries such US, Europe and Asia (see below)(The Economist 2011a). Nevertheless, in terms of economic (growth) performance Japan still has yet to recover fully. Following a slight expansion in mid 2000s, the global financial crisis and the Tahoku Earthquake and Tsunami of 2011 brought yet more obstacles in achieving sustainable growth. Lipscy and Takinami (2013), note that in nominal terms Japan's GDP has remained the same in two decades. In 1991 Japanese nominal GDP was recorded to have been 470 trillion yen and in 2012 this figure was nearly the same totalling 471 trillion yen.

This chapter makes use of the same empirical and methodology framework as the previous one. Using the capital market inflation theory the probability of bank default is estimated using Tier I capital ratio as the sole predictor. A simple logit model is estimated on a pool cross sectional data for the period 1998-2000.

As discussed in chapter 3, even though this thesis find no explicit evidence of the capital market inflation since 1990, the empirical predictions on the relationship between Japan's central bank stock purchases and Nikkei stock price movement indicate that the capital market inflation still holds. Furthermore, the arguments presented below and elsewhere in the literature are sufficient to conclude that inflation has been a phenomenon in the country's capital market prior to the period under consideration[57].

Analysing the Japanese banks probability of default during the 1990s financial crisis is perhaps more revealing than the case of US or any other country. That is mainly for two reasons. The first reason is the timing of both the financial crisis and the introduction of capital requirements that occurred during the 1990s. In the aftermath of the financial crisis, banks were under major pressure to meet the regulatory capital standards in deteriorating market conditions. As argued below, the introduction of the Basel capital requirements had a huge negative impact on Japanese banks. For example, Peek and Rosengren (1999) argue that most international active Japanese banks, such as Daiwa, Yasuda Trust, Mitsui Trust and Nippon Credit Bank, in the 1990s announced plans to close their overseas operations as a consequence of the

[57] And during banks capital adjustment process in meeting the Basel regulatory standards which began in 1988.

difficulties they faced to comply with the international capital requirements. Operating only as domestic banks allowed them to hold lower capital ratios. One interesting fact about these banks is that, following their decision to close international operations, all of them either failed, or were rescued by the government, or were forced to merge with another bank (as explained below). Shimizu (2007), on the other hand argues that the Basel regulatory framework failed to take into account the conditions of the Japanese financial market. He states that ‘when, however, some macro shocks emerged for which individual banks has no control, the BIS regulation should aggravate the macro economic conditions of the BIS criteria did not adjusted somehow. This is a lesson we can learn from Japan’s experience in the 1990s’ (Shimizu 2007, pg. 4)

These facts provide a foundation in building an argument that identifies the timing of these regulatory standards as a possible added factor in exacerbating the problems in the Japanese banking sector.

The second reason is linked to the capital market inflation theory this thesis employs to explain probability of bank default. The underlying assumptions of this theory are closely associated with the evidence that the crisis has brought about. Not only did the country experienced a prolonged recession that lasted over 15 years, but also the productive investment of the Japanese corporations steadily declined during this period. As argued above, the Basel capital requirements were implemented at a time when the capital market conditions were weak, in the aftermath of the stock market crash in 1990. Therefore banks had to offer a higher price in order to raise their needed regulatory capital. There is mounting evidence in the literature that records the substantial reduction in the productive investment by Japanese corporations during the 1990s. These facts support the underlying assumptions of the capital market inflation theory, that forcing banks to hold higher capital ratios is a way of crowding-out the nonfinancial sector, which may lead to a decline in fixed capital formation. Banks inelastic demand for capital at the time could have indeed been a factor contributing to the reduction of productive investment by Japanese corporations during the crisis. If banks would have not been under major demand to meet such regulatory capital ratios, the capital market might have been an (alternative) important source of funding that would have assisted the Japanese firms not only to overcome the difficulties they faced in the aftermath of the crisis but also to fund future productive investment.

6.2 The Japanese banking system

Given the vast amount of literature devoted to Japan it is perhaps safe to claim that its economy is one of the most studied economies of all times. This is both in explaining the high economic growth the country experienced during the period 1953-1973, and the prolonged recession the country experienced during the 1990s and the subsequent slow recovery. During the boom decades the Japanese annual average real economic growth was around 10 percent, making Japan the world's second largest economy, after the US (Ohno 2006). Over the same period Japan also became the world's leading exporter of steel and automobiles (Krugman 2009). However, the high economic growth era ended after 1973, when growth rates fell to around 4 percent.

Barsky (2009) states that the economy started to shows signs of recovery, in 1986, when figures of GDP, corporate earning and dividends started to increase. Many mark this period as the start of the 'bubble economy' and associate it with the Plaza Accord in 1985. The agreement reached between the G5 nations, called for a depreciation of the US dollar against the yen[58]. As a result, the yen appreciated substantially, increasing by nearly 46 percent against the dollar. This damaged Japanese exports, and subsequently the economy. The Japanese government undertook different policy measures to stimulate the economy. Interest rates were reduced by approximately 3 percentage points[59], followed by the introduction of a large fiscal package in 1987. By the time of the fiscal stimulus the Japanese economy had already started to recover, as stated above the economy started to grow again in 1986. The boom was associated with growing credit and rising asset prices. An exceptionally large increase occurred in stock and land prices, which tripled form 1985 to 1989 (IMF 2011). Indeed prices were so high that the land surrounding the Imperial Palace in Tokyo was reported to be worth more than the whole state of California (Krugman 2009). However, in the summer of 1990 the bubble burst and the stock market crashed.

[58] The agreement aimed to devalue the dollar against the deutsche mark as well, given that Germany and Japan were the two countries with a current account surplus
[59] And kept within this range until 1989

Krawczyk (2006), argues that the privatization programmes undertaken during the 1980s, such as the privatisation of Japan Railway and Nippon Telephone and Telegraph, together with the partial financial liberalization contributed greatly to the asset bubble that characterised the Japanese economy at the time.

In the financial markets liberalisation started in the 1970s. Before that the Japanese financial system was bank based, known as the 'main bank system'. Corporate firms had limited access to bond markets and equity issuance was rather minimal (Hoshi and Kashyap 1999). Therefore, banks were the main external source of finance for Japanese corporations. With the dissolution of the Keirestu in the 1990s, Japanese corporations were left with large debts that they could not refinance into equity.

In late 1970s a secondary market for government bonds was created marking the start of deregulation. This gave investors an alternative investment opportunity to, for example, bank deposits, which offered rather low interest rates. Financial institutions at the time in Japan were subject to interest rates controls, which were set in 1947 under the Temporary Interest Rate Adjustment Law (TIRAL). The law permitted the Bank of Japan (BOJ) to place ceilings on all kinds of deposits rates and on short term lending rates. All financial institutions, apart from the government financial institutions and postal savings, were subject to these restrictions. Whereas, shinkin banks[60], agricultural cooperative and the credit cooperatives were not subject to

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[60] Shinkin banks are non-profit cooperatives known also as credit associations. They are relatively small in size and are owned by members living in the same geographical area as the institutions' headquarters or branches. They operate in the same way as commercial banks but restrict their lending mostly to members. They could however locate up 20 percent of their loans to non-members (Hutchison and Westermann 2006).

lending rates regulation. The introduction of certificates of deposits (CD) in 1979, for which TIRAL regulation did not apply, marked the start of the deregulation of interest rates. The restrictions were gradually lifted for all other deposits in stages and in 1994 they were completely abolished (Kanaya and Woo 2000).

The liberalisation of domestic corporate bond and equity markets also started in mid 1970s. Also, the lifting of the foreign exchange controls in 1980 and the abolition of the 'real demand principle' in 1984, allowed firms to obtain finance abroad. Another step towards financial liberalization was the opening of the Tokyo offshore banking market in December 1986. These developments created new ways, by which firms could raise funds, thus reducing their reliance on bank borrowing. Hoshi (2001) shows that the ratio of bank loans to total assets of large manufacturing firms in the 1970s was nearly 0.35 but declined steadily thereafter, falling to 0.15 in 1990.
In the mean time, banks deregulation was a slower process, and in many respects they were still subject to tight regulation during the 1980s. For example, banks could not engage in loan securitization and fee-generating activities until late 1990's (Hoshi and Kashyap 1999). Furthermore, the banking industry was still subject to the Securities and Exchange Act of 1947[61], which separated investment and commercial banking activities. With this regulation in place, the role of banks was limited to the traditional approach, in which deposits are used to make loans. However, when banks lost their best borrowers to capital markets, they engaged in high- risk lending activities such as real estate, small and medium businesses, private equity etc.

[61] Similar to the US 1933 Glass- Steagall Act.

When the bubble burst, banks were highly exposed to land, through its use as collateral but also by lending to *jusen* companies (see below). As a consequence, the quality of banks loans deteriorated substantially in the aftermath of the bursting of the land price bubble. In 1998 the non-performing loans of Japanese banks were equivalent to 7 percent of GDP (Hoshi and Kashyap 1999).

Japanese banks were only able to be more competitive and engage in non-traditional operations when the 'Financial Big Bang' was were first introduced in 1996 and fully implemented in 2001. The Big Bang reforms aimed to make the Japanese financial sector " free, fair and global". The programme lifted any restrictions that were in place between banks, securities industry and insurance sector (Montgomery and Takahashi 2011).

Thus the stock market crash and the collapse of land prices placed Japanese banks under considerable financial stress. Kanaya and Woo (2000) provide the following link of the events that led to the deterioration of the health of the banking system: Firstly the significant decline in land prices reduced the quality of real estate loans; secondly, the value of collateral was wiped out; thirdly the lost value of banks' equity holdings undermined bank capital and fourthly, debtors were unable to meet their loan obligations due to weaker economic conditions (Kanaya and Woo 2000, pg. 8).

The Japanese banking sector started to show signs of weakness in late 1994 when the operations of two credit cooperatives, Tokyo Kyowa and Anzen Credit were closed. Tokyo Kyodo Bank was created, funded by the Bank of Japan, commercial banks and credit cooperatives, by the regulatory bodies to assume all assets and liabilities of the two insolvent credit cooperatives (Kanaya and Woo 2000). A year later two credit unions, the Cosmo Credit Corporation and Kizu Credit Cooperative, and one region bank, also collapsed. These failures were followed by a scandal over Daiwa bank later in November that year. The bank was forced to close its operations in the US following accusations of illegal activities in covering-up around $1.1 trillion in bond trade losses (Truell 1995).

During the same period Japan experienced the so-called *jusen* crisis. The *jusen* companies, which were specialised housing loan companies, were created in the 1970s by banks and other financial institutions to provide mortgage loans. As non-deposit taking financial institutions the *jusen* companies, unlike commercial banks, were not subject to tight interest rate restriction. During late 1980s and early 1990s they provided loans in the real estate market (Krawczyk 2006). They were mainly funded by agricultural cooperatives, which even though they were regulated by the MOF, were not restricted to lend in the real estate sector (Kanaya and Woo 2000). When the real estate market started to decline substantially in early 1990's the quality of the lending of *jusen* companies by 1992 became a serious concern. In mid 1995, after a special evaluation of the *jusen* companies conducted by the MOF which found that over 74 percent of their loans were nonrecoverable, seven out of eight *jusen* companies were dissolved (ibid). In order to prevent a panic, which could have led to massive withdrawals from other financial institutions, which had provided finance to *jusen* companies, the Japanese authorities designed a plan to use public funds to facilitate the liquidation of the seven *jusen* companies. A special account was established in the Deposit Insurance Corporation (DIC) to assist such liquidations, which included nearly 680 billion yen in government funds (GAO 1996). These funds covered around 10 percent of the losses. While, the parent banks covered the largest percentage of the losses, some 55 percent, worth 5.3 trillion yen, 27 percent of the losses was covered by other creditor banks and only 8 percent by the agricultural cooperatives (Krawczyk 2006).

The *jusen* crisis together with the failure of the above mentioned financial institutions led to the so –called 'Japan Premium'- a premium on borrowing costs of Japanese banks on international financial markets. Spiegel (2001) relates the premium to government policy. He states that the failure of Hyogo Bank, the first listed bank failure in Japan, with assets worth $37 billion, influenced the 'Japan Premium'. This is because prior to Hyogo collapse, the Japanese government intervened when needed to prevent any possible financial institution failure, by arranging a merger of the insolvent bank with a sound bank[62]. Within such a policy framework the market perceived Japanese banks to be solvent and quite safe. However, when the authorities

[62] For example, in 1992, Toho Sogo Bank, a small local banks, became insolvent and the Deposit Insurance Corporation assisted its' merger with Iyo Bank.

failed to save Hyogo Bank this perception changed and Japanese banks had to face a premium on their borrowing costs (Spiegel 2001).

In 1996 some Japanese banks were downgraded by credit rating agencies. The reduction in credit rating had started since 1989, however in 1996 the reduction was quite radical. For example for some banks, such as Long Term Credit Bank of Japan, Nippon Credit Bank, Hokkaido Takushoku Bank and Daiwa, credit ratings were reduced from A to BBB (Miyajima and Yafeh 2003).

In 1997, the Japanese economy experienced another recession when higher consumption taxes were implemented. In April 1997, the operations of Nissan Life Insurance were suspended by the MOF. On 3 November that year Sanyo Securities, a second-tier securities firm in Japan, filed for bankruptcy, under the Corporate Rehabilitation Law. On the same day, Sanyo also defaulted on overnight interbank loans market. This was the first default in the Japanese interbank market. By mid November, Yamaichi Securities, one of Japan's large four securities companies, and Hokkaido Takushoku Bank, one of the country's city banks, collapsed. On the 26 November, the failure of Tokuyo City bank, a small regional bank, was announced (Montgomery and Shimizutani 2009). These failures were associated with massive disruptions in the interbank market, a sell-off of bank shares in the Tokyo Stock Exchange and an increase in the 'Japan Premium' (Kanaya and Woo 2000; Krawczyk 2006).

Prior to these events Japanese depositors were guaranteed up to 10 billion yen (approximately $100,000) per account. However, this changed on 26 November 1997, when then the Minister of Finance announced that the Japanese government would guarantee 100 percent of the deposits until March 2001. In February 1998, the Japanese government passed two laws for financial stabilization, allowing the DIC to use 30 trillion yen of public money to bail out troubled banks and to strengthen depositor protection. 17 trillion yen was made available to provide full deposit protection, and the remaining 13 trillion yen went to banks with financial difficulties (Montgomery and Shimizutani 2009).

In March 1998, 21 banks applied for government funds, with the exception of Tokyo-Mitsubishi bank that was persuaded to apply for a capital injection. All major city banks received on average 100 million yen each, whereas three Regional banks, Yokohoma Bank, Ashikaga Bank and Hokuriku Bank applied for smaller funds (ibid). In total, 1.8 trillion yen was spent on capital injections, mainly in the form of subordinated debt, for the banking system.

However financial stabilisation was far from achieved as the crisis continued further in 1998. In June 1998, the newly created financial regulatory, Financial Supervisory Agency (FSA), took over supervisory powers from the Ministry of Finance (MOF) and other regulatory bodies to supervise banks and other financial institutions, such as securities firms, insurance companies, shinkin banks and credit cooperatives[63]. In October 1998, the Diet passed two laws: the Financial Revitalization and Financial Early Strengthening Law in an attempt to resolve the problems in the banking system. Under these laws authorities were able to better deal with bank failures, rather than just focusing on finding suitable healthy banks to take over failed banks, as well as having more funds at their disposal for bank resolution. A total of 60 trillion yen (12 percent of GDP) of government funds became available to strengthen the Japanese banking sector. Out of the 60 trillion yen, 25 trillion yen was allocated to recapitalize weak but solvent banks, 18 trillion yen for the insolvent banks, to assist their liquidation and/or nationalisation and 17 trillion yen to fully protect the deposits of insolvent banks (Kanaya and Woo 2000).

Following the new legislation, in October 1998 the Long Term Credit Bank of Japan (LTCB) was nationalised. In 1989 LTCB was the ranked the 9th largest bank in the world by assets, applied voluntarily for nationalisation after suffering massive losses as a result of the non-performing loans accumulated by lending to the real estate sector and *jusen* companies. In March 2000, the bank was sold to the US investment fund, Ripplewood Holdings, and reopened for business as a private commercial bank, under the name Shinsei Bank. In November 1998, another nationalisation took place, that of Nippon Credit Bank. The credit bank was involuntarily nationalised, since

[63] MOF had previously supervised banks, securities firms, insurance companies and other non-bank financial institutions, whereas the Regional Financial Bureaus had been the supervisor of shinkin banks, and credit cooperative were under the supervision of prefectural governments (Kanaya and Woo 2000).

previous attempts to strengthen its financial position were not successful. The bank was reported to have had a capital deficit of 94 billion yen as of March 1998 (Harada, Ito and Takahashi 2013). Nippon Credit Bank was later sold and renamed Aozora Bank in 2001.

In 1999, a second round of capital injection of around 15 trillion yen was provided to a total of 15 banks. However, this time rather than a standard capital amount, banks received government funds in accordance to their individual financial needs. In order to qualify for the requested capital injection, the Financial Revitalization Commission (FRC), which was established under the Financial Revitalization Law, required banks to provide a restructuring plan, which had to include plans to raise capital in the private sector (Montgomery and Shimizutani 2009).

The year 1999 marks the beginning of the so-called ‘merger-wave’ period. In May that year, Mitsui Trust and Chuo Trust announced their merger plans (Kanaya and Woo 2000). A few months later, Industrial Bank of Japan, Dai-Ichi Kangyo Bank and Fuji Bank revealed their merger plans, forming Mizuho Group. All three banks were amongst the largest banks in Japan, with total assets worth, 42.09 trillion yen, 52.53 trillion yen and 46.38 trillion yen, respectively (Harada and Ito 2012). In October of the same year Sumitomo Bank and Sakura bank, which had 51.53 trillion yen and 48.30 trillion yen in assets, respectively, also announced that the two banks were to merge to form Sumitomo Mitsui Financial Group (ibid).

In March 2000 Asahi Bank, Tokai Bank and Sanwa Bank announced their plan to merge, forming UFJ Holdings[64]. At the time of the announcement, Sanwa Bank had 47.59 trillion yen in assets and Tokai Bank's assets were worth 30.36 trillion yen (ibid). In April, the creation of the Mitsubishi Tokyo Financial Group was announced. The group was formed by the merger of Bank of Tokyo-Mitsubishi, which had a total of 69.81 trillion yen in assets, Mitsubishi Trust Bank, a rather smaller bank with 16.37 trillion yen in asset, and Nippon Trust Bank. In 2001 Daiwa bank and Asahi bank merged to form Resona Holdings.

Kawai (2003) suggests that the reason behind the 'merger wave' period in which large Japanese banks decided to merge with one another, was financial distress. Merging was seen not only as a way of becoming more efficient but also, and most importantly, to avoid failure. Harada and Ito (2008) use the Distance to Default approach to evaluate the merger effect in the Japanese banking sector for the period between 1985 and August 2005. They examined four merger cases: that of Mizuho GF, UFJ Holdings, Sumitomo Mitsui Financial Group and Mitsubishi Tokyo Financial Group, in order to determine whether a merger bank financially improved, worsened or remain on average, in comparison with predecessor banks. The evidence show that merged banks did not necessarily become better off, in the sense that merging did not ameliorate their financial health (Harada and Ito 2008).

[64] Even though Asahi Bank did not join the formation of UFJ Holdings.

By late 1999, the Japanese banking system took a turn towards stability. Between 1999-2002 there is no recorded major bank failure. This was achieved not only the capital injection provided by the government but also following the new guidelines of the newly created FSA to restructure the banking sector. The restructuring was conducted using different measures such as reducing the number of bank branches and overseas operations, tighter loan classification[65], better provisioning and write-offs[66] and others (Kawai 2003).

However, 2003 proved to be another difficult year for the Japanese banking sector. The newly created, 5th largest bank in 2003, Resona Bank came under considerable stress after suffering a massive capital shortage. Resona Holdings capital adequacy ratio was reported to have been well below 4 percent. In May 2003, As a result the government injected 1.96 trillion yen of public funds through its subsidiary Resona Bank. This was followed by the nationalisation of Ashikaga Bank in November of the same year.

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[65] Banks in Japan had been able to have a tax-deductible general reserve accounts for any potential loan losses since 1964. The accounts allowed the classification of ‘normal’ and ‘substandard’ loans, for which any additional specific provision against the latter classification did not apply. On the other hand banks were required to make specific provisions not only for loss loans but also for those loans that were doubtful, out of which 50 percent were tax deductible.

[66] Japanese banks were known to have been slow at writing off loans with low chances of recovery. One reason for this is due to tax rules, which only allowed banks to write-off loans after losses accruing to those loans had been ascertained in bankruptcy. Another possible reason was the worry of sending wrong signals to their customers.

After more than a decade of repeated failures, insolvency and financial weakness the Japanese financial system started to gain strength. The economy also started to pick up around 2003, with GDP growing more than 2 percent and the rate of unemployment declined (Krugman 2009). The Japanese banking sector, has also now recovered and in the 2007-08 US crisis looked in much a better position than that of US. The situation changed in favour of Japan's banks, which were once heavily criticised for their structure and took much of the blame for the economic stagnation the country experienced. Most of the criticism came from commentators in western developed countries, urging the Japanese authorities to change the regulatory framework and promote inventiveness (Montgomery and Takahashi 2011). As explained above, the Japanese banking sector has been heavily regulated and even after the Big Bang deregulation reforms were implemented its banking sector remained traditional, in the sense that financial innovation never really took off. In contrast the US banking sector, with a free market regime, came to be too complex for its own good, as reflected in the 2007-08 financial crisis. However, during this crisis it was the US banks that faced major difficulties, and for some it was the Japanese banks that came to the rescue. For example, in January 2008 Mizuho Financial Group invested $1.2 billion in purchasing 18 percent in preferred shares, in Merrill Lynch (Montgomery and Takahashi 2011; Taniguchi and Sato 2011). In September 2008, Mitsubishi UFJ Financial Group purchased a fifth of Morgan Stanley in a $9 billion dollars deal (Story and Sorkin 2008). In the same month Nomura Holding Inc., Japan's biggest brokerage firm, announced the purchase of Lehman Brother's equities and investment banking operations in Europe and Middle East (Slater 2008).

These deals provide evidence that the balance sheet of Japanese banks might have finally repaired and with the economy stepping towards recovery. This is far reaching, considering that with stock and land prices falling since 1990, the country experienced not only the worst and longest recession in post-war history but also suffered the highest loss of wealth, amounting to a total of 1,500 trillion yen (Koo 2008). As stated above, there are many studies that have examined the causes of the Japanese crisis that lasted from 1990 to the early 2000. While many blame the problems on the banking sector as the main cause, others identify the mismanaged monetary policy as well as structural and cultural factors.

Koo(2008) argues that the prolonged recession that the Japanese economy experienced since 1990 was a ‘balance sheet recession’. The stock market crash and falling land prices not only destroyed the wealth of Japanese corporations but also severely damaged their balance sheets. On the one hand corporations saw the value of their assets, i.e. a property or land, sharply reduced, and, on the other hand, they were still liable for repayments on the loans used to acquire those assets. With mounting debt levels, Japanese firm began paying down their debts, thus moving away from the standard approach of profit maximisation to debt minimisation. He argues that corporations did this through all the 1990s and early 2000s. This argument is based on the fact that corporations were not borrowing despite interest rates being virtually zero through this period. By 2000 Japanese corporations had net savings higher than households. As consequence of firms’ demand for credit declined by more than 20 percent of GDP. Only when firms stopped repaying their debt and began to borrow again the Japanese economy started to recover (Koo 2008).

An important feature of the above arguments is that indebtedness of the corporate sectors plays an important part in bringing about a recession. This statement is perhaps the most important point that this research attempts to illustrate within a capital market inflation theory framework, taking into account the capital requirements imposed on banks. The important role of the corporate sector in the economy is also highlighted in Shimizu (2007). His argument is built upon the causes and consequences of the fall in demand for loans by Japanese corporations. He analyses the impact of the Basel regulation on the Japanese economy and argues that the result of the imposed capital requirements was a reduction in bank lending, hence a reduction in corporate borrowings. He argues that once firms realized that banks were unable to continue lending in the aftermath of the stock market crash, firms changed their credit demand expectations and halted their investment plans. According to Shimizu (2007) the lack of confidence of corporations in economic conditions is one of the major sources for the prolong recession in Japan (Shimizu 2007). Japanese companies as of 2011 were still reluctant to invest preferring to hoard large amounts of cash, which totalled nearly 200 trillion yen. This is despite having lowered their debt levels. The Economist argues that nearly half of the Japanese listed companies had more cash than debt, in 2011 (The Economist 2011b). However, when financing is needed capital markets play the key role rather than banks. An important feature of this method of financing by Japanese corporations provides some evidence that Japan has moved away from a bank-based system, and towards a market oriented financial system.

Similar to the vast amount of studies conducted on the prolonged Japanese recession, the literature also provides extensive studies examining the banking crisis that the country experienced till mid 2000s. Some argue that the crisis was as a consequence of the regulatory framework that characterised the Japanese banking sector. Some blame the slow process of deregulation of the financial market whilst others pinpoint the corporate governance framework as the main cause for the banking crisis. One small group of studies examines the consequences of the introduction of the Basel capital requirements and many of them blame such regulation for the credit crunch the country experienced during the 1990s. However, none of them explicitly examine the impact of the international regulation on the probability of bank default.

Before the introduction of the Basel capital regulatory standards, Japanese banks were required to hold a minimum of 4 percent of deposits in capital. By March 1993, when Basel I was fully implemented all Japanese banks met the capital regulatory standards, 8 percent of total risk weighted assets, despite the stock market crash in 1990 (Kanaya and Woo 2000). Many argue that a reason for banks not having any difficulties in meeting the capital requirements was that domestic regulation allowed the inclusion of 45 percent of unrealized gains-the difference between book value and market[67] value- towards their Tier II capital. However, Kanaya and Woo (2000) argue that the proportion of the unrealized gains to total bank capital in March 1998 was approximately 25 percent[68]. It is worth noting here that the inclusion of 45 percent of unrealized gains toward Tier II was allowed only if the proportion of Tier I capital toward total capital was at least 50 percent (Peek and Rosengren 1999).

Furthermore, general loan loss reserves[69], dated subordinated debt and dated preferred stocks were included in the calculation of Tier II capital. Also since 1998, up to 45 percent of any land revaluation was countable toward Tier II. In March 1999, banks were allowed to include deferred tax assets in calculating Tier 1 capital ratios.
It is been suggested that some of these changes[70] in the calculation of the capital ratios was in response to the difficulties that banks faced in late 1990's in meeting the regulatory capital standards. As stated above, when Basel I was a first introduced Japanese banks had no problems in adjusting their capital ratios partly due to the above mentioned factors and partly because they had already raised capital in the market, by issuing equity, when market conditions were booming. In fact at the time, Japanese banks held nearly one-fifth of the total Japanese common stock (Peek and

[67] Prior to the introduction of the mark-to-market accounting approach in 2001, banks were able to choose between these two methods. Before 1997, Japanese banks used the market value approach to value their stock holdings.
[68] Referring to a study conducted by Fukao (1998), the authors claim that the market value of stocks held by banks at the time was 56.4 trillion yen, whereas the book value was 34.5 trillion yen.
[69] For the Basel capital requirements, the general loan loss reserve that counts toward Tier II capital is limited up to 1.25 percent of risk-weighted asset.
[70] Specifically, the option to choose what accounting method (fair or market method) to use when valuing the securities held and the inclusion of the 45 percent of land revaluation toward Tier II.

Rosengren 1999). Thus the collapse of the stock market had a significant impact on banks' capital. Another factor contributing to the (temporary) decline of some of the banks in Japan was the large proportion of non-performing loans.

Nevertheless, as in the case of US banks[71], some of the Japanese banks that failed during the crisis had reported high capital ratios prior to their collapse. Hokkaido Takushoku Bank had one of the highest capital ratios amongst city banks, of 9.34 percent, months before its demise. Similarly, LTCB that failed in October 1998 reported a 10.34 percent Tier I capital ratio in March that year. Japan Credit Bank, another bank that failed in December 1998, had a Tier I capital ratio of 8.19 percent two months before its collapse. In line with others, Harada and Ito (2008), argue that this was due to the way capital ratios were calculated. For example, the use of subordinated debt toward Tier II and loan misclassification[72], together with the inclusion of tax deferred in Tier I capital, overstated their true capital ratios.

The practice of double gearing (explained in chapter 3) between banks and insurance companies also helped Japanese banks increase their equity capital in order to meet Basel I capital requirements standards. Banks issued to insurance companies substantial amount of subordinated debt, which counts towards Tier II capital.

[71]For example, Lehman Brothers had a Tier I capital of 11 percent two weeks before its demise in 2008

[72] Because banks were reluctant to classify a large amount of non-performing loans, resulted in inadequate loan loss reserves

The problem whether the recorded capital ratios of Japanese banks during the crisis reflect their true value, could indeed be a major concern in the research of this dissertation. However, because no other data is available, this supposition is ruled out and their published capital ratios are taken to show their true value. Also this research uses Tier I capital as a measure for capital adequacy so any practices undertaken by banks to boost their Tier II capital ratios does not effect the results.

6.3 Methodology

The same methodology as in the previous chapter is employed here to estimate the probability of bank default applied to a sample of Japanese banks, for the period 1998-2000. In contrast to the pervious chapter, due to data limitation[73], the following simple logit model is estimated using only Tier I capital ratios as explanatory variable:

$$Log\ \left[\frac{P_i}{(1-P_i)}\right] = \beta_0 + \beta_1 TierI + \ \beta_2\, size + \delta_1 y99 + \delta_2 y00 + u \qquad (6.1)$$

The model also includes a dummy variable, β_2, to account for bank size, and two year dummy variables, δ_1 and δ_2, to allow the intercept to differ across years.

[73] Bankscope database provides limited information for some of the Japanese banks used in this analysis. Whilst other various sources we used to construct the dataset the information was still limited and only Tier I capital ratios for some banks were available.

The literature provides enough evidence to support the simple model used in this research. For example, Estrella et al (2000), state that a simple model using only capital ratios as sole predictor can accurately predict bank failure. Similarly Jagtiani et al (2003), provide empirical evidence that a simple model using only lagged capital ratio and lagged change in capital ratio as explanatory variable to predict bank failure performs better than a multivariate logit model using 48 different financial ratios as explanatory variables.

The same classification criteria as in the previous chapter is used here, in which the conditions for a bank to be considered as failure are: 1) bank that failed for Chapter 11 bankruptcy protection; 2) was seized by the government or financial institutions and 3) merged with another bank or 4) is still operating because of a government bailout which otherwise would not be. For bank regulatory target capital adequacy ratio the Tier I capital ratio is used, obtained mainly from Bankscope database[74].

6.3.1 Sample summary

Banks that failed during the 1998-2000 period are included in this research. This period was chosen to reflect the large the number of bank failures as well the massive

[74] For some banks the following sources were used to construct the dataset used in this research. 1998 Tier I capital ratio for : Nippon Trust Bank; Fuji Bank; Daiwa Bank; Sanwa Bank; Industrial Bank of Japan; Long-Term Credit Bank; Yasuda Trust; and Toyo Trust were obtained from Kanaya and Woo (2001). 1999 Tier I capital ratio for: Fuji; Daiwa, Sanwa and Industrial Bank of Japan was obtained from Suzuki (2006). The rest of the data was obtained form Bankscope.

government financial aid that the banking system received in order to be able to survive. The period under consideration is mainly due to data limitation. Firstly, banks' Tier 1 capital ratio data prior to 1998 was difficult to obtain[75]. Secondly, most banks merged after 2000; therefore their individual data no longer exist. Because of these restrictions the model is limited to a three-year period with a total of 57 observations. According to the classification criteria, outlined above, there were 12 bank failures out of 57 observations, thus the frequency rate for failure is 21 percent (Table 6.3.1-1). The dummy variable takes the value zero for banks that have failed and the value one if the bank has not failed. A bank is defined as failed in a particular year, when it meets one of the above criteria, and its last reported Tier I capital ratio was in the previous year.

Before the Big Bang reforms there were four types of banks in the Japanese banking: city banks, regional banks, trust banks and long-term credit banks.

City banks, the largest groups, are commercial banks that operated throughout the country, with some even having oversees branches. They are the main lenders to Japanese corporations, mainly by extending short-term loans (Flath 2005). In 2003, city banks held more than 25 percent of the deposits and around 28 percent of credits were supplied by these banks (Bou-Said and Saucier 2003).

[75] Bankscope database only provides information for a very few banks prior to this year

Regional banks conduct the same activities as city banks but have branches only in one of the Japanese prefectures, and tend to provide finance to smaller companies. They are also a major source of finance to city banks in the interbank market. Some of the Japanese regional banks are as large as city banks (Flath 2005).

Trust banks are somewhat different from city banks and regional banks. A distinguishing activity between them is that trust banks were allowed to manage trusts and corporate pension funds. They were originally funded mainly by accepting trust deposits, such as ‘money trust deposits’, which are nearly the same as passbook savings accounts, and ‘loan trust deposits’, which are trust certificates with maturities varying between two to three years (Flath 2005).

Long-term credit banks specialized in providing long- term credit mainly to large corporations. They were mainly funded by issuing debentures with one year and five year maturities. The amount of issuance however was limited up to 30 times of the capital held by them (Bou-Said and Saucier 2003).

The sample data used in this chapter consist of nine city banks, seven trust banks, six regional banks and two long-term credit banks. Regardless of the different types of banks that characterise the Japanese banking sector, the banks size dummy variable is constructed based on the asset size, as in chapter 5. Banks with asset value of 10 trillion yen or less are classifies as small-medium banks and those that exceed the 10 trillion yen are classified as big banks.

Table 6.3.1-1 Sample Summary

Year of failure/non-failure	Number of non-failed banks	Number of failed banks	% of banks that failed	Total number of banks
1998	17	2	10.5	19
1999	15	6	28.5	21
2000	13	4	23.5	17
Total	45	12	21.0	57

The dataset used in this study is a pooled cross-section between 1998 and 2000. An individual bank can appear as a separate observation in each sample year. Data contains 57 observations, which includes 24 individual banks. Table 6.3.1-1 provides the sample summary of the data used in the analysis.

As can be seen, in 1998 two banks are classified as failures. It is worth noting here that all major banks received a standard 100 billion yen of capital injection in 1998, which makes it difficult to apply the fourth classification criteria to determine the failure of an individual bank. The two banks that are identified as failed in 1998 are: Long Term Credit Bank and Yasuda Trust. The former was temporarily nationalised in October 1998, and a month later, Fuji and Dai-Ichi Kangyo banks announced the take over of Yasuda Trust.

Table 6.3.1-2 Banks included in the sample

	Failed Banks	**Non-Failed Banks**

1	Dai-Ichi Kangyo Bank	Sumitomo Bank Ltd
2	Asahi bank	Sumitomo Trust
3	Sakura bank	Tokyo Mitsubishi
4	Tokai	Daiwa
5	Nippon Trust bank	Sanwa
6	Mitsubishi Trust	Toyo
7	Fuji	Bank of Yokohoma
8	Industrial Bank of Japan	Hokkaido bank
9	LTCB	Bank of Fukuoka
10	Mitsui Trust	Shiga bank
11	Yasuda	Ashikaga
12	Chuo Trust	Gunma

The number of bank failures was highest in 1999. Dai-ichi Kangyo, Fuji Bank and Industrial Bank of Japan announced their merger plans in August 1999. Therefore all these three banks are classified as failed. Similarly, Mitsui Trust and Chuo Trust are also classified as failed as on the same year they announced their agreement to merge. There was another merger announcement on October of the same year, that of Sumitomo Bank and Sakura Bank. This announcement was seen as a rescue for

Sakura Bank, which faced greater financial difficulties than Sumitomo Bank (CNNMoney 1999). The bank was reported to have had bad loan problems amounting to 1.8 trillion yen on March 31 1999. Therefore, only Sakura Bank is classified as failed.

Another reinforcing fact for choosing these banks as failed is the amount of capital funds they received in March 1999. For example, Fuji Bank received the largest capital injection, a total of 1000 billion yen, followed by Dai-Ichi Kangyo with 900 billion yen. Sakura Bank also was among the highest receivers of government funds with 800 billion yen (Montgomery and Shimizutani2009).

In March 2000, Sanwa, Asahi and Tokai banks announced their plans to establish a joint holding company, creating the second biggest Japanese institution at the time worth $1 trillion (Chicago Tribune 2000). There is no data available in Bankscope database for Sanwa Bank in 2000; hence only Asahi[76] and Tokai are classified as 'failed' (and Sanwa bank for this year is dropped from the dataset). A month later, Mitsubishi, Nippon and Tokyo Trust banks announced their plans to merge. Together with Tokyo Mitsubishi Bank they were to create a joint holding company (Kawai 2003). Because there is no data available for Tokyo Trust only Nippon and Mitsubishi Trust are identified as failure in 2000.

[76] Even though Asahi did not go through with the merger, because the announcement is taken as an indication of failure, this research treats this case as one.

6.3.2 Descriptive Statistics

Table 6.3.2-1 presents summary statistics for the Tier I capital ratio and bank size dummy. Banks included in the sample are divided into two groups, failed and non-failed, and the t-test of the mean is calculated.

Table 6.3.2-1 Tier I ratio variable mean used in the sample

	All banks	Failed	Non-Failed	Difference in Mean	T-test on the difference
Tier I capital ratio	6.233684	6.946667	6.043556	-0.9031111	-1.9524[77]
Bank size	0.5789474	0.5833333	0.5777778	-0.0055556	-0.0340

The mean Tier I capital ratio of banks that failed is higher than that of banks that survived. The t-test mean difference is significant at a 5 percent significance level, so the null hypothesis of equal difference in the mean is rejected. Put differently, the mean of Tier I capital ratio of failed banks is different from that of non-failed banks. The banks size dummy variable is not statistically significant, indicating that the likelihood of failure is the same for all banks, regardless of their size.

6.4 Results

The logit model estimates the probability of bank failure as a function of Tier I capital

[77] Significant at the 5 percent level

ratio, banks size dummy[78] and year dummies[79]. The latter are included in the model to allow the intercept to differ across years. The results of the estimated logit model[80] are presented below:

Table 6.4-1 Logit Model

	Coefficient	Robust SE	Marginal effect
Tier I capital ratio	0.528**	0.248	0.077
Year dummy: 1999	0.760	1.002	0.001
Year dummy: 2000	0.421	1.183	0.065
Bank size dummy	0.648	0.632	0.092
Constant	-5.595*	1.767	-
Number of observations= 57; Wald $X^2(4)$= 8.43; p> X^2=0.07; pseudo R^2=.094; log-likelihood= -26.570 *, **, Correspond to the 1% and 5% significance level, respectively			

As in the case of US, the coefficient associated with Tier I capital ratio is positive and statistically significant. This positive relationship implies that banks with higher

[79] The base year is 1998
[80] The Pearson X^2 goodness of fit test used reveals that the number of covariate patters is the same as the number of observations therefore the Hosmer and Lemeshow goodness of fit test with 10 groups is used. The Homser and Lemeshow goodness of fit, obtained by calculating the percentiles of the estimates probabilities, shows that the model fits the data reasonably well. The output of the test are as follows: X^2 (8)= =8.53, prob>X^2= 0.38 (See Appendix 5)

capital ratios have a higher probability of default. This findings support yet again the hypothesis of this research, under the capital market inflation theory framework. Table 6.4-1 shows the marginal effect of Tier I capital on the probability of banks default. As can be seen, the marginal effect associates with Tier I capital ratio implies that a one percentage increase in Tier I capital ratio increases the probability of a bank default in the next year by 7.7 percentage points. The year dummies are both statistically insignificant, thus the probability of default was the same in both years. Also the bank size is not statistically significant, implying that size is not a factor in predicting the likelihood of bank failure.

In order to determine the ability of the model to correctly predict probabilities the fraction of bank failure in the sample data is used, as opposed to the commonly used value of 0.5. The results are presented in Table 6.4-2.

Table 6.4-2 Model predicting accuracy

Classified	Failed	Non-failed	Total
+	8	18	26
-	4	27	31
Total	12	45	57
Sensitivity	p(+failed)	66.67%	
Specificity	p(-non-failed)	60%	
Positive predictive value	p(failed+)	30.77%	
Negative predictive value	p(non-failed-)	87.10%	
Correctly classified		61.40%	
Classified + if predicted p *(*failed) ≥0.21(i.e. symmetric loss function)’ non-failed denotes failure=0			

The model's overall accuracy of forecasting is 61.4 percent at a cut off point of 0.21[81]. The threshold value for the cutoff point was used in accordance to the proportion of bank failure in the sample data (see Table 6.3.1-1). The model failed to accurately predict 4 of the 12 failed banks, and mistakenly predicted 18 of the 45 sound banks as failure.

Figure 6.4-1 Area under receiver ROC- Japan logit model

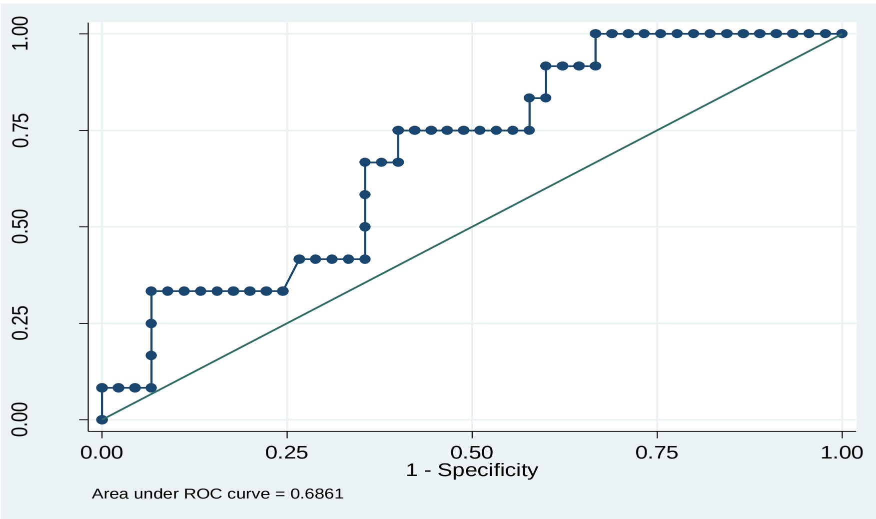

Figure 6.4-1 shows the area under the ROC curve, which is 0.6861. As discussed in Chapter 5, an AUC above 0.5 is needed in order for the model to have some predictability power. However, an AUC value between 07 and 0.8 is the considered acceptable discrimination, which clearly is not obtained in the case of Japan. This implies that the simple logit model in this chapter does not have a high predictability power to discriminate between banks that have failed and have not failed. This could be due to the relatively small sample of banks included in the model. In other words

[81] The overall classification of the model at a 0.5 cutoff point is just over 80 percent, with a sensitivity of 8.33 percent and specificity of 100 percent.

the small sample may be a factor that limits the ability of the model to accurately discriminate between failed and non-failed banks.

6.5 Concluding remarks

The empirical evidence of both Japanese and US bank failures presented in this chapter and the previous one support the hypothesis of this research, that a bank with higher capital ratio has a higher probability of default than a bank with a lower Tier I capital ratio. These findings are in contrast with the common belief that higher capital ratios serve as a cushion to withstand any unanticipated losses, thus lowering banks probability of default. It has been argued that the reason for this is that, when banks raise capital by issuing equity under conditions of capital market deflation, they drain out the long-term finance that corporations need to conduct their business operations, thus limiting their productive investment potential.

Another common characteristic of the crisis in Japan in the 1990s and in US in 2007-09 is the subsequent lower productive investment by firms in both countries. In relation to Japan, Shimziu (2007) argues that when regulators impose higher capital requirements banks reduce their lending to firms so firms reduce their investment. Toporowski argues that firms that cannot refinance their debts into equity reduce investment. In the case of Japan this phenomenon is more evident and linked to debt overhang from dissolution of keiratsu explained above.

6.6 Data Appendix

Table 6.6 Data used to estimate the logit model in Chapter 6

	Tier 1 Capital Ratio	Banks
1998	4.63	Dai-Ichi Kangyo
1998	4.69	Asahi
1998	4.56	Sakura
1998	5.41	Tokai
1998	4.76	Sumitomo Bank
1998	9.26	Nippon Trust Bank
1998	5.27	Sumitomo Trust
1998	4.65	Tokyo Mitsubishi
1998	5.92	Mitsubishi Trust
1998	4.79	Fuji
1998	5.35	Daiwa
1998	4.8	Sanwa
1998	4.95	Industrial Bank of Japan
1998	5.16	LTCB
1998	6.02	Mitsui Trust
1998	7.14	Yasuda
1998	5.78	Toyo
1998	7.95	Chuo Trust
1998	4.83	Bank of Yokohoma
1999	5.86	Dai-Ichi Kangyo
1999	6.3	Asahi
1999	7.23	Sakura
1999	7.75	Tokai
1999	5.58	Sumitomo Bank
1999	7.55	Nippon Trust Bank
1999	7.11	Sumitomo Trust
1999	5.99	Tokyo Mitsubishi
1999	7.46	Mitsubishi Trust
1999	5.7	Fuji
1999	7.8	Daiwa
1999	6	Sanwa
1999	5.99	Industrial Bank of Japan
1999	9.34	Mitsui Trust
1999	8.85	Chuo Trust
1999	5.04	Bank of Yokohoma
1999	6.23	Bank of Fukuoka

1999	2.41	Hokkaido bank
1999	6.59	Shiga bank
1999	2.15	Ashikaga
1999	7.14	Gunma
2000	6.1	Dai-Ichi Kangyo
2000	6.43	Asahi
2000	7.46	Sakura
2000	7.9	Tokai
2000	5.88	Sumitomo Bank
2000	6.49	Nippon Trust Bank
2000	6.63	Sumitomo Trust
2000	6.53	Tokyo Mitsubishi
2000	7.27	Mitsubishi Trust
2000	9.59	Mitsui Trust
2000	6.04	Chuo Trust
2000	5.67	Bank of Yokohoma
2000	6.86	Bank of Fukuoka
2000	5.42	Hokkaido bank
2000	6.89	Shiga bank
2000	6.43	Ashikaga
2000	7.74	Gunma

Chapter 7. Conclusion

This thesis has empirically examined the impact of capital adequacy regulation on the probabilities of bank default and has theoretically analysed the impact of such regulation on the economy as a whole. The analysis began by giving an overview of how the capital markets actually work, with a particular focus on explaining how it links the sectors of the economy. Understanding such link and the market conditions in which banks operate provides a platform from which the impact of the Basel capital requirements on banks at an individual level can be examined.

The US and Japan case studies chosen in this thesis to examine the impact of capital adequacy regulation on the probabilities of bank default are not without intention. Firstly is the large number of bank failures during the periods under consideration, US during the latest crisis starting in 2007 and Japan during the 1990s, which has perhaps been the most revealing hint in doubting the effectiveness of capital adequacy regulation in promoting a safe and sound financial system. The large number of bank failures occurred despite the fact that most banks not only met the Basel capital standards, but also held capital in excess to the regulatory requirements. Secondly, during these periods, the banking crisis and the subsequent recessions, both countries experienced a significant decline in private investment. The previously inflated capital markets fostered a delusion that capital adequacy is the most effective prudential regulation of the banking system.

This concluding chapter provides a concise summary of the research conducted in this thesis. The evidence provided in this thesis suggests that capital adequacy regulation gives misleading signals about the soundness of banks. Therefore, it is argued that such regulation is theoretically flawed, taking no account how banks are overcapitalised, or put differently it takes no account of balance sheet reconstruction to achieve overcapitalisation. Some of the implications associated with the current framework of bank capital regulation are discussed in section 2. Section 3 reflects on the empirical results presented in this thesis, and provides recommendations for future regulatory capital requirements, using the ideas put forward by both Toporowski and Minsky.

7.1 Summing up

This thesis consists of 7 chapters. The first chapter gave an outline of the objectives, motivations, the methodological approach and the structure of the thesis. The second chapter gave an historical background of the Basel Accords, together with the literature review on capital adequacy regulation. Two fundamental flaws were identified in this chapter in relation to the existing literature: the first one is the lack of the literature in providing empirical evidence on the impact of Tier I capital ratios on the probabilities of bank default and the second one concerns the lack of the literature in providing an analysis of the impact of such regulation that considers the economic system as a whole.

Chapter 3 presented a detailed explanation of the theoretical aspects of the capital market inflation theory. It then developed a simple model to estimate stock price movements taking into account the net excess inflows into the capital market. The net excess inflows is calculated using the demand and supply for equity capital, derived from the flow of funds accounts. The demand for equity capital represents issues of equity capital from the non-financial and financial sector. The supply for equity capital represents purchases of corporate equity from the household, institutional investors and the external sector. The results of the time series regression provide evidence that the excess supply of capital does affect stock price movements. However, whilst these results empirically validate the assumptions of the capital market inflation theory when applied to the US, the model does not yield the same results when applied to the Japanese capital market. Various factors were highlighted which could explain such results. In particular the Japanese central bank purchases of shares and other equities were argued and shown empirically to have a positive effect on the Nikkei 225 stock price index. This on the other hand suggests that these purchases offset private sector outflows of credit form the capital market. Therefore, capital market inflation theory may still be valid in this case.

The purpose of this chapter was to provide a platform from which the effectiveness of the capital adequacy regulation in promoting the soundness of the banking sector can be examined. An effective analysis for banking distress cannot be conducted by considering the banking sector in isolation from the other sectors in the economy. Therefore it is imperative to understand how a capitalist economy works, the development is other sectors of the economy and how these sectors are linked, in order to better examine the behaviour and soundness of banks, given any capital regulatory restrictions.

From a macro-perspective the capital market inflation theory argument is that in conditions of capital supply rationing bank overcapitalisation makes the financial system in *general* more fragile, because it crowds out available capital for non-financial firms. This fragility then appears as growing risky debt in the banking system. This statement, which is supported empirically in this thesis, is then used to explain the probability of default of individual banks.

The discussion on the shadow banking system, presented in chapter 4, enters as a way in which banks 'dress-up' their balance sheets by transferring those risky assets in the non-bank subsidiaries. In this way shadow banking, provides an explanation of how banks respond to the growing riskiness of their assets.

Chapter 5 provides an empirical evaluation of the relationship between capital adequacy ratios, and the probability of default of US banks. The analysis employs a logit model to estimate the probability of bank default on a pooled cross sectional data over the period 2007-2009. The results imply that a 1 percentage point in Tier I capital ratios increases the probability of default by 1.8 percentage points. In contrary a 1 percentage point increase in the unweighted capital ratios lowers the probability of default by 2.7 percentage points. It was argued that the unweighted capital ratio coefficient is the effect of illiquidity in the market for relatively risk-free assets, whereas the risk-weighted capital ratio, i.e. Tier 1 capital ratio, is the effect of crowding out in the capital market. In other words the current risk-weighted capital requirement account only for risk of insolvency, ignoring the risk of illiquidity in the capital market.

Similarly, chapter 6 provides empirical evidence on the impact of capital adequacy regulation on the probability of default of Japanese banks, over the period 1998-2000, using the same methodology as in chapter 5. However, due to data limitation only risk-weighted capital ratio was used to estimate the probability of bank default. The results indicate that when Tier I capital ratio is increased by 1 percentage point, banks probability of default increases by 7.7 percentage points.

7.2 Some further comments

This thesis has provided empirical evidence arguing against the capital adequacy regulation currently placed on banks. However, despite this, it is of great importance to stress that in this thesis, these results do not provide evidence against such regulation per se. Rather these results provide evidence against the *framework* of capital adequacy regulation. In other words this thesis does not advocate restricting banking regulation, i.e. a lighter regulatory regime, but it rather argues that any regulatory restrictions placed on banks need to take into account developments in other sectors of the economy and on the fringes of the banking system itself.

The banking sector is closely connected to all sectors in the economy, by means of providing credit and liquidity. Perhaps the most important role of all of the banking sector, is the provision of credit to facilitate investment expenditure, with the latter being a crucial component of aggregate demand. Therefore, any factor limiting the willingness and ability of banks to increase the money supply and credit is bound to have a direct effect of the level of investment, and hence on economic activity. However the banking sector is connected with other sectors in the economy also on its liability side, especially in the most developed economies, as argued in this thesis. This way, in which the activities of the banking sector affect the rest of the economy should not be ignored.

7.3 Recommendations for future regulatory capital standards

As outlined above this thesis argues that capital adequacy regulation is theoretically flawed. Therefore, this thesis suggests that theory on banking regulation needs to move beyond an unsophisticated model of a single bank balance sheet to a more complex view of how bank balance sheets are integrated with other balance sheet in the economy. This section borrows the ideas put forward by Toporowski and Minsky to provide recommendations that should be taken into account when placing regulatory standards on banks.

As a recommendation tool for banking regualtion, an important argument that is derived from Toporowski's argument against the Basel capital requirements is bank heterogeneity. He states that 'The strategy of securing banks stability by enforcing capital adequacy is based on a fallacy of composition: what is good for one bank is not necessarily good for all banks taken together' (Toporowski 2009, pg. 1). This line of reasoning is also given by Minsky (1967, 1975a). As explained in chapter 2, Minsky suggests a bank examination approach in order to determine an exact appropriate level of capital and liquidity for a bank. His argument is built upon the suggestion that each bank needs to be assessed individually. Minsky states 'the liquidity of an institution cannot be measured by assigning universal predetermined liquidity quotients to assets and similar liquidity requirement factors to liability' (Minsky 1967, pg.6). However, the information obtained from each bank then needs to be incorporated with market aggregates. That is because, 'liquidity is not an innate attribute of an asset but rather that liquidity is a time related characteristic of an ongoing, continuing economic institutions' (Minsky 1967, pg. 6).

In order to better determine the liquidity needs of a particular bank it is necessary not only to examine its initial balance sheet but also to estimate cash flows taking into account future economic conditions that are likely to effect the banks' ability to adjust its cash position[82]. This way, regulatory bodies would be better informed not only on the financial position of a particular bank but also would have a more in depth

[82] Minsky notes that banks generate cash flows not only from ordinary operations but also by operating in asset and liability markets. He refers to the activities that banks undertake to adjust their cash position as position- making activities.

knowledge on their operation activities as well as on their interactions with other financial institutions, and most importantly with shadow banks which Minsky called ‘fringe banks’. The importance of the latter point was highlighted in Chapter 4, in which it was argued that prior to the 2008 financial crisis US regulatory bodies had little knowledge on the banks interactions with the shadow banking system. Examining bank’s balance sheet will not only serve to gather accurate information about the position making ability of a particular bank and the interactions with other financial institutions but will also reveal the connections it has with other sectors in the economy. When all data is generated for each individual bank is then aggregated to give a real picture of all markets in which banks operate.

This thesis advocates a banking framework proposed by Minsky, which recognizes that the ability of banks to convert assets into cash, thereby the ability of banks to be liquid is more important than raising capital, which has major implications for the productive investment process by non-financial corporations. But this is not to say that this is the full remedy for promoting stability in the economy. Whilst regulating the banking sector is indeed an importance task for governments, other sectors in the economy could also benefit from government monitoring. The monitoring process here is meant to say, not heavily regulating for example the non-financial corporate sector or institutional investors, but is intended to say that if governments were better informed on their business activities it can give them better information and assist in finding ways to discourage their over-reliance on the financial markets to continue their business operations. As Toporowski (2009b) states, ‘Economic activity must be reorganised to make the real economy more stable and financial markets more boring, so that enterprise is focussed on innovations that enhance welfare, rather than financial inflation' (2009, pg. 9).

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Appendices

Appendix 1. Capital market inflation theory – Empirical Results

Dlprice- first difference of log S&P 500 stock index price

SD- excess supply of capital (supply –demand)

Table A1-1 S&P 500 stock price index price estimation- US (in million $)

Dependent Variable: DLPRICE
Method: Least Squares
Date: 04/24/13 Time: 20:55
Sample (adjusted): 1965 2010
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.066081	0.024068	2.745592	0.0088
SD	5.26E-06	2.66E-06	1.978937	0.0543
SD^2	1.80E-11	9.85E-12	1.827952	0.0745

R-squared	0.088018	Mean dependent var	0.058880
Adjusted R-squared	0.045600	S.D. dependent var	0.163986
S.E. of regression	0.160203	Akaike info criterion	-0.761754
Sum squared resid	1.103598	Schwarz criterion	-0.642495
Log likelihood	20.52034	F-statistic	2.075032
Durbin-Watson stat	1.984064	Prob(F-statistic)	0.137944

Table A1-2- ADF stationary test for first difference of log price index

Null Hypothesis: DLPRICE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.705683	0.0000
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLPRICE)
Method: Least Squares
Date: 20/02/15 Time: 09:34
Sample (adjusted): 1966 2010
Included observations: 45 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLPRICE(-1)	-1.029219	0.153485	-6.705683	0.0000
C	0.059389	0.026400	2.249554	0.0297

R-squared	0.511176	Mean dependent var	0.001913
Adjusted R-squared	0.499808	S.D. dependent var	0.236841
S.E. of regression	0.167504	Akaike info criterion	-0.692188
Sum squared resid	1.206482	Schwarz criterion	-0.611892
Log likelihood	17.57423	Hannan-Quinn criter.	-0.662254
F-statistic	44.96618	Durbin-Watson stat	1.997525
Prob(F-statistic)	0.000000		

Table A1-3-PP stationary test for first difference of log price index

Null Hypothesis: DLPRICE has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.705580	0.0000
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.026811
HAC corrected variance (Bartlett kernel)	0.026660

Phillips-Perron Test Equation
Dependent Variable: D(DLPRICE)
Method: Least Squares
Date: 20/02/15 Time: 09:34

Sample (adjusted): 1966 2010
Included observations: 45 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLPRICE(-1)	-1.029219	0.153485	-6.705683	0.0000
C	0.059389	0.026400	2.249554	0.0297

R-squared	0.511176	Mean dependent var	0.001913
Adjusted R-squared	0.499808	S.D. dependent var	0.236841
S.E. of regression	0.167504	Akaike info criterion	-0.692188
Sum squared resid	1.206482	Schwarz criterion	-0.611892
Log likelihood	17.57423	Hannan-Quinn criter.	-0.662254
F-statistic	44.96618	Durbin-Watson stat	1.997525
Prob(F-statistic)	0.000000		

Table A1-4 KPSS stationary test for first difference of log price index

Null Hypothesis: DLPRICE is stationary
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.138124
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.026307
HAC corrected variance (Bartlett kernel)	0.022806

KPSS Test Equation
Dependent Variable: DLPRICE
Method: Least Squares
Date: 20/02/15 Time: 09:35
Sample (adjusted): 1965 2010
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.058880	0.024178	2.435236	0.0189

R-squared	0.000000	Mean dependent var	0.058880
Adjusted R-squared	0.000000	S.D. dependent var	0.163986

S.E. of regression	0.163986	Akaike info criterion	-0.756575
Sum squared resid	1.210110	Schwarz criterion	-0.716822
Log likelihood	18.40123	Hannan-Quinn criter.	-0.741683
Durbin-Watson stat	2.039728		

Table A1-5- ADF stationary test for net inflows

Null Hypothesis: SD has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.444823	0.5499
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SD)
Method: Least Squares
Date: 20/02/15 Time: 09:36
Sample (adjusted): 1974 2010
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SD(-1)	-4.139693	2.865190	-1.444823	0.1605
D(SD(-1))	3.515732	2.772233	1.268195	0.2160
D(SD(-2))	3.460042	2.749070	1.258623	0.2194
D(SD(-3))	-0.305918	2.674906	-0.114366	0.9098
D(SD(-4))	3.103018	2.187388	1.418595	0.1679
D(SD(-5))	1.110718	2.188681	0.507483	0.6161
D(SD(-6))	-0.570240	2.019830	-0.282321	0.7799
D(SD(-7))	0.424374	1.496439	0.283589	0.7790
D(SD(-8))	4.405098	1.323372	3.328692	0.0026
D(SD(-9))	-5.013828	1.620706	-3.093608	0.0047
C	-9176.342	6125.325	-1.498099	0.1462

R-squared	0.851557	Mean dependent var	397.8378
Adjusted R-squared	0.794464	S.D. dependent var	60983.49
S.E. of regression	27647.53	Akaike info criterion	23.53423
Sum squared resid	1.99E+10	Schwarz criterion	24.01316
Log likelihood	-424.3833	Hannan-Quinn criter.	23.70308
F-statistic	14.91517	Durbin-Watson stat	2.873109
Prob(F-statistic)	0.000000		

Table A1-6- PP stationary test for net inflows

Null Hypothesis: SD has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.685640	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.67E+09
HAC corrected variance (Bartlett kernel)	1.47E+09

Phillips-Perron Test Equation
Dependent Variable: D(SD)
Method: Least Squares
Date: 20/02/15 Time: 09:36
Sample (adjusted): 1965 2010
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SD(-1)	-0.858438	0.149650	-5.736317	0.0000
C	-6290.229	6258.666	-1.005043	0.3204

R-squared	0.427868	Mean dependent var	313.0435
Adjusted R-squared	0.414865	S.D. dependent var	54545.59
S.E. of regression	41724.17	Akaike info criterion	24.15805
Sum squared resid	7.66E+10	Schwarz criterion	24.23756
Log likelihood	-553.6352	Hannan-Quinn criter.	24.18784
F-statistic	32.90533	Durbin-Watson stat	1.952019
Prob(F-statistic)	0.000001		

Table A1-7- KPSS stationary test for net inflows

Null Hypothesis: SD is stationary
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.291585
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1.66E+09
HAC corrected variance (Bartlett kernel)	1.90E+09

KPSS Test Equation
Dependent Variable: SD
Method: Least Squares
Date: 20/02/15 Time: 09:37
Sample: 1964 2010
Included observations: 47

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7224.362	6014.533	-1.201151	0.2358

R-squared	0.000000	Mean dependent var	-7224.362
Adjusted R-squared	0.000000	S.D. dependent var	41233.56
S.E. of regression	41233.56	Akaike info criterion	24.11294
Sum squared resid	7.82E+10	Schwarz criterion	24.15230
Log likelihood	-565.6541	Hannan-Quinn criter.	24.12775
Durbin-Watson stat	1.711934		

Table A1-8 Granger causality – 2 lags

Pairwise Granger Causality Tests
Date: 09/22/14 Time: 12:38
Sample: 1964 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
DLPRICE does not Granger Cause SD	44	0.02556	0.97478
SD does not Granger Cause DLPRICE		5.04214	0.01128

Table A1-9 Granger causality – 4 lags

Pairwise Granger Causality Tests
Date: 20/02/15 Time: 09:39
Sample: 1964 2010
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DLPRICE does not Granger Cause SD	42	0.32119	0.8617
SD does not Granger Cause DLPRICE		3.63288	0.0147

Table A1-10 Granger causality – 1 lag

Pairwise Granger Causality Tests
Date: 20/02/15 Time: 09:41
Sample: 1964 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
DLPRICE does not Granger Cause SD	45	0.34576	0.5597
SD does not Granger Cause DLPRICE		8.67153	0.0052

Table A1-11 Ramsey Reset Test

Ramsey RESET Test:

F-statistic	3.381462	Probability	0.043486
Log likelihood ratio	6.867831	Probability	0.032260

Test Equation:
Dependent Variable: DLPRICE
Method: Least Squares
Date: 04/25/13 Time: 00:27
Sample: 1965 2010
Included observations: 46

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.295721	0.309877	0.954318	0.3454

SDB	0.015019	0.007872	1.907888	0.0633
FITTED^2	236.3397	100.2745	2.356927	0.0232
FITTED^3	-4653.613	2582.586	-1.801920	0.0787

R-squared	0.153462	Mean dependent var	0.058880
Adjusted R-squared	0.092995	S.D. dependent var	0.163986
S.E. of regression	0.156175	Akaike info criterion	-0.792740
Sum squared resid	1.024404	Schwarz criterion	-0.633728
Log likelihood	22.23303	F-statistic	2.537945
Durbin-Watson stat	1.896101	Prob(F-statistic)	0.069436

Table A1-12 Test for autocorrelation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.342554	Probability	0.711967
Obs*R-squared	0.756024	Probability	0.685222

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/22/14 Time: 12:41
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000830	0.024477	0.033894	0.9731
SD	3.38E-08	2.73E-06	0.012372	0.9902
SD^2	3.78E-14	1.01E-11	0.003743	0.9970
RESID(-1)	0.009027	0.157177	0.057433	0.9545
RESID(-2)	-0.132939	0.160787	-0.826804	0.4131

R-squared	0.016435	Mean dependent var	1.22E-17
Adjusted R-squared	-0.079522	S.D. dependent var	0.156603
S.E. of regression	0.162710	Akaike info criterion	-0.691369
Sum squared resid	1.085460	Schwarz criterion	-0.492604
Log likelihood	20.90149	F-statistic	0.171277
Durbin-Watson stat	1.962539	Prob(F-statistic)	0.951846

Table A1-13 Test for heteroskedasticity

White Heteroskedasticity Test:

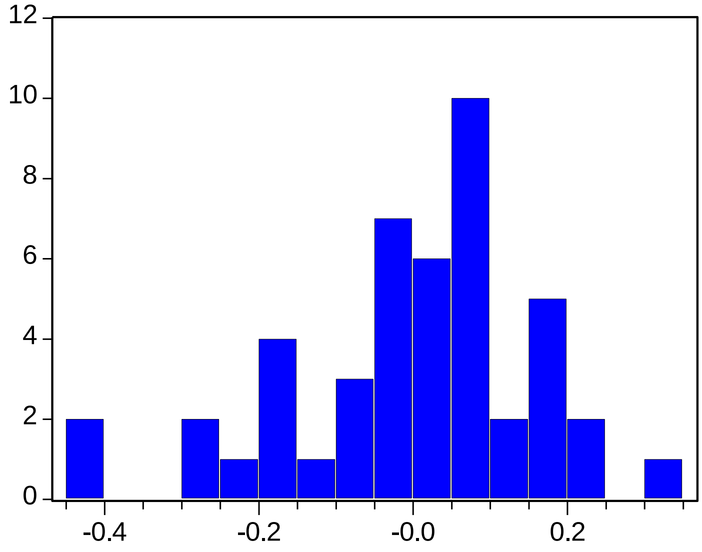
F-statistic	1.278351	Probability	0.294183
Obs*R-squared	3.848855	Probability	0.278254

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/10/15 Time: 15:35
Sample: 1965 2010
Included observations: 46

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021551	0.005709	3.775076	0.0005
SD	4.09E-07	7.61E-07	0.537107	0.5940
SD^2	3.68E-11	2.22E-11	1.662643	0.1038
(SD^2)^2	-4.67E-22	2.67E-22	-1.748873	0.0876

R-squared	0.083671	Mean dependent var	0.023991
Adjusted R-squared	0.018219	S.D. dependent var	0.037072
S.E. of regression	0.036733	Akaike info criterion	-3.687363
Sum squared resid	0.056670	Schwarz criterion	-3.528351
Log likelihood	88.80935	F-statistic	1.278351
Durbin-Watson stat	1.682079	Prob(F-statistic)	0.294183

Table A1-14 Test for normality of residuals



Series: Residuals	
Sample 1965 2010	
Observations 46	
Mean	1.22e-17
Median	0.023549
Maximum	0.310716
Minimum	-0.407596
Std. Dev.	0.156603
Skewness	-0.695700
Kurtosis	3.335807
Jarque-Bera	3.926789
Probability	0.140381

Appendix 2 Capital market inflation theory- Empirical results for Japan

Table A2-1 Nikkei 225 stock price estimation

Dependent Variable: DLPRICE
Method: Least Squares
Date: 09/23/14 Time: 14:45
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015858	0.052888	0.299841	0.7665
SUPPLY-DEMAND	-1.41E-08	7.85E-07	-0.017902	0.9858

R-squared	0.000011	Mean dependent var	0.016405
Adjusted R-squared	-0.035702	S.D. dependent var	0.232250
S.E. of regression	0.236360	Akaike info criterion	0.017415
Sum squared resid	1.564243	Schwarz criterion	0.110828
Log likelihood	1.738775	F-statistic	0.000320
Durbin-Watson stat	1.699425	Prob(F-statistic)	0.985844

Table A2-2 Ramsey rest test

Ramsey RESET Test:

F-statistic	0.733431	Probability	0.489932
Log likelihood ratio	1.646511	Probability	0.439000

Test Equation:
Dependent Variable: DLPRICE
Method: Least Squares
Date: 09/23/14 Time: 14:43
Sample: 1981 2010
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-618.5187	591.3699	-1.045908	0.3052
SUPPLY-DEMAND	0.000840	0.000799	1.051217	0.3028
FITTED^2	3610679.	3467832.	1.041192	0.3074
FITTED^3	-72599398	70414989	-1.031022	0.3120

R-squared	0.053416	Mean dependent var	0.016405
Adjusted R-squared	-0.055806	S.D. dependent var	0.232250
S.E. of regression	0.238642	Akaike info criterion	0.095865
Sum squared resid	1.480705	Schwarz criterion	0.282691
Log likelihood	2.562031	F-statistic	0.489059
Durbin-Watson stat	1.943978	Prob(F-statistic)	0.692889

Figure A2-3 Test of autocorrelation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.358482	Probability	0.702136
Obs*R-squared	0.805066	Probability	0.668624

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/10/15 Time: 15:40
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012226	0.056062	0.218084	0.8291
SD	3.15E-07	8.94E-07	0.352099	0.7276
RESID(-1)	0.156662	0.209441	0.748000	0.4612
RESID(-2)	0.070988	0.226888	0.312875	0.7569

R-squared	0.026836	Mean dependent var	2.22E-17
Adjusted R-squared	-0.085453	S.D. dependent var	0.232249
S.E. of regression	0.241968	Akaike info criterion	0.123546
Sum squared resid	1.522266	Schwarz criterion	0.310372
Log likelihood	2.146808	F-statistic	0.238988
Durbin-Watson stat	1.958294	Prob(F-statistic)	0.868345

Figure A2-4 Test of heteroskedasticity

White Heteroskedasticity Test:

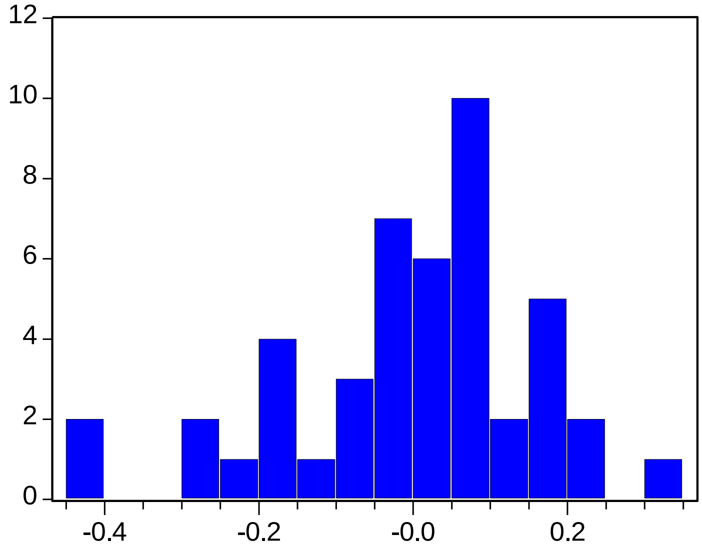
F-statistic	0.076350	Probability	0.926691
Obs*R-squared	0.168713	Probability	0.919104

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/10/15 Time: 15:40
Sample: 1981 2010
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.053577	0.015175	3.530588	0.0015
SD	-1.04E-07	3.62E-07	-0.286083	0.7770
SD^2	-1.21E-12	3.10E-12	-0.389086	0.7003

R-squared	0.005624	Mean dependent var	0.052141
Adjusted R-squared	-0.068034	S.D. dependent var	0.064423
S.E. of regression	0.066579	Akaike info criterion	-2.486225
Sum squared resid	0.119683	Schwarz criterion	-2.346105
Log likelihood	40.29338	F-statistic	0.076350
Durbin-Watson stat	2.363051	Prob(F-statistic)	0.926691

Figure A2-5 Test of heteroskedasticity



Series: Residuals
Sample 1965 2010
Observations 46

Mean	1.22e-17
Median	0.023549
Maximum	0.310716
Minimum	-0.407596
Std. Dev.	0.156603
Skewness	-0.695700
Kurtosis	3.335807
Jarque-Bera	3.926789
Probability	0.140381

Figure A2-6 ADF stationary test for first difference of log price index- NIKKEI 225

Null Hypothesis: DLPRICE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.466876	0.0014
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLPRICE)
Method: Least Squares
Date: 03/10/15 Time: 15:41
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLPRICE(-1)	-0.855935	0.191618	-4.466876	0.0001

C	0.012447	0.044220	0.281474	0.7805

R-squared	0.424957	Mean dependent var	0.002850
Adjusted R-squared	0.403659	S.D. dependent var	0.308008
S.E. of regression	0.237853	Akaike info criterion	0.032148
Sum squared resid	1.527505	Schwarz criterion	0.126444
Log likelihood	1.533856	F-statistic	19.95298
Durbin-Watson stat	1.981813	Prob(F-statistic)	0.000128

Figure A2-7 PP stationary test for first difference of log price index- NIKKEI 225

Null Hypothesis: DLPRICE has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.418312	0.0016
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.052673
HAC corrected variance (Bartlett kernel)	0.046284

Phillips-Perron Test Equation
Dependent Variable: D(DLPRICE)
Method: Least Squares
Date: 03/10/15 Time: 15:42
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLPRICE(-1)	-0.855935	0.191618	-4.466876	0.0001
C	0.012447	0.044220	0.281474	0.7805

R-squared	0.424957	Mean dependent var	0.002850

Adjusted R-squared	0.403659	S.D. dependent var	0.308008
S.E. of regression	0.237853	Akaike info criterion	0.032148
Sum squared resid	1.527505	Schwarz criterion	0.126444
Log likelihood	1.533856	F-statistic	19.95298
Durbin-Watson stat	1.981813	Prob(F-statistic)	0.000128

Figure A2-8 KPSS stationary test for first difference of log price index- NIKKEI 225

Null Hypothesis: DLPRICE is stationary
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.256698
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.052142
HAC corrected variance (Bartlett kernel)	0.064339

KPSS Test Equation
Dependent Variable: DLPRICE
Method: Least Squares
Date: 03/10/15 Time: 15:42
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016405	0.042403	0.386895	0.7017

R-squared	0.000000	Mean dependent var	0.016405
Adjusted R-squared	0.000000	S.D. dependent var	0.232250
S.E. of regression	0.232250	Akaike info criterion	-0.049240
Sum squared resid	1.564261	Schwarz criterion	-0.002534

Log likelihood	1.738604	Durbin-Watson stat	1.698288

Figure A2-9 ADF stationary test for net inflow-Japan

Null Hypothesis: SD has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.736458	0.0085
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SD)
Method: Least Squares
Date: 03/10/15 Time: 15:44
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SD(-1)	-0.695004	0.186006	-3.736458	0.0008
C	-26499.54	12488.23	-2.121962	0.0428

R-squared	0.332716	Mean dependent var	1846.267
Adjusted R-squared	0.308884	S.D. dependent var	65357.00
S.E. of regression	54333.48	Akaike info criterion	24.70801
Sum squared resid	8.27E+10	Schwarz criterion	24.80142
Log likelihood	-368.6201	F-statistic	13.96112
Durbin-Watson stat	1.783097	Prob(F-statistic)	0.000848

Figure A2-9 PP stationary test for net inflow-Japan

Null Hypothesis: SD has a unit root

Exogenous: Constant
Bandwidth: 16 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.384829	0.0196
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.76E+09
HAC corrected variance (Bartlett kernel)	1.42E+09

Phillips-Perron Test Equation
Dependent Variable: D(SD)
Method: Least Squares
Date: 03/10/15 Time: 15:46
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SD(-1)	-0.695004	0.186006	-3.736458	0.0008
C	-26499.54	12488.23	-2.121962	0.0428

R-squared	0.332716	Mean dependent var	1846.267
Adjusted R-squared	0.308884	S.D. dependent var	65357.00
S.E. of regression	54333.48	Akaike info criterion	24.70801
Sum squared resid	8.27E+10	Schwarz criterion	24.80142
Log likelihood	-368.6201	F-statistic	13.96112
Durbin-Watson stat	1.783097	Prob(F-statistic)	0.000848

Figure A2-10 KPSS stationary test for net inflow-Japan

Null Hypothesis: SD is stationary
Exogenous: Constant
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.253977
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	2.93E+09
HAC corrected variance (Bartlett kernel)	2.47E+09

KPSS Test Equation
Dependent Variable: SD
Method: Least Squares
Date: 03/10/15 Time: 15:43
Sample: 1980 2010
Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-38327.13	9888.891	-3.875776	0.0005

R-squared	0.000000	Mean dependent var	-38327.13
Adjusted R-squared	0.000000	S.D. dependent var	55059.02
S.E. of regression	55059.02	Akaike info criterion	24.70193
Sum squared resid	9.09E+10	Schwarz criterion	24.74818
Log likelihood	-381.8798	Durbin-Watson stat	1.363209

Figure A2-11 Granger causality test- 2 lags

Pairwise Granger Causality Tests
Date: 03/11/15 Time: 12:38
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
SD does not Granger Cause DLPRICE	28	0.38135	0.68717
DLPRICE does not Granger Cause SD		1.95528	0.16435

Figure A3-12 Granger causality test- 4 lags

Pairwise Granger Causality Tests
Date: 03/11/15 Time: 12:38
Sample: 1980 2010
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
SD does not Granger Cause DLPRICE	26	0.32795	0.85533
DLPRICE does not Granger Cause SD		0.89689	0.48734

Table A2-13 Japanese central bank equity purchases

Banks: commercial banks
CB: Central bank

Dependent Variable: DLPRICE
Method: Least Squares
Date: 02/10/13 Time: 03:29
Sample (adjusted): 2003 2011
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.093539	0.088831	-1.053000	0.3405
BANKS	-1.90E-06	7.32E-06	-0.259521	0.8056
CB(-1)	5.02E-05	1.40E-05	3.570102	0.0160
CB	**-8.69E-05**	2.51E-05	-3.464496	**0.0180**

R-squared	0.803045	Mean dependent var	-0.003549
Adjusted R-squared	0.684872	S.D. dependent var	0.252750

S.E. of regression	0.141885	Akaike info criterion	-0.766504
Sum squared resid	0.100656	Schwarz criterion	-0.678849
Log likelihood	7.449269	F-statistic	6.795500
Durbin-Watson stat	2.660796	Prob(F-statistic)	0.032501

Table A2-14 Test for autocorrelation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.480477	Probability	0.659147
Obs*R-squared	2.183462	Probability	0.335635

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/22/14 Time: 13:02
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002405	0.115654	-0.020797	0.9847
BANKS	1.31E-06	9.21E-06	0.141810	0.8962
CB	-1.05E-05	3.56E-05	-0.295098	0.7872
CB(-1)	5.44E-06	1.80E-05	0.302410	0.7821
RESID(-1)	-0.636037	0.649897	-0.978674	0.3999
RESID(-2)	-0.482245	0.901348	-0.535027	0.6297

R-squared	0.242607	Mean dependent var	-4.01E-17
Adjusted R-squared	-1.019715	S.D. dependent var	0.112170
S.E. of regression	0.159412	Akaike info criterion	-0.599933
Sum squared resid	0.076236	Schwarz criterion	-0.468449
Log likelihood	8.699696	F-statistic	0.192191
Durbin-Watson stat	2.299220	Prob(F-statistic)	0.946327

Table A2-15 Test for heteroskedasticity

White Heteroskedasticity Test:

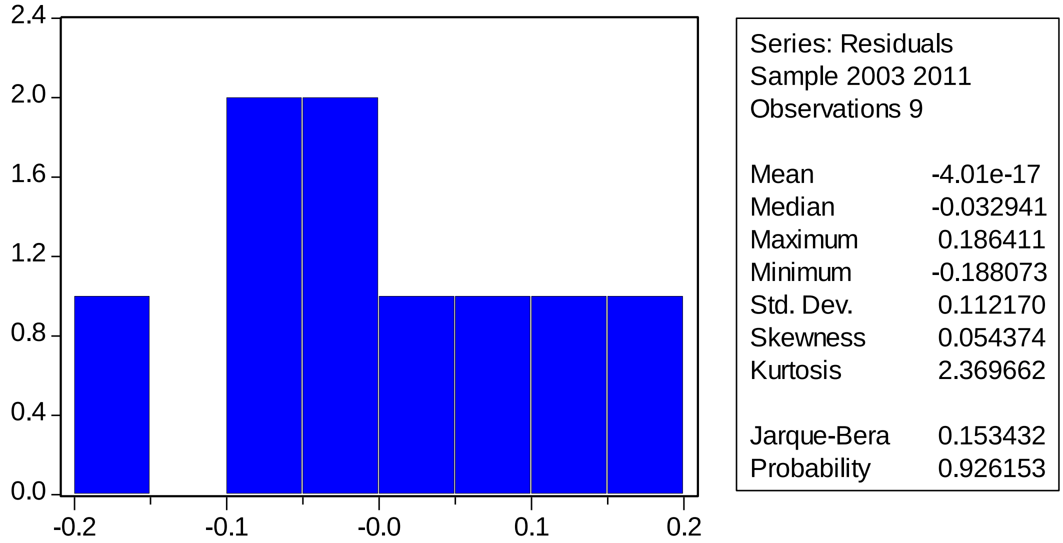
F-statistic	8.240927	Probability	0.112153
Obs*R-squared	8.650116	Probability	0.194232

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/22/14 Time: 13:03
Sample: 2003 2011
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.032093	0.004785	6.706674	0.0215
BANKS	4.67E-06	9.45E-07	4.947056	0.0385
BANKS^2	2.03E-10	6.17E-11	3.292903	0.0812
CB	2.32E-06	1.04E-06	2.239404	0.1545
CB^2	-4.57E-10	2.13E-10	-2.144954	0.1651
CB(-1)	1.55E-06	1.20E-06	1.286342	0.3271
CB(-1)^2	-2.71E-10	2.08E-10	-1.299287	0.3234

R-squared	0.961124	Mean dependent var	0.011184
Adjusted R-squared	0.844496	S.D. dependent var	0.013883
S.E. of regression	0.005475	Akaike info criterion	-7.525921
Sum squared resid	5.99E-05	Schwarz criterion	-7.372524
Log likelihood	40.86664	F-statistic	8.240927
Durbin-Watson stat	2.984072	Prob(F-statistic)	0.112153

TableA2-16 Test for normality of residuals



Appendix 3 Empirical results for U.S. simple logit model

Tier- Tier I capital ratio
D08- 2008 dummy variable
D09- 2009 dummy variable
Size- Bank size dummy variable

Table A3-1 Result of simple logit model

```
Iteration 0:   log pseudolikelihood = -47.725037
Iteration 1:   log pseudolikelihood = -41.149972
Iteration 2:   log pseudolikelihood = -40.413974
Iteration 3:   log pseudolikelihood = -40.385355
Iteration 4:   log pseudolikelihood = -40.385233

Logistic regression                               Number of obs   =        103
                                                  Wald chi2(4)    =      11.72
                                                  Prob > chi2     =     0.0196
Log pseudolikelihood = -40.385233                 Pseudo R2       =     0.1538

                                  (Std. Err. adjusted for 38 clusters in id)
```

failure	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
tier	.1657921	.0848963	1.95	0.051	-.0006016	.3321857
size	-1.09822	.5367322	-2.05	0.041	-2.150195	-.0462437
d08	2.127516	.9446655	2.25	0.024	.276006	3.979027
d09	1.840682	.9641751	1.91	0.056	-.0490664	3.730431
_cons	-4.044033	1.38124	-2.93	0.003	-6.751214	-1.336852

.

Table A3-2 Result of marginal effects, for simple logit model

Marginal effects after logit
y = Pr(failure) (predict)
= .12536018

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
tier	.0181783	.00823	2.21	0.027	.002057	.0343	9.03447
size*	-.1325574	.06491	-2.04	0.041	-.259785	-.00533	.601942
d08*	.2965114	.1299	2.28	0.022	.041907	.551116	.359223
d09*	.2738615	.14733	1.86	0.063	-.014903	.562626	.271845

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table A3-3 Tier I variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	85	8.842824	.2680394	2.471202	8.309798	9.375849
1	18	9.939444	.6669037	2.829433	8.532401	11.34649
combined	103	9.034466	.251955	2.557064	8.534715	9.534218
diff		-1.096621	.6577462		-2.401412	.2081705

diff = mean(0) - mean(1) t = -1.6672
Ho: diff = 0 degrees of freedom = 101

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0493 Pr(|T| > |t|) = 0.0986 Pr(T > t) = 0.9507

Table A3-4 Bank size dummy variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	85	.6470588	.0521415	.4807207	.5433698	.7507479
1	18	.3888889	.1182356	.5016313	.1394335	.6383443
combined	103	.6019417	.0484675	.4918912	.5058067	.6980768
diff		.2581699	.1256581		.008898	.5074418

diff = mean(0) - mean(1) t = 2.0545
Ho: diff = 0 degrees of freedom = 101

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9787 Pr(|T| > |t|) = 0.0425 Pr(T > t) = 0.0213

Table A3-5 Net interest margin ratio variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	85	3.166824	.0985003	.9081276	2.970945	3.362702
1	18	2.748333	.1475093	.6258289	2.437116	3.059551
combined	103	3.093689	.0864591	.877464	2.922198	3.265181
diff		.4184902	.224971		-.0277918	.8647722

```
    diff = mean(0) - mean(1)                                      t =   1.8602
Ho: diff = 0                                     degrees of freedom =      101

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9671         Pr(|T| > |t|) = 0.0658          Pr(T > t) = 0.0329
```

.

Table A3-6 Liquidity ratio variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	85	15.74118	2.074198	19.12316	11.61641	19.86595
1	18	15.32167	3.634584	15.42023	7.653365	22.98997
combined	103	15.66786	1.819039	18.46123	12.05981	19.27592
diff		.4195098	4.813452		-9.129084	9.968104

```
    diff = mean(0) - mean(1)                                      t =   0.0872
Ho: diff = 0                                     degrees of freedom =      101

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.5346         Pr(|T| > |t|) = 0.9307          Pr(T > t) = 0.4654
```

.

TableA3-7 Asset quality ratio variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	83	.6296386	.0756272	.6889962	.4791921	.7800851
1	18	1.585556	.5107608	2.166975	.5079444	2.663167
combined	101	.8	.1144386	1.150094	.572957	1.027043
diff		-.955917	.2847696		-1.520962	-.3908723

diff = mean(0) - mean(1)   t = -3.3568
Ho: diff = 0   degrees of freedom = 99

Ha: diff < 0   Ha: diff != 0   Ha: diff > 0
Pr(T < t) = 0.0006   Pr(|T| > |t|) = 0.0011   Pr(T > t) = 0.9994

.

TableA3-8 Unweighted capital ratio variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	85	10.01529	.3726618	3.435772	9.274215	10.75637
1	18	7.793333	.5141399	2.181311	6.708593	8.878074
combined	103	9.62699	.3302455	3.351626	8.97195	10.28203
diff		2.221961	.8454822		.5447514	3.89917

diff = mean(0) - mean(1)   t = 2.6280
Ho: diff = 0   degrees of freedom = 101

Ha: diff < 0   Ha: diff != 0   Ha: diff > 0
Pr(T < t) = 0.9950   Pr(|T| > |t|) = 0.0099   Pr(T > t) = 0.0050

Table A3-9 Parson X² goodness to fit test, simple logit model

Logistic model for failure, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

number of observations = 103
number of groups = 10
Hosmer-Lemeshow chi2(8) = 5.84
Prob > chi2 = 0.6651

.

Table A3-10 Results of model predicting accuracy

Logistic model for failure

Classified	True D	True ~D	Total
+	12	30	42
-	6	55	61
Total	18	85	103

Classified + if predicted Pr(D) >= .17
True D defined as failure != 0

Sensitivity	Pr(+| D)	66.67%
Specificity	Pr(-|~D)	64.71%
Positive predictive value	Pr(D| +)	28.57%
Negative predictive value	Pr(~D| -)	90.16%
False + rate for true ~D	Pr(+|~D)	35.29%
False - rate for true D	Pr(-| D)	33.33%
False + rate for classified +	Pr(~D| +)	71.43%
False - rate for classified -	Pr(D| -)	9.84%
Correctly classified		65.05%

Table A3-11 Optimal cutoff point

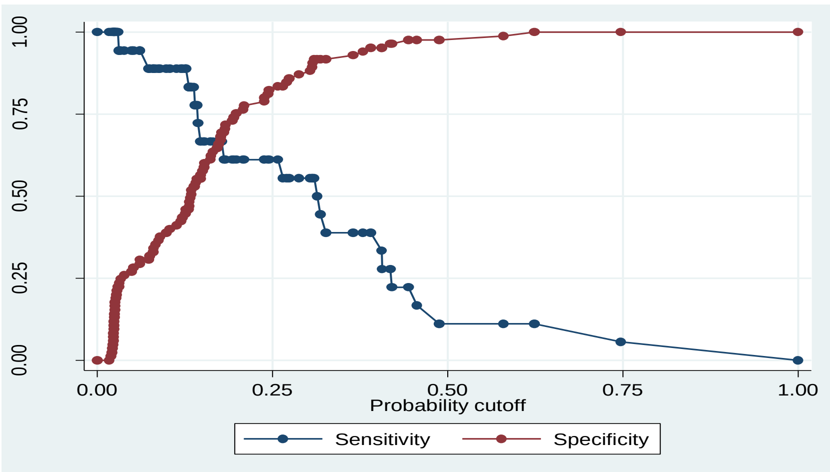
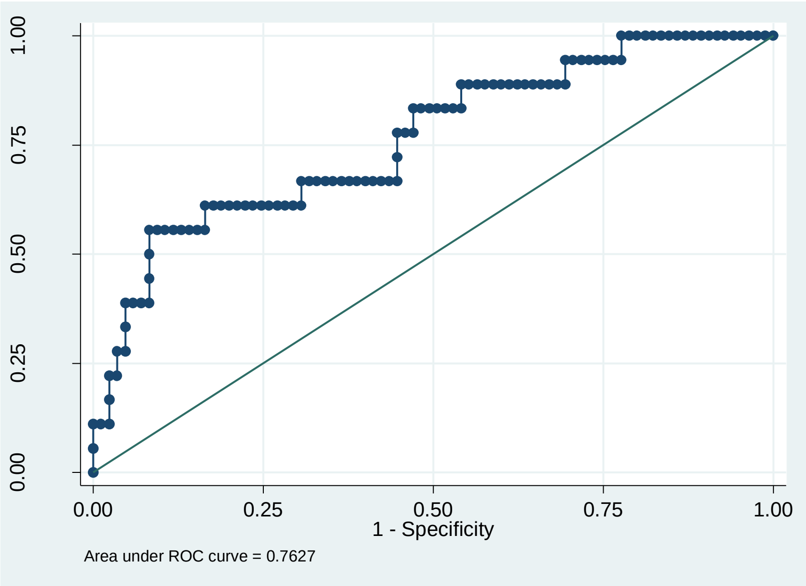


Table A3-12 Area under receiver ROC



Appendix 4 Empirical results of US multivariate logit model

Interest- Net interest margin ratio
Asset- Asset quality margin ratio
Liquidity- Liquidity ratio
Leverage- Unweighted capital ratio (Equity/Total Assets)

Table A4-1 Result of multivariate logit model

```
Iteration 0:   log pseudolikelihood =  -47.33671
Iteration 1:   log pseudolikelihood =  -33.78636
Iteration 2:   log pseudolikelihood = -31.972392
Iteration 3:   log pseudolikelihood = -31.804674
Iteration 4:   log pseudolikelihood =  -31.80198
Iteration 5:   log pseudolikelihood = -31.801979

Logistic regression                               Number of obs   =        101
                                                  Wald chi2(7)    =      24.79
                                                  Prob > chi2     =     0.0008
Log pseudolikelihood = -31.801979                 Pseudo R2       =     0.3282

                                   (Std. Err. adjusted for 38 clusters in id)
```

failure	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
tier	.1810537	.0951448	1.90	0.057	-.0054267	.367534
asset	1.174078	.4247322	2.76	0.006	.3416178	2.006537
interest	-.7833716	.4335364	-1.81	0.071	-1.633087	.0663442
liquidity	-.0364474	.0150969	-2.41	0.016	-.0660368	-.006858
leverage	-.3171703	.1239734	-2.56	0.011	-.5601538	-.0741869
d07	1.925221	1.012669	1.90	0.057	-.0595742	3.910016
d08	-.0751217	1.253673	-0.06	0.952	-2.532276	2.382032
_cons	.5440427	2.024541	0.27	0.788	-3.423984	4.51207

Table A4-2 Marginal effects

```
Marginal effects after logit
     y  = Pr(failure) (predict)
        =  .09656691
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
tier	.0157954	.00853	1.85	0.064	-.000929	.03252	9.05158
asset	.1024286	.04887	2.10	0.036	.006644	.198214	.8
interest	-.0683427	.04589	-1.49	0.136	-.15828	.021595	3.11337
liquid~y	-.0031797	.00174	-1.82	0.068	-.006596	.000237	14.8394
leverage	-.0276705	.01038	-2.67	0.008	-.04802	-.007321	9.59644
d07*	.2184713	.1189	1.84	0.066	-.014559	.451501	.356436
d08*	-.0064664	.10702	-0.06	0.952	-.216223	.20329	.277228

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table A4-3 Parson X^2 goodness to fit, multivariate logit model

```
Logistic model for failure, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       101
             number of groups =        10
      Hosmer-Lemeshow chi2(8) =         6.77
                  Prob > chi2 =         0.5614
```

.

Table A4-4 Model predicting accuracy results

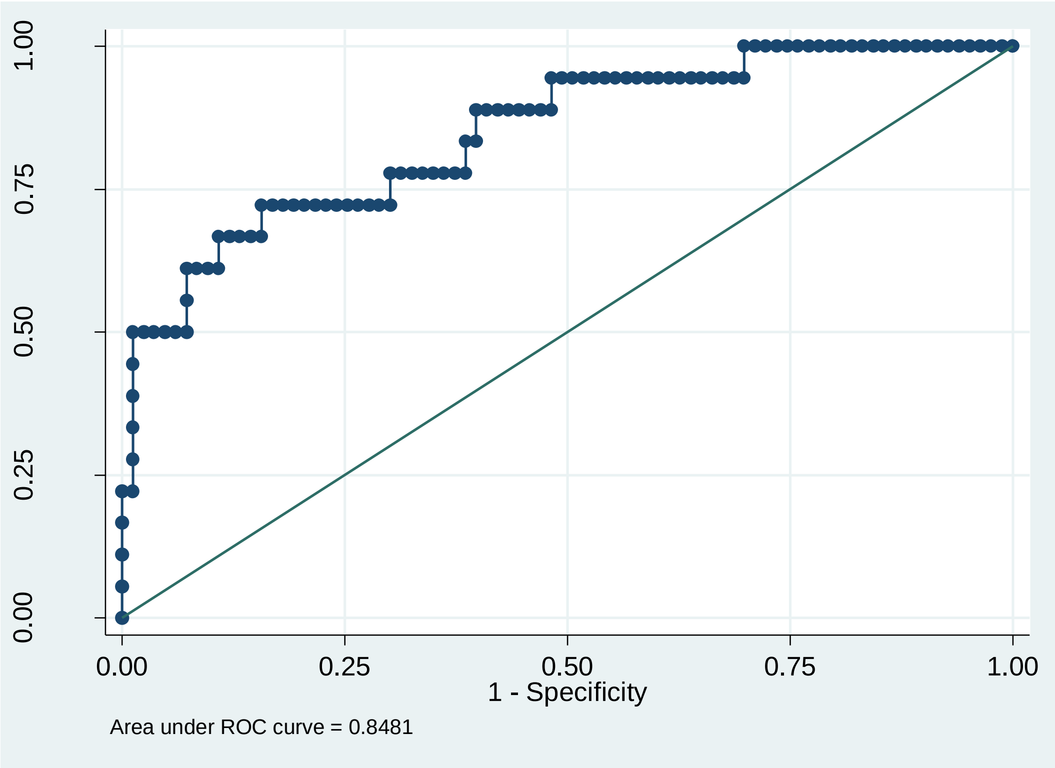
Logistic model for failure

Classified	True D	True ~D	Total
+	13	18	31
-	5	65	70
Total	18	83	101

Classified + if predicted Pr(D) >= .17
True D defined as failure != 0

Sensitivity	Pr(+| D)	72.22%
Specificity	Pr(-|~D)	78.31%
Positive predictive value	Pr(D| +)	41.94%
Negative predictive value	Pr(~D| -)	92.86%
False + rate for true ~D	Pr(+|~D)	21.69%
False - rate for true D	Pr(-| D)	27.78%
False + rate for classified +	Pr(~D| +)	58.06%
False - rate for classified -	Pr(D| -)	7.14%
Correctly classified		77.23%

Table A4-5 ROC curve



Appendix 5 Empirical results of Japan logit model

Table A5-1 Results of logit model

```
Iteration 0:   log pseudolikelihood =  -29.33523
Iteration 1:   log pseudolikelihood = -26.736199
Iteration 2:   log pseudolikelihood = -26.572235
Iteration 3:   log pseudolikelihood = -26.570651
Iteration 4:   log pseudolikelihood = -26.570651

Logistic regression                               Number of obs   =         57
                                                  Wald chi2(4)    =       8.43
                                                  Prob > chi2     =     0.0769
Log pseudolikelihood = -26.570651                 Pseudo R2       =     0.0942

                                      (Std. Err. adjusted for 24 clusters in id)
```

failure	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
tier1	.5288622	.2483225	2.13	0.033	.042159	1.015565
d00	.4215844	1.1838	0.36	0.722	-1.89862	2.741789
d99	.7600944	1.002448	0.76	0.448	-1.204667	2.724856
size	.6484714	.6327005	1.02	0.305	-.5915987	1.888541
_cons	-5.595542	1.767489	-3.17	0.002	-9.059757	-2.131328

Table A5-2 Marginal effect

```
Marginal effects after logit
      y  = Pr(failure) (predict)
         =  .17981798
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
tier1	.0779984	.03346	2.33	0.020	.012415	.143582	6.23368
d00*	.0656175	.19216	0.34	0.733	-.311007	.442242	.298246
d99*	.119487	.16247	0.74	0.462	-.198939	.437913	.368421
size*	.0927452	.08826	1.05	0.293	-.080249	.265739	.578947

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table A5-3 The Parson X^2 goodness to fit test

```
Logistic model for failure, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =        57
             number of groups =        10
      Hosmer-Lemeshow chi2(8) =         8.53
                  Prob > chi2 =         0.3834
```

Table A5-4 Tier I variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	45	6.043556	.2175235	1.459192	5.605166	6.481945
1	12	6.946667	.3672138	1.272066	6.138434	7.754899
combined	57	6.233684	.1932549	1.459043	5.846548	6.62082
diff		-.9031111	.462562		-1.830106	.0238839

diff = mean(0) - mean(1) t = -1.9524
Ho: diff = 0 degrees of freedom = 55

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0280 Pr(|T| > |t|) = 0.0560 Pr(T > t) = 0.9720

Table A5-5 Bank size dummy variable mean test

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	45	.5777778	.0744603	.4994947	.427713	.7278426
1	12	.5833333	.1486471	.5149287	.2561633	.9105034
combined	57	.5789474	.0659772	.4981168	.4467792	.7111155
diff		-.0055556	.1632976		-.3328113	.3217001

diff = mean(0) - mean(1) t = -0.0340
Ho: diff = 0 degrees of freedom = 55

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.4865 Pr(|T| > |t|) = 0.9730 Pr(T > t) = 0.5135

Table A5-6 Optimal cutoff point

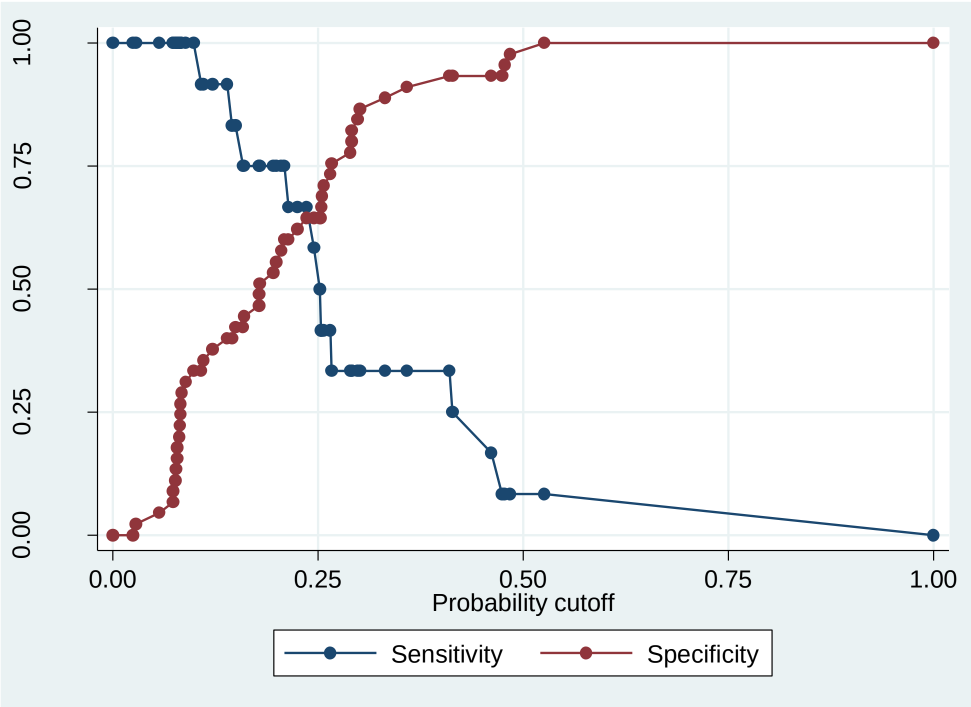


Table A5-7 Model predicted accuracy

Logistic model for failure

Classified	True D	True ~D	Total
+	8	18	26
-	4	27	31
Total	12	45	57

Classified + if predicted Pr(D) >= .21
True D defined as failure != 0

Sensitivity	Pr(+| D)	66.67%
Specificity	Pr(-|~D)	60.00%
Positive predictive value	Pr(D| +)	30.77%
Negative predictive value	Pr(~D| -)	87.10%
False + rate for true ~D	Pr(+|~D)	40.00%
False - rate for true D	Pr(-| D)	33.33%
False + rate for classified +	Pr(~D| +)	69.23%
False - rate for classified -	Pr(D| -)	12.90%
Correctly classified		61.40%

Table A5-8 ROC curve