
# The Impact of Changes of Capital Regulations on Bank Capital and Portfolio Risk Decision: A Case Study of Indonesian Banks

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# THESIS DECLARATION

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**Ratna Derina**
**June, 2011**

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# THESIS SUMMARY

## Research Objectives

This thesis studied bank risk taking behaviour with regards to capital and asset portfolio adjustments. It also evaluated the impact of economic uncertainty and capital regulations on banks' risk taking behaviour. There were two objectives of this thesis. The first objective was to investigate the impact of adverse shocks in the economy on a bank's decisions regarding capital and asset portfolio management. The second objective was to examine the interrelationship between decisions on capital and asset portfolios. Further, the impact of economic uncertainty and changes in capital regulations on this relationship was also examined.

This thesis was motivated by several issues. First, even though supervisory authorities and banks are aware of the importance of capital in the prevention of bank failures, empirical studies are inconclusive on the effectiveness of capital regulations in controlling bank risk taking behaviour. Second, the contradictory conclusions in current literature regarding the effectiveness of capital regulations in controlling bank risk taking attitudes do not incorporate economic shocks. Therefore, the existing studies do not examine the impact of economic uncertainty on capital and portfolio risk decisions, or the impact of such

uncertainty on the effectiveness of capital regulations in controlling bank risk taking behaviour.

The impact of the Asian financial crisis in 1997 and the Global Financial Crisis on Indonesian banks provided an opportunity to study bank risk taking attitudes in a dynamic economic and regulatory environment. Indonesia experienced severe banking and financial crisis as a result of the Asian financial crisis, and Indonesian banks had also been exposed to different capital regulations as part of recapitalisation and restructuring of the banking sector due to the Asian financial crisis.

**Methodology**

As previously mentioned, the first objective was to investigate the impact of adverse shocks in the economy on banks' decisions on asset portfolio and capital management. In this regard, this study first examined the impact of the economic crisis on the capital regulations and the market structure that affected trends and components of asset portfolios and liabilities including capital. This study next sought to identify and confirm whether the impact of the economic crisis was permanent or transitory. Further, breaks in the series of the components of assets and liabilities were also identified. These breaks might have been caused due to the economic crisis, or changes in capital, banking, or other major financial regulations. The model used in this study extended Jacques' (2003) model by not

only incorporating liabilities in the model, but also the interrelated decisions regarding assets and liabilities adjustments.

The second objective was to investigate the interrelationship between capital and asset portfolio decisions and the impact of economic uncertainty on this relationship. Further, the impact of the changes in capital regulations on this relationship both during and after the financial crises was also investigated. To achieve this objective, explanatory variables that affect capital and asset portfolio risk decisions were first explored individually. These factors were identified in related literature. Second, the interrelationship between decisions of capital and portfolio risk was studied, and further, the way in which this relationship changed due to the economic crisis and changes in capital regulations. Simultaneous equations with partial adjustment processes were used to estimate the relationship between capital and asset portfolio risk, the way in which this relationship changed due to the economic crisis as well as any changes in capital regulations. Finally, the contribution of the explanatory variables on changes in capital and asset portfolio risk was also estimated.

**Empirical Results**

The empirical results revealed several important findings:

1. The Asian financial crisis of 1997 had a permanent impact on these banks' asset portfolios and capital. The results also supported multiple breaks

and shifts in asset portfolio composition as a result of both the financial crisis and of changes in financial and banking regulations during the capital-constrained period.

2. Explanatory variables such as type of bank ownership, size, profitability, market power, economic uncertainty and regulatory and peer pressure significantly impacted on banks' capital and portfolio risk decisions.

   - The privately owned banks (private domestic, joint venture and foreign banks) changed their capital and restructured the credit risk of an asset portfolio differently compared to government owned banks (state owned and regional banks). The relationships between capital decisions and the credit risk of privately owned banks changed due to the Asian financial crisis. On the other hand, government owned banks did not show any change in their capital and risk taking attitude as a result of the Asian financial crisis in 1997. Government owned banks exhibited negative relationships between portfolio credit risk and changes in capital, confirming the moral hazard effect of the "too big or too important to fail" theory of insurance provided by government ownership of the banks that was occasioned explicitly or implicitly by government.

   - Significant differences were evident in risk taking behaviour of large banks, compared to medium and small sized banks. Small and large

banks also displayed significant changes in risk taking behaviour as a result of the financial crisis. After the financial crisis, large banks were found to display higher levels of risk aversion than smaller banks and the risk taking attitude revealed to be negatively correlated with profitability.

- Profitable banks increased their capital through retained earnings and generated returns by investing in lower risk assets.

- Proportion of equity in financing investments were positively related to the banks' market power, while risk of investment portfolios were found to be negatively related to the market power. Banks with greater market power protected their valuable banking charter by financing with more equity and choose to invest in safer portfolios even though this implied foregoing profitable investment opportunities.

- Banks were more risk averse during higher levels of economic uncertainty.

3. The empirical results on the interrelationship between capital and portfolio risk decisions lent support to the hypothesis that changes in capital and portfolio risk were interrelated and that this relationship changed after the Asian financial crisis.

The results suggested that prior to the Asian financial crisis banks tended to offset regulatory-induced capital increases with increasing the proportion of risky assets. After the crisis, banks' capital ratios were shown to be negatively related to the asset risk, and revealed a greater degree of risk aversion.

This study shows that the experience from the crisis combined with regulatory and peer pressure, effectively forced banks to maintain a higher capital ratio than required. This thesis concluded that capital regulations were only partially effective in coercing banks to hold adequate levels of capital. However, changes in the banks' attitude toward insolvency and portfolio risks after the crisis were not found to be due to the new capital regulations. Banks self regulated themselves by maintaining a higher capital ratio than required and by adjusting their risk taking activities. These actions were taken not only to send a signal of solvency, but they also reflected the banks' belief that holding capital at the regulatory required level will not necessarily protect them from insolvency. Therefore, banks had an incentive to hold more capital than required as an assurance to avoid severe market discipline they had experienced during the economic crisis.

# Chapter 1

# Introduction

## 1.1. Background

During the last two decades banking crises in several countries have made regulators, supervisory authorities and the banks themselves more aware of the importance of maintaining a sufficient equity capital to assets ratio. Although capital generally accounts for a small percentage of the financial resources of banking institutions, it plays an important role in their long-term financing and solvency, and therefore in the level of public confidence that they maintain. The most important function of bank capital is that it provides a buffer to absorb unexpected losses and thus assists in preventing bank failures. Regulating capital requirements to ensure that banks hold a minimum level of capital in proportion to their asset risk reduces the probability of insolvency, and therefore avoids the negative externalities faced by the financial system.

Nevertheless, empirical studies are still unable to reach a firm conclusion on the effectiveness of capital regulations in controlling bank risk taking, and there is still no consensus on how banks should be regulated (Santos, 2000). Some studies support the effectiveness of capital regulations in enhancing bank safety (Furlong and Keeley 1987, 1989; Keeley and Furlong 1990). Other studies explore the unintended impacts of capital regulations or the way they are implemented.

Santomero and Watson (1977) find that capital regulations that are too restrictive cause banks to reduce asset credit risk by decreasing loans. This action helps improve their capital ratio and complies with the regulatory requirements but results in a fall in overall productive investments. Other studies question the effectiveness of capital standards, and find that risk-independent capital requirements without accompanying portfolio constraints are generally ineffective. The risk independent capital ratio regulation induces banks to increase the proportion of higher yielding, high-risk assets in their total assets without increasing equity capital. This action may in turn result in greater bank risk-taking, and thus may not prevent bank failure (Kahane 1977; Koehn and Santomero, 1980; Gennotte and Pyle 1990)).

The risk-based capital standards established by the Basel Agreement are designed to minimise the incentive to increase asset risk *(asset-substitution incentives* moral hazard) caused from applying risk independent capital requirements (Battacharya et al, 1998). The Basel Capital Accords (Basel I and Basel II) set minimum credit risk-adjusted capital requirements. However, Basel II applies more risk-sensitive measurements. Both Basel I and II apply the same basic principle: a bank is required to increase its equity capital in proportion to increases in the level of asset risk. Asset substitution incentives are therefore minimised. Requirements arising from a higher risk-adjusted capital to assets ratio would reduce the use of a bank's cheap and relatively interest rate insensitive deposits to fund risky investments; this in turn reduces the incentive for such risk-taking.

However, Hovakiman & Kane (2000) find that the risk based capital requirements do not provide full control over the asset substitution incentives. Acharya (2001a,b) also show that risk-based capital adequacy regulations could actually intensify systemic risk. As international financial markets get more integrated, synchronization of only some aspects of banking regulations (such as applying uniform capital requirements), but not other aspects (such as forbearance closure policies) might in fact increase negative externalities that in turn destabilise the global market system. The evidence from the Global Financial Crisis(GFC) in 2008 proves these concerns and demonstrates that Basel I and Basel II capital requirements do not effectively minimise the asset substitution moral hazard as banks take advantage of the loopholes in the capital regulations, which enable them to restructure and reengineer items on the balance sheet so that they improve their capital ratios but at the same time increase their overall risk.

## 1.2. Research Objectives

This thesis studies banks' risk taking behaviour with regard to adjustments of capital and credit risk of asset portfolios. This thesis also investigates how economic uncertainty and capital regulations affect the risk taking behaviour.

This thesis addresses two specific objectives:

1. To investigate the impact of adverse shocks in the economy on a bank's decisions in adjusting its capital and the credit risk of its asset portfolio.

This thesis addresses this objective by first discussing the impact of economic crises on capital regulations and the market structure of the Indonesian banking sector resulting from mergers and the liquidation of insolvent banks. This is covered in chapter 3. The changes in capital regulations and market structure may affect risk taking attitudes of the surviving banks. Furthermore, economic shocks may also have an impact on a bank's risk attitude where the bank may become more risk averse, shifting its portfolio away from risky assets to safer assets while maintaining its capital levels. Therefore, the trends and compositions of the asset portfolio and liabilities are investigated to see whether they are affected by the economic crisis, and/or changes in capital regulations. The analysis will help determine whether banks significantly change their asset and liability compositions under different capital requirement regimes. Conclusions will also be drawn regarding the effectiveness of the different capital requirements imposed in controlling banks' risk taking behaviour and whether the asset substitution moral hazard of the unconditional government guarantee is minimized.

Second, chapter 5 discusses the permanent impact of economic crises and regulations that may have caused structural breaks in the composition of the assets and liabilities, including equity capital. The thesis tests Jacques' (2003) study which argues that exogenous shocks such as economic crises have permanent effects on a bank's asset portfolio over time, but application of new capital standards does not significantly affect the level and trend of the portfolio. The model presented in chapter 5 extends Jacques' model by incorporating liabilities in the model and therefore acknowledges the interrelated nature of asset and liability decisions. It

identifies multiple breaks in the series of asset and liability components caused by major banking regulations and other events following the economic crisis.

2. To examine the interrelationship between capital and asset portfolio decisions and the impact of economic uncertainty and changes in capital regulations on this relationship.

In order to address this objective, chapter 2 explores the existing literature for explanatory variables that affect the capital and credit risk of asset portfolios individually. Second, the thesis studies the interrelationship between decisions of capital and credit risk and how the relationship changes as a result of economic crises and changes in capital regulations. There are two hypotheses presented in chapter 6, the first hypothesis, based on the moral hazard theory, contends that changes in capital and asset credit risk are interdependent, and that they are affected by both endogenous and exogenous characteristics, such as economic uncertainties and capital regulations. Moral hazard theory states that in order to comply with the risk-independent capital requirements, a majority of banks minimise the effects of increases in capital level requirements by increasing asset risk.

The second hypothesis on the effectiveness of capital regulations, based on O'Hara (1983) and Furfine's (2001) buffer theory, contends that banks hold more capital than required to avoid regulatory pressure. During a period of crisis, banks may hold higher capital than required due to increased risk aversion of the bank

managements due to increased costs of raising deposits and borrowings during periods of economic instability. Additionally, higher capital may be held to avoid market discipline and supervisory intervention if the capital falls below the regulatory minimum capital standards (Furfine 2001). The effectiveness of capital requirements is tested especially after an economic crisis when banks may attempt to gain greater returns from investing in risky assets to compensate for any substantial losses incurred during the crisis.

### 1.3. Motivation

These objectives are motivated by the contradictory conclusions in the existing literature regarding the effectiveness of capital regulations to control banks' risk taking attitudes. However, these studies do not incorporate economic shocks and/or the impact of dynamic changes in capital regulations and are based in comparatively stable economic environments with no changes in capital regulations, and with unconditional guarantees in the form of explicit deposit insurance provided by the government. Furthermore, even though the impact of capital requirements on bank risk taking has become a topical issue in light of the current banking and economic crises, not many studies have examined the effectiveness of capital regulations in controlling banks' risk taking behaviour during periods of economic instability and uncertainty. Therefore the hypotheses on capital regulations and their impact on bank risk taking have not been tested in a dynamic regulatory environment under turbulent economic conditions. Moreover, the existing studies were undertaken in developed economies. Very few studies

have been conducted in less developed countries, especially in those countries that are in their early stages of financial system development. Banks in less developed countries, with weak institutional environments and low levels of regulation, tend to take excessive risks compared to those in strong institutional environments, thereby increasing the moral hazard of implicit government guarantees (Dermiguc-Kunt and Kane, 2002). Therefore regulatory capital requirements have a different impact on bank risk taking in less developed countries.

### 1.4. Rationale for Examining Indonesian Banks

This thesis examines the capital and credit risk of asset portfolio decisions of Indonesian banks before, during and after the Asian financial crisis in 1997 as well as before and during the GFC in 2008. There are three major reasons for studying Indonesian banks. First, Indonesia has been exposed to two major financial crises: the Asian financial crisis in 1997 and the GFC in 2008. While the 2008 financial crisis did not affect Indonesia's economy and financial sector, Indonesia was most severely affected during the 1997 Asian financial crisis as measured by the magnitude of currency depreciation and contraction of economic activity. As a result of the Asian financial crisis, the currency depreciation and the resulting banking crisis reduced annual GDP by over 50%. Consequently, large scale restructuring took place in the Indonesian banking sector that resulted in a 44% decrease in the number of banks between 1997 and 2004 (Bank of Indonesia, 2001).

Second, the severity of the 1997 banking crisis forced Indonesian banking regulators to adjust the capital regulations as part of the recapitalisation and restructuring of the banking sector, applying both leverage ratio (risk-independent capital ratio) and risk-adjusted Capital Adequacy Requirements (CAR) during different periods. Before the Asian financial crisis, regulators had planned to raise the minimum leverage ratio from 8% to 12%. As a result of the crisis, and in order to reduce the need for further injection of new equity for recapitalisation purposes, the leverage ratio was reduced to 4% in February 1999 instead. Following this, regulators announced the application of an 8% risk-adjusted CAR by the end of 2001.

Lastly, before the Asian financial crisis, Indonesia did not adopt an explicit deposit insurance system, even though it had adopted a full blanket guarantee until 2001. Therefore during the crisis banks were not able to benefit from an explicit deposit insurance system that may have encouraged risk taking. On the other hand, the Asian financial crisis showed the evidence of a too big to fail fallacy, as large number of depositors withdrew their funds out of the smaller sized private banks, regardless of the health of the bank, and moved those funds into larger state banks, which were considered safer. Therefore, using Indonesian banks provides the opportunity to test the existence of implicit government guarantee in the form of the too big to fail fallacy. Using data from Indonesian banks during the Asian financial crisis then controlling for the impact of deposit insurance, allows this thesis to study the impact of the implicit government guarantee. This has not been explored in the existing literature.

In conclusion, the impacts of both the Asian financial crisis in 1997 and the GFC in 2008 on Indonesian banks provide an opportunity to study bank risk taking attitudes in a dynamic economic and regulatory environment. Using Indonesian banks during the economic crises enriches the literature on capital regulations and risk-taking behaviour that is currently dominated by banks in countries with stable capital regulations and explicit deposit insurance systems.

## 1.5. Organisation of the Thesis

The remainder of this thesis is divided into 6 chapters. Chapter 2 reviews the literature on banking capital regulations and bank risk taking. The organisation of this chapter is based on the development of the capital regulations and the two opposing views regarding the impact of regulations on bank risk taking.

The development of the Indonesian banking sector and capital regulations is covered in chapter 3. This chapter reviews the financial crises and the impact of the crises on the Indonesian banking sector as well as the recapitalisation and restructuring programs that led to the changes in capital regulations. This chapter addresses the thesis' first objective by discussing the impact of both the economic crises and changes in capital regulations on shifts in liability and asset portfolio composition.

Chapter 4 discusses data employed in this thesis which includes types of data and sources of data.

Chapter 5 extends the first objective of this thesis by discussing structural breaks in the composition of the assets and liabilities including equity capital that may have been caused by the economic crises and regulations. This chapter also discusses the permanent impact of the economic crises on assets and liability components. The methodology employed is stationary tests with multiple structural breaks.

Chapter 6 addresses the second objective of the thesis, and discusses the empirical results of the relationships between changes in capital and asset credit risk, and the impact of the economic crises and changes in capital regulations as well as the explanatory variables on the changes in capital and asset credit risk. This chapter also investigates how the economic crises and changes in capital regulations affect the relationships for different types of bank ownership. The method used in this chapter is the simultaneous equations with partial adjustment process.

Chapter 7 provides concluding remarks, policy implications, details the limitations of this thesis and discusses directions for further research.

# Chapter 2

# The Literature on the Impact of Capital Regulations on Bank Risk Taking

## 2.1. Introduction

This chapter discusses the literature on the impacts of capital regulations on bank risk taking. First, the economic importance of banks is discussed, as are the conflicting theories and empirical studies on the importance of bank capital. The discussion extends corporate finance theory and the role of capital for industrial firms, acknowledging the special characteristics of banking firms. Second, the chapter considers a theoretical framework of market and optimal capital structure and regulatory capital requirements in order to explain why regulators set mandatory capital requirements. Finally, the impacts of regulatory capital requirements and other factors on bank risk taking are discussed.

## 2.2. The Economic Role of Banks

Bank theories conclude that financial intermediaries are not required in a perfect world with symmetric information and markets with no friction. In such a perfect world, transaction costs would not exist nor would any other costs for acquiring information. There is no need for financial intermediaries, as investors and borrowers would be able to achieve efficient risk allocation on their own (Santos,

2001). However, evidence shows that we live in an imperfect and incomplete world which justifies the increasing need for financial intermediaries.

In order to explain the existence of financial intermediaries, past studies adjust the assumptions underlying the perfect and complete world framework and acknowledge the existence of market frictions. A literature review by Santos (2001) separates the theories into earlier and contemporary theories. In the early theories, transaction costs are considered as the main reason for the presence of market frictions, whilst contemporary theories emphasise the existence of asymmetric information as the major cause of market frictions.

Three theories, each focussing on a specific banking function, dominate the early literature justifying the existence of banks. The first is the role played by intermediaries as asset transformers, transforming securities issued by firms into securities demanded by investors (Gurley and Shaw, 1960). Financial intermediaries are important due to the existence of transaction costs which make it too costly for savers and investors to perform the asset transformation activities on their own (Benston and Smith, 1976, Mishkin 2004). Financial intermediaries bundle funds of many savers and investors so that they can take advantage of economies of scale, i.e., the reduction in transaction costs per dollar of investment as the scale of transactions increase. Consistent with these arguments, Kane and Buser (1979) focus on the ability of banks to transform large denomination financial assets into smaller units. This is an important role of banks since they perform diversification activities for both their depositors and equity holders.

The second role of banks emphasised in earlier theories is the nature of a bank's demand deposit liabilities as the medium of exchange. The studies especially focus on the ability of demand deposits to minimize the transaction costs of converting income into optimal consumption (Niehans 1969,1971; Barro and Santomero 1976). The studies further suggest that the monetary mechanism offers the opportunity to attract deposits which may be reinvested to generate positive returns.

Finally, earlier theories study the two-sided nature of banks as explored by Pyle (1971). The study concludes that the importance of financial intermediation is to facilitate risk-averse investors in maximising their returns by transforming deposits into loans, which is explained by the covariance between return on loans and deposits. Sealey (1980) further expands this argument and shows that if interest rates are determined by the financial intermediaries rather than by the open market, the correlation between profits and level of rates also explains the importance of financial intermediation.

Contemporary theories on financial intermediation provide plausible arguments for the existence of intermediaries, these being the provisions of liquidity, and monitoring services. The important role of banks in these theories arises from the existence of asymmetric information. The asymmetric information problem arises between firms and investors, where firms are assumed to know more about the value of their assets and opportunities than outside investors. The asymmetric

information causes adverse selection because investors are unable to differentiate between underperforming assets and well performing assets, and to identify moral hazard where firms misuse investors' funds (Mishkin and Eakins 2009).

The asymmetric information problems are investigated by Akerlof (1970), Myers and Majluf (1984) and Greenwald et all (1984). Akerlof (1970) showed how a financial structure is influenced by adverse selection. Akerlof argues that markets can be dysfunctional when potential buyers cannot verify the quality of the product they are offered. Faced with the risk of buying a lemon, the buyers will demand a discount, which in turn discourages the potential sellers who do not have lemons to sell their products because their products will be undervalued. As a result, a market will function poorly as it is dominated by sellers with lemons. In order to minimise this risk, buyers have to spend informational costs but face free rider problems from other buyers who do not spend to gain information but take advantage of the information that the other buyers have paid for. The existence of financial intermediaries solves this problem since financial intermediaries are capable of reducing informational costs, produce good quality information and avoid free rider problems by primarily making private loans instead of purchasing securities that are traded in the open market (Mishkin and Eakins 2009).

Myers and Majluf (1984) and Greenwald et al (1984) explain how informational imperfections have a fundamental effect on the choice between debt and equity contracts for firms and hence justify the role of banks. Myers and Majluf argue that due to the informational imperfections between firms' managers and outside

investors, firms may refuse to issue stock even though it means passing up valuable investment opportunities in order to protect old investors' interests. A decision not to issue shares conveys good news and, on the other hand, a decision of an issue conveys bad news. As a result, firms prefer to use internal sources of funds, and to prefer debt to equity if external financing is required.

Assuming that bankers can perfectly differentiate and hence discriminate among borrowers -based on the appropriate risk classes - but that the equity market treats all those seeking equity the same, Greenwald et al (1984) develop an informational imperfections theory based on a credit rationing theory. Banks impose credit rationing due to greater uncertainty concerning the prospects of borrowing firms and an increase in the bankruptcy loss. The informational imperfections theory shows that firms whose credit is constrained do not avail themselves of the equity market. They argue that this is due to the informational imperfections of equity markets. Managers of the credit constrained firms have less incentive to make additional efforts in maximising the firms' profits since debt financing imposes large bankruptcy costs on managers already, and the value of these incentives is reduced by additional equity finance. Moreover, a signalling effect may restrict a firm's access to equity markets. Managers of "good" firms may be willing to take greater debt burdens. Greater reliance on debt by good firms means that equity will predominantly be sold by inferior ones. Therefore, selling equity may convey a negative signal about a firm's quality and reduce its market value accordingly.

Diamond and Dybvig (1983) argue that banks are important because of their role in providing liquidity services by issuing demand deposits. By providing this role, banks also provide insurance as they guarantee a reasonable return when investors liquidate or cash-in before maturity, which is required for optimal risk sharing. The important role of banks in this model is due to the existence of asymmetric information because the shock affecting an investor's consumption needs is not publicly observable. They also show that bank deposit contracts provide allocations superior to other financial assets traded in the exchange markets. In the Diamond-Dybvig model, asset liquidity is not linked to the operations of the markets. Jacklin (1997) questions the role of banks as providers of liquidity in the presence of active markets. He shows that when a secondary market where bank deposits can be traded for other financial assets is recognised, banks become irrelevant. However, Diamond (1987) argues that as long as there are some investors who do not trade in the market, banks still remain important despite the financial market impact on bank activities.

The other theory highlighting the importance of banks is the contemporary theory of a bank's role in providing monitoring services. Consistent with the liquidity provider argument, the monitoring services provider argument is also based on the asymmetric information problem. Diamond (1984) develops a theory of financial intermediation based on the minimum cost of the production of information. Banks act as delegated monitors to investors and gain cost advantages in collecting this information by avoiding duplication of monitoring effort and costs. Therefore by providing the monitoring activities, not only do banks save the monitoring costs for

investors but they also provide funds at a lower cost than through direct lending to borrowers.

Investigating the reasons why banks provide both liquidity services and monitoring services, Diamond and Rajan (1998) develop a model using both the liability and asset sides of a bank's balance sheet. In their model, both investors and borrowers are concerned about liquidity. Depositors are concerned about having access to their funds and borrowers are concerned about their funding risk. Diamond and Rajan argue that it is important for banks to accept deposits and provide loans because they ensure depositors have access to their funds on demand, which is unlikely to happen if they invested directly in firms. At the same time, banks insure borrowers from the risk that funding will be cut off before the end of the project, which could happen if the funds were obtained from direct lending.

Allen and Santomero (2001) investigate the impact of development in financial markets on the transformation of the banking industry. Developing a framework using market based economies (such as the US and UK) and bank based economies (such as Japan, Germany and France), they generally conclude that development of financial markets and competition from financial markets force banks to move away from their traditional borrowing and lending activities and develop new fee-based sources of revenue. Banks are able to eliminate risk by intertemporal smoothing when there is no stiff competition from financial markets. Intertemporal smoothing is achieved by building up buffers of short term liquid assets when returns are high and running them down when the returns are low. On the other

hand, when financial markets are more developed, accessible and provide a strong competition for banks, such intertemporal smoothing is impossible since depositors would withdraw their funds completely and invest them in markets instead. Therefore banks use cross-sectional risk sharing in the form of investing in derivatives, develop new fee-based sources of revenue and other similar strategies.

In conclusion, studies of financial intermediation confirm the importance of banks. In an imperfect world with market frictions and asymmetric information, banks produce services that are not easily replicated in the capital markets. Banks play a major role in financial markets because they are well positioned to engage in information-producing activities that facilitate productive investment for the economy.

### 2.3. The Importance of Bank Capital

Studies on the economic roles of banks indicate that banks are fundamentally different to industrial firms and the importance of bank capital cannot be explained using the same parameters as those of industrial firms.

Contradictory theories on the importance of capital structure for industrial firms raise questions about the importance of capital for banks and non-industrial firms that are highly leveraged and highly regulated. Can the hypotheses on industrial firms' capital structure also be applied to banks? Consistent with the discussion on the role of capital for industrial firms, different studies give different justifications

of the role of bank capital and the importance of bank capital structure. Using the Modigliani and Miller (M&M) propositions on capital structure and acknowledging the existence of government guarantees for bank demand deposits, Miller (1995) argues that bank capital structure is irrelevant in a "perfect" world with full information and complete contracts. The decision to increase the leverage within a bank's capital structure will increase the expected earnings per share on equity, but will be just enough to compensate the shareholders for the risks added by leverage.

Weakening some of the M&M assumptions (i.e. on taxes, expected costs of financial distress, transaction costs and asymmetric information problems) leads to the additional conclusion, namely that the capital structure of banks may matter. The information acquisition function of banks creates asymmetric information problems between bank management, shareholders, and lenders. A signalling equilibrium may exist in which banks that expected to have better future performance have lower capital (Ross, 1977). Therefore, as in industrial firms, bank managers take advantage of the asymmetric information problem by signalling information to the market through their capital structure (Ross (1989)). Using the same asymmetric information argument, Stein (1998) shows that asymmetric information creates adverse-selection problems where the inability of investors to distinguish the good banks from the bad leads to banks having difficulties in issuing long term equity. High cost of equity issuance affects bank capital structure decisions since greater bank capitalisation can only be obtained at some increased cost.

Berger et al (1995) explain that by relaxing the M&M assumptions and incorporating a safety net such as deposit insurance, government unconditional payment guarantees and access to the discount window may explain optimal market capital 'requirements' for banks. The safety net reduces market capital requirements by protecting banks from potential market discipline. Therefore, banks generally have lower capital than firms in other industries that are not protected by the safety net. They further argue that if raising capital quickly is costly then banks may hold additional capital.

Diamond and Rajan (2000) present a theory of bank capital using a model where a bank's assets and liabilities are tied together. As capital holders do not have the first-come-first-served right to cash flows as do depositors, it may be optimal for the bank to partially finance itself with capital. They identify the role of bank capital as ensuring bank safety by providing a buffer to absorb losses, thus better enabling the bank to pay their debt holders in full. By maintaining a certain level of capital and reducing deposits to a safe level, it enables banks to refinance at low cost and minimize distress costs. They suggest that an appropriate capital structure can allow a bank to extract more from borrowers, thus allowing it to lend more.

### 2.4. Bank Capital Regulation

As most of the studies support the importance of banks and bank capital, the next issue is whether banks and bank capital should be regulated. Some research supports the view that banks need to be regulated by considering the fragility of

their financial structures and the important roles they play in the payment system and the wider economy. One of the most prominent arguments in favour of bank regulation is that it reduces the negative externalities resulting from government supported deposit insurance. On the other hand, other studies argue that even though markets are not perfect, they perform better than governments in securing the banking system. They therefore conclude that market discipline should be improved and banks should not be regulated.

### 2.4.1 Free Banking System

Those who are against bank regulation argue that regulations and other forms of government intervention themselves create negative externalities that weaken the banking system. They are against any kind of government discipline, suggesting that most arguments that are frequently used to support special regulation for banks are supported by neither theory nor empirical evidence. They also question the establishment of a central bank in order to regulate a banking system. This is not only costly to manage but also creates conflicts of interest. Using the United States as their strongest case, they argue that bank failure rates were lower than those for non- banks from 1865 until the establishment of the Federal Reserve System in 1913. The failure rate increased only after the establishment of the central bank that was intended to reduce the severity of bank crises (Benston and Kaufman 1996). Furthermore, Dowd (1996) argues that there is no need to establish a central bank in order to provide the lender of last resort function. A lender of last resort providing liquidity assistance to non-performing banks would,

for example, protect bad banks from the consequences of their own actions and hence reduce the incentives for good banks to adopt a virtuous strategy. Free banking would supply adequate liquidity on condition that there would be no legal restrictions for banks to supply the loans to other banks with good collateral.

Moreover, free banking theorists oppose government interventions in the form of government sponsored deposit insurance and government regulation of the financial system, highlighting the moral hazard created by these interventions. They argue that empirical evidence shows intervention generally weakens the financial system by encouraging banks to increase their risk and lower their capital positions, hence causing the problem it is meant to solve. Dowd argues that deposit insurance would diminish the incentives for depositors to monitor bank management and that therefore bank managers would be less concerned about maintaining depositors' confidence. The fight for market share would force them to cut their capital so that they could offer a better rate to their depositors. Furthermore, deposit insurance encourages banks to take excessive risks to maximise the insurance premium. In effect, deposit insurance reduces the safety and health of the banking system.

Dowd concludes that an unregulated banking system with no lender of last resort or deposit insurance system is a stable system. Assuming that information is symmetrically available in the markets so that markets are able to value bank's assets and liabilities and also assuming limited supremacy of big banks, the market forces banks to gain depositors' confidence by maintaining their safety. Depositors

would compensate these safe banks by accepting lower interest rates on deposits. Also, the free market banking system ensures competition between banks and forces them to maintain their capital at a level required by their customers. Therefore banks will be precisely as safe as their customers demand.

Essentially, Benston and Kaufman (1996) support Dowd's free banking system position. They argue that the most important justification for government-imposed regulations is the presence of negative externalities arising from government provided deposit insurance. They reason that other negative externalities such as contagious runs on solvent banks and economic distress or collapse due to bank failure are not strong enough reasons to justify bank regulations.

Benston and Kaufman assert that the market is able to measure and price a bank's risk since in order to gain market confidence banks have the incentives to provide adequate and accurate information to the market. Banks will gain by demonstrating that they are unlikely to fail by providing information about their conditions and operations, via audited financial statements, public announcements and the like. The market would discipline banks that are considered illiquid and unsafe by increasing the required rate of return or withdrawing deposit funds unexpectedly. Banks recognize the risk of insolvency caused by massive deposit withdrawals; therefore they would plan their liquidity and solvency by holding sufficient amounts of liquid assets and capital. However, they admit that a run on one bank might cause a run on a solvent bank if depositors are unable to distinguish between solvent and insolvent banks. Nevertheless, they believe depositors are able to

distinguish between solvent and insolvent banks and that there is very little support from the empirical literature that depositor runs on solvent banks cause insolvencies (Kaufman, 1984). They argue that depositor runs on banks and shareholder sell-offs of bank stocks are bank specific rather than industry specific, and are based on information.

Despite this, Benston and Kaufman (1996) recognise political difficulties in demolishing government-imposed deposit insurance. In response, they suggest having regulation that mimics the way free markets would operate. They conclude that a stable banking system is created with less regulation and government intervention but more market discipline. Markets are not perfect but they have performed better than government in providing a banking system that serves the public well. However, without reliable and adequate information, the market is ineffective in performing its role in disciplining banks. Basel II recognizes the important role of market discipline and the importance for bank managers to disclose required information to enable the market discipline to be effective. Therefore, they include the requirement for banks to disclose information to the market in one of their regulatory pillars as discussed in the next section.

### 2.4.2. Regulated Banking Systems

Supporters of bank regulation base their arguments on two points. First, they argue that regulations insure banks against bank runs and therefore against the risk of systemic failure. Second, they protect liability and capital providers (depositors and

shareholders) from corporate governance problems resulting from the inability of depositors and shareholders to monitor banks. The 2008 Global Financial Crisis highlighted the importance of regulators in protecting shareholders from agency problems resulting from the inability of the market to assess bank risk profiles.

Banks are susceptible to runs because of the nature of their businesses. The asset transformation activities which include liquidity and maturity transformations expose banks to several risks, including bank runs and banking panics (Bhattacharya and Thakor, 1993). Offering debt contracts for liquid deposits that finance illiquid assets creates an inherent potential instability in the banking system. Moreover, even though the first-in-first-served demand deposit contracts are able to provide liquidity for depositors, it leaves banks vulnerable to runs. Bank runs cause real economic problems because even solvent banks can fail, causing the recall of loans and the termination of productive investment (Diamond and Dybvig 1983). Nevertheless, Kaufman (1994) and Benston et al (1986) show very little evidence that bank runs cause solvent banks to become insolvent, even if the depositors are not insured. Moreover, the probability that the failure of a single bank will induce a systemic problem may be very low, but if it were to occur it would be serious and the costs would be high (LLewelyn 1999).

Provision of liquidity services and asymmetric information are two of the main causes of bank runs. Jacklin and Bhattacharya (1988) develop a model that includes information on a bank's risky long-term investments to show how bank runs are triggered. They argue that the release of information when there are informational

asymmetries between depositors and banks could result in depositor panic, which in turn may cause a bank run. Moreover, the liquidity provision function of banks also creates a source of bank run risk since banks operate with liquid liabilities and illiquid assets. The illiquid assets may generate a lower return than that of the liquid deposits if the assets are required to be liquidated early. Therefore, if depositors panic, this position in the balance sheet leaves banks exposed to runs regardless of whether there is perfect information, or even in the absence of adverse information about the bank's assets. Depositors would rush to withdraw their funds before other depositors out of fear that they would be unable to withdraw their funds in full since their position in the queue at the time of withdrawal would determine their ability to withdraw their funds (Diamond and Dybvig, 1983). This would force banks into insolvency regardless of their financial soundness. Realising the fragility of their balance sheet position, banks will be very cautious in maintaining depositor confidence.

Based on the short-term consequences of bank failures, Battacharya, Boot and Thakor (1998) suggest that *information-based runs*, those caused by the release of information on the poorly performing banks, are significant, and provided suitable discipline for banks during the pre-insurance period. Without such market discipline, government-imposed discipline may not be as effective as is expected.

On the other hand, *liquidity-based runs* that are triggered by depositor panic do not seem to be beneficial for the banking system. The costs of such runs come not only in the form of disruption to the operational process but also in the potential to

trigger contagious runs, which may result in failure of the wider financial system. Therefore proper and adequate instruments are required to protect the system from liquidity-based runs.

Several proposals have been made for methods to insulate banks from runs. Dewantripont and Tirole (1993, 1994) propose the representation hypothesis, which focuses on the importance of monitoring banks for depositors because banks are subject to moral hazards and adverse selection problems created by the separation of ownership from management. However, monitoring is costly and efficient monitoring requires adequate information. Moreover, as bank liabilities are mainly held by uninformed depositors and most of them hold only a small deposit, depositors have little incentive to perform the efficient monitoring function required. This problem creates the need for a sophisticated and fully coordinated representative to control and monitor banks.

Others propose government supported deposit insurance (Diamond and Dybvig 1983) which guarantees banks full protection from runs. However, the insurance scheme is not socially free as it is funded by taxes from other sectors in the economy. Furthermore, deposit insurance may create a moral hazard for banks. Empirical evidence shows that deposit insurance weakened the incentive for depositors to monitor banks (Flannery 1998, Peresetsky 2008, Peria and Schmukler 2001,Ioannidou & Dreu 2006). Also, banks would increase their risks to maximise the value of the insurance premiums paid, especially because deposit insurance premium systems (either flat rate or risk-related premium system) are

unable to determine the appropriate deposit insurance premium that reflects banks' risk profiles. Many studies show that to be effective, deposit insurance premiums must be sensitive to the risks to which a bank is exposed. With the ineffective insurance premium, banks can potentially expropriate wealth from the insuring agent and achieve the wealth transfer by increasing their overall risk (Merton 1977, Cummins 1988). Unfortunately, due to asymmetric information problems between banks and regulators and rapid innovation of financial products, pricing risk sensitive deposit insurance premium is still a challenge for regulators (Kaufman 1995).

Therefore, to mitigate the moral hazard of deposit insurance while maintaining protection for depositors, complementary regulations on capital structure are suggested. Allen and Gale (2005) suggest that if properly designed and implemented, bank regulations in the form of capital regulations may reduce systemic risk. However, with the growing innovation of credit risk transfer there have been increased concerns whether capital requirements actually improve financial stability (Calomiris, 2007). There is a small but growing literature on how credit risk transfer affects financial stability. Even though credit risk transfer improves liquidity of bank assets, probability of crisis may also increase since banks tend to increase the level of risks they are prepared to take (Wagner 2005b). Wagner (2005a) shows credit risk transfer can increase portfolio diversification possibilities but it can also increase the probability of liquidity based crises. This is because banks tend to reduce the amount of liquid assets and increase their holdings in risky assets with the increased diversification. Hellwig (1994, 1998) has

argued that attempts to shift risks can lead to a situation where these risks come back in the form of counterparty credit risk.

The role of poorly designed regulation and its interaction with credit risk transfer in increasing systemic risk is investigated by Allen and Gale (2007). Their research shows that transfers of risk around the economy are desirable if markets function well in the sense that risk-sharing opportunities are complete. However, the risk transfers are not desirable if they are the result of inefficient regulation and regulatory arbitrage. Quantifying the use of credit risk derivatives, Minton, Stulz, and Williamson (2005) provide evidence that regulatory capital arbitrage could be a factor in bank decisions to use credit derivatives to hedge loans. Nevertheless, Calomiris (2007) argues that from the perspective of market discipline of financial institutions, regulatory capital arbitrage may not create a significant systemic risk. The greater threat to systemic risk likely comes from government protection and government prudential regulation and supervision that remove market incentives to limit bank risk and maintain adequate capital. Regulatory arbitrage is mainly a problem in the financial system when government removes any private incentive to manage bank risk and puts itself in charge to do so, and then fails to provide an adequate regulatory substitute for private market discipline (Calomiris, 2007).

The following sections discuss regulatory capital requirements and the unintended effects of imposing capital requirements on bank risk taking.

## 2.5. Capital Requirements

Capital requirements determine the capital level maintained by banks in proportion to their assets. Recognising the important role of the banking sector in the payment system and the various impacts of banking crises on the economy, regulators impose mandatory capital requirements which may differ from market generated optimal capital structure.

In order to understand the ideal regulatory capital requirements, theoretical frameworks of market-based capital requirements are discussed in the following section. This is followed by discussion of the regulatory capital requirements applied uniformly by international banks in most developed countries.

### 2.5.1 Market Generated (Optimal) Capital Requirements

Berger et al (1995) define market capital requirements as a bank's optimal capital structure, and they describe the market capital ratio as "the capital ratio that maximizes the value of the bank in the absence of regulatory capital requirements (and all the regulatory mechanisms that are used to enforce them), but in the presence of the rest of the regulatory structure that protects the safety and soundness of banks."

Market capital requirements are determined by introducing the imperfections – taxes, expected costs of financial distress, transaction costs and asymmetric information problems – back into the perfect world of M&M.

Tax may reduce market capital requirements because of the tax deductibility on interest payments. As taxation is reduced, substituting debt for equity allows banks to generate greater returns for investors. However, as risk of financial distress increases with the increase in debt, banks are required to add more capital to protect against bankruptcy risk. Therefore, the expected costs of financial distress tend to raise capital requirements. Optimal capital ratios are determined to be those where the tax advantages of additional debt are offset by the increase in the expected cost of financial distress. This proposition obviously contradicts Miller's (1977) argument. Even though Miller (1977) acknowledges the existence of bankruptcy costs, he insists that the costs seem to be disproportionately small relative to the tax savings they are supposedly balanced against.

The existence of asymmetric information between banks, borrowers, lenders and capital markets enables managers to signal information to the market through capital decisions (Ross 1977; Acharya 1988). Combined with the transaction costs of new equity issues, asymmetric information influences the relative costs of internal versus external finance and the relative costs of debt versus equity. Transaction costs may encourage banks to hold a capital buffer to fund unexpected investment opportunities as well as to protect them against costly unexpected shocks to capital (Berger et al, 1995).

Finally, Berger et al (1995) argue that the safety net provided by regulators, which includes deposit insurance, payments guarantees, as well as capital unrelated regulations and supervision, protects bank creditors from the full consequences of bank risk taking. Therefore it tends to reduce market capital requirements.

### 2.5.2. Regulatory Capital Requirements

Governments provide implicit and explicit unconditional guarantees for most bank creditors. Explicit guarantees come in the form of deposit insurance and implicit guarantees often occur in the form of too big to fail policy (TBTF) , a widespread belief that because of the severe impacts banking crises have on the wider economy, governments will act to guarantee bank deposits. Such implicit guarantees are politically binding (Merton, 1977); the cost on the guarantor is essentially the same as for explicit guarantees.

This safety net creates moral hazard incentives for banks to undertake excessive risk taking. By protecting the 'big' financial institutions, the TBTF policy removes any possibility of bankruptcy and thus allows banks, especially large banks, to avoid paying premiums for the additional risk they undertake, which gives banks more incentives to increase risks in their operations (O'Hara & Shaw 1990). Moreover, the TBTF policy increases banks' moral hazard by reducing uninsured depositors' incentives to discipline banks (Mishkin 2006; Rime 2005; Stern &

Feldman 2004). Due to the lack of monitoring, 'big' financial institutions might take on even greater risks than they otherwise would (Mishkin 1999).

The unconditional guarantees provided by governments imply that banks can obtain deposit funds at essentially the risk-free rate even though those deposits are used to finance risky investment portfolios. Using the Black-Scholes option pricing formula, Merton (1977) shows that, by guaranteeing deposits, the guarantor effectively issues a put option on the assets of the bank which gives management the right to sell the assets to the insurer for a promised payment on the maturity of the deposits. Naturally, the put option is in the money when the value of shareholder capital falls below zero. Therefore, to maximise the value of an insurance subsidy, banks increase the asset risk and leverage since the option value of deposit insurance increases as leverage or asset risk increases (Sharpe 1978; Kareken and Wallace 1978).

Kane (1995) and other studies suggest the reconstruction of the analogy of the put option and by introducing the possibility of government contributed capital. Kane (1995) ultimately questions the application of the Black-Scholes assumptions on the fair premium of deposit insurance. He argues firstly that the pricing model portrays the option as a one period European contract that matures on the bank's next examination date. He reasons that this assumption is not realistic as deposit-insurance options do not expire on a known date. The only reason for a deposit insurance option to expire occurs if, and only if, the authorities decide to make it expire. The second argument concerns the non-randomness of the value of a bank's

liabilities at the expiration date. This assumption fails to recognise the possibility that liability values may fluctuate so that it increases the credit and interest rate risk exposure of the insurers. Pyle (1983) and Ritcken et al (1993) argue that the distribution of asset and liability returns is fixed between examination dates, and that this ignores the possibility that banks tend to increase their risk taking if they are not adequately monitored and disciplined. Lastly, McCulloch (1981) suggests that the lognormal distribution of the Black-Sholes model ignores the possibility of a sudden decline in asset value.

By guaranteeing deposits, regulators become the largest "uninsured creditor" of banks. This raises the need to force mandatory capital requirements to protect regulators from the moral hazard triggered by deposit insurance (Berger et al 1995). Therefore the first objective of capital requirements regulation is to protect consumers as well as the regulators from exploitation by better-informed banks. The second purpose of capital regulation is to protect the economy from systemic risk. Combined with the fragility of their financial structure, banks are often considered to be the source of systemic risk because of their central role in the payments system and in the allocation of financial resources (Berger et al 1995; Saidenberg and Schuermann 2003). Black, Miller and Posner (1978) show that regulatory capital standards are similar to the contractual enforcement of private lending agreements by private debt holders. Furlong and Keeley (1989) show that the marginal value of a deposit insurance option with respect to increasing asset risk declines as leverage declines. Thus, they argue that more stringent capital

regulation will reduce the risk exposure to the insurance system as long as the stringency of the regulations on asset portfolio risk remains unchanged.

Most of the theoretical corporate finance literature agrees that capital and other restrictions may be needed to protect regulators against the costs of financial distress, agency problems and the reduced levels of market discipline caused by the safety net (Berger et al 1995). Santomero and Watson (1977) show that enforcing capital regulation can impose social costs because increasing equity beyond the optimal requirement reduces bank value and increases its weighted average cost of financing. Since capital costs are likely to be passed on to bank customers, increases in financing costs may reduce the size of the banking sector. Therefore they conclude that formulating capital regulation involves a trade off between the marginal social benefit of reducing the risk of negative externalities from bank failures, and the marginal social cost of diminishing financial intermediation.

Berger et al (1995) conclude that regulatory capital requirements differ substantially from market-generated capital requirements. Even though regulators have access to confidential bank information, and are hence able to appropriately price risk and set capital requirements (Berger and Davies, 1994), regulatory requirements only incorporate differences in bank risk. They do not incorporate dynamic changes in demand amongst uninsured depositors resulting from changes in riskiness of individual banks.

#### 2.5.2.1. Impact of (Risk Independent) Regulatory Capital Requirements on Bank Risk Taking

During the initial stages of capital requirement development, most countries used 'flat' or risk unadjusted capital requirements, which are simply a capital level maintained by banks in proportion to their (risk unadjusted) assets.

Theoretically there is no clear indication on the effectiveness of capital regulation in stabilising the levels of risk taking within the banking system. Previous research is conflicting about whether or not banks will generally increase or decrease their portfolio and insolvency risks, as a result of increased capital requirements.

Developing the existing utility maximisation literature, some studies support the hypothesis that the direct effect of a mandatory increase in a bank's capital is to reduce insolvency risk by providing a 'buffer stock' of reserve funds to absorb losses. However, it may also create indirect effects for insolvency risk by inducing portfolio changes. Other theories show that for undercapitalised banks, the indirect effect of increased capital will also reduce insolvency risk, as forced increases in capital induce a reduction in portfolio risk by mitigating the moral hazard incentives to undertake excessive risk created by deposit insurance.

Many studies explain the effectiveness of capital requirements in protecting the banking sector from insolvency, indicating that when banks are forced to hold some minimum levels of capital, a decrease in insolvency risk is observed. On the other

hand, other studies show that when banks are required to hold higher levels of capital, this leads to increased portfolio risk and hence increased insolvency risk.

#### 2.5.2.2. Theories Implying Unintended Effect of Risk Unadjusted Capital Requirements

The ability of risk unadjusted (flat) capital requirements to strengthen the stability of the banking system has been challenged in models based on the mean-variance framework. Utilizing mean-variance utility maximisation models, some studies show that in response to an increase in its required capital ratio, a bank might increase its portfolio risk and hence raise its probability of failure. Koehn and Santomero (1980) and Kim and Santomero (1988) show that if capital is relatively expensive, a compulsory increase in capital diminishes bank expected returns. As a consequence, whilst attempting to maximise its returns, a bank may maximise utility along the restricted risk-return frontier and choose a higher point on the efficiency frontier, with a higher return and a higher risk. In some cases, the increase in bank risk may overcompensate for the increase in capital, and as a consequence insolvency risk might be increased following the raised capital requirements. Including put option value in the utility maximisation model, Keeton (1980) shows the possibility of banks increasing their portfolio risk as a consequence of increased capital standards. However, as Avery and Berger (1991) point out, Keeton's arguments fail to prove whether the increased capital is sufficient to compensate for the increase in portfolio risk, and the resulting impact

on insolvency risk. Clarifying Keeton's findings, Gennotte and Pyle (1991) use a value maximisation model to show that portfolio risk and the probability of bank failure might increase as a result of increased capital requirements. In their model, they show that when a bank has to increase its capital, the bank may simultaneously decrease the size of its portfolio and hence increase its portfolio risk. This new equilibrium may result in a higher overall probability of failure.

On the other hand, Buser et al (1997) argue that even though imposing capital requirements would create positive relationships between capital and portfolio risk, it does not necessarily create unintended impacts. Acknowledging regulation costs, they assert that regulators adjust implicit costs associated with asset risk and bank capital level in order to achieve desired changes. Regulation allows a bank whose capital level has increased to pursue riskier investment. Consequently, a bank with higher risk level will be forced through regulatory pressure to increase its capital level. Therefore changes in capital level and assets risk will be positively related.

Other studies suggest that in the absence of capital requirements, there are other factors such as bankruptcy costs and agency theory that induce positive relationships between capital and portfolio risk. The traditional view of the effect of bankruptcy costs on capital structure decisions explains the positive relationship between changes in bank portfolio risk and capital level. For example, Orgler and Taggart (1983) show that because the value of expected bankruptcy costs is an

increasing function of the probability of bankruptcy, banks would increase capital levels when they increase portfolio risk and vice versa. Agency theory, which explains the different risk preferences between owners and managers as a source of agency costs, also explains the positive relationship between changes in capital level and portfolio risk. Recognising that managers are compensated by risky fixed claims of the bank and have industry and firm specific human capital, Saunders et al (1990) argue that managers have an incentive to reduce bank insolvency risk below the levels that are desired by owners since managers have a great deal to lose personally in the event of insolvency. Managers whose banks have high risk portfolios may compensate for increases in asset risk by setting low leverage (high capital) and vice versa.

#### 2.5.2.3. Theories Implying Risk –Independent Capital Requirements Reduce insolvency risk

Other studies suggest that the mean-variance framework used to analyse the effects of regulatory capital requirements on the portfolio and insolvency risks of banks do not support the conclusion that stringent capital regulation will reduce insolvency risk because they neglect the option value of deposit insurance. Furlong and Keeley (1989, 1990) argue that a bank will never increase portfolio risk as a result of increased capital standards. The capital increase reduces the value of the deposit insurance put option, and hence reduces the incentive for a bank to increase its portfolio risk.

#### 2.5.2.4. Studies Implying Risk Independent Capital Requirements Create a Simultaneous Positive Relationship between Capital and Portfolio Risk.

Some studies acknowledge that adjustments in risk and capital level are simultaneously related. Utilising simultaneous equation estimation and including the partial adjustment process at the risk and capital level, Shrieves and Dahl (1992) indicate that not only are risk exposure and capital level simultaneously related, but also that the majority of banks alleviate the effects of increases in capital level by increasing asset risk posture, and vice versa. They find this relationship holds for banks with capital ratios in excess of regulatory minimum levels. This supports the conclusion that a positive association between risk and capital is not strictly the result of regulatory influence, but rather reflects the view that risk-taking behaviour tends to be constrained by the private incentives of bank owners and/or managers.

### 2.5.3. Risk-Based Capital Requirements

Many studies show that to be effective, capital requirements must be sensitive to the risks to which a bank is exposed. After experiencing high default rates in banking industries, regulators reformed their 'flat' unadjusted risk capital requirements by adjusting bank asset portfolios to the assets' perceived risks.

### 2.5.3.1. Basel Accord I

Released in 1988, the Basel Accord I (Basel I) is the first formalised risk-based capital accord, which sets minimum capital standards for international banks. Basel I focuses on credit risk, which can be defined as the risk of loss due to borrower or counterparty default. Most developed countries apply Basel I as the standard regulatory capital requirement for their banks. The 1988 Basel Agreements work in the following way (Basel Committee of Banking Supervision (1988). In order to obtain the total amount of risk-adjusted assets for any bank, the on-balance sheet assets and off-balance sheet activities of the bank are divided into four categories based on their perceived risk characteristics and they are then multiplied by the corresponding risk factor weight of each category:

- Category I assets (e.g. cash, reserves and government securities) are risk free. The risk factor weight is zero.
- Category II assets (e.g. interbank deposits, fully backed mortgage bonds, general obligations of state and local governments, and securities issued by government agencies) are considered slightly riskier than category I. The risk factor weight is 20%.
- Category III assets (e.g. revenue bonds of state and local governments and residential mortgages) are considered even more risky. The risk factor weight is 50%.
- Category IV assets (e.g. commercial paper, business and household loans, and various fixed assets) are the most risky. The risk factor weight is 100%.

These four categories are then added up to get the total risk-adjusted assets. In order to comply with Basel I, banks must meet two equity capital requirements:

- Tier 1 capital (common stock, retained earnings and perpetual preferred stock) must equal at least 4% of the total risk adjusted assets.
- Tier 1 capital plus tier 2 capital (defined as fixed maturity preferred stock, loan loss reserves and subordinated debt) must equal at least 8% of the total risk based assets.

The Basel I relates bank financing decisions to asset portfolio decisions. When banks shift the composition of their portfolio from the safe assets (e.g. category I and II assets) into more risky assets (e.g. category III and IV assets), they are required to increase their tier 1 and 2 capital, thereby reducing their financial leverage. Similarly, when they shift from risky assets into safer assets, they are allowed to reduce their tier 1 and 2 capital, thereby increasing their financial leverage.

#### 2.5.3.1.1. Critique of Basel Accord I (Basel I)

Basel I risk-based capital standards were introduced as an attempt to remove the possible negative effects of risk-unadjusted capital requirements. Unfortunately, empirical studies demonstrate that the Basel I risk-weighting framework does not

reflect bank risk-taking perfectly. One reason for this is that Basel I risk-based capital standards only take into account credit risk; they do not explicitly incorporate interest rate risk (Jaques and Nigro, 1997). Most studies also found that Basel I is only fairly related to bank risk taking activities (Avery and Berger 1991; Saidenberg and Schuermann 2003). They argue that Basel Accord I capital requirements are insufficient for the protection of bank liabilities. According to Basel I, a shift from categories I – III assets into category IV assets requires additional equity financing. However no additional capital is required for portfolio adjustments which take the form of risk deepening within category IV assets. By applying Basel I, banks are encouraged to structure their activities in such a way as to minimise their regulatory requirements by undertaking activities whose main purpose is to reduce capital requirements with disproportionate reductions in actual risk taking. An undercapitalised bank can increase its risk-based capital ratio by substituting interest-sensitive, low credit risk assets, for shorter-term, higher credit risk assets. The end result would be the bank increasing both its interest rate and portfolio risks, while at the same time reducing its required capital level (Jacques and Nigro, 1997). Furthermore, as a result of its simple additive nature, Basel I fails to incorporate potential capital savings from credit (loan) portfolio diversification. It does not accurately differentiate changes in asset composition for hedging (portfolio risk reducing) purposes from those that are speculative in nature and result in increased portfolio risk (Saldenberg and Schuermann (2003).

### 2.5.3.2. Basel Accord II

The shortcomings of Basel I motivated the creation of a new Basel Accord for capital regulations. Basel Accord II (Basel II) was released in 1999 (see Basel Committee on Banking Supervision, 1999). The objective of Basel II is to produce a capital requirement more closely linked to the actual credit risk exposure of individual banks. It introduces a standardised internal rating-based (IRB) approach for assessing credit risk. Basel II rests on three pillars. The first pillar establishes a minimum capital requirement by replacing the 8% ratio with a new risk-adjusted capital requirement using asset risk weightings based on the creditworthiness of borrowers. The second pillar is a supervisory review process, particularly in assessing the quality of risk management in banking institutions and in evaluating whether these institutions have adequate procedures to determine how much capital they need. The third pillar is the effective use of market discipline by requiring the disclosure of the details of the bank's credit exposures, its amount of reserves and capital, the officials who control the bank and the effectiveness of its internal ratings system (Basel Committee on Banking Supervision, 2001).

The reform process is undertaken in stages with the final objective being to enable banks to develop and use their own credit risk models in calculating their capital requirements. During the first stage the 8% risk based ratio is replaced with the new asset risk weightings based on borrower creditworthiness. At this stage, the credit risk assessments of borrowers are conducted by external credit rating agencies. At the second stage banks use their own internal loan rating system, and

at the final stage, banks are allowed to calculate their capital requirements using their own credit risk model (Altman and Saunders 2001).

#### 2.5.3.2.1. Critique of Basel Accord II

Extensive debate on Basel II mostly is over the reliance on credit ratings agencies in assessing credit risk, the model's continued use of the 8 per cent capital ratio, the model's pro-cyclical effects, and the effectiveness of market discipline. These issues are discussed below.

The credit risk weights and use of credit rating agencies to assess credit risk, as included in stage 1 of the proposal, raises many concerns. Altman and Saunders (2001) find that by using traditional agency ratings, Basel II minimum capital requirements would have been lagging rather than leading during recession, resulting in an enhanced degree of instability in the banking and financial systems. They argue that "a well-designed regulatory system should see capital reserves rising during a period of high profitability and earnings for banks, and falling during recession as 'unexpected losses' are written off against capital". On the other hand, Altman, Bharath and Saunders (2002) challenge the credit-risk weights for the standardised approach as well as the range of risk categories for corporate loans proposed in the early version of Basel II. Using the default history of US corporate bonds, they found that the capital requirements on highly rated borrowers were *significantly higher* under Basel II than is justified by the default experience of such high-grade bonds, while for more poorly rated borrowers the risk weight was *about right*. A number of issues have also been raised about stages two and three of the

reform proposal. For example, Tracey and Carey (2000) are concerned about how internal rating systems of different banks are put together in some standardised set of capital risk weights.

Another important criticism of Basel II is its *pro-cyclical* effects on economic activity that could intensify and extend economic instability. Analysing the cyclical nature of probabilities of default, exposure at time of default and losses given default and the consequences of capital requirements that are adjusted for these cyclical risk factors, a substantial literature confirms Altman and Saunders (2001) findings, namely that regulatory capital under Basel II would increase during recessions and decrease during periods of strong economic growth (Resti 2002; Kashyap and Stein 2004; Goodhart, Hofmann and Segoviano 2004; Illing & Paulin 2005; Altman *et al*. 2005).

Another important concern about Basel II is whether the 8% required capital is adequate. The Basel Committee on Banking Supervision (BCBS) reports that the historical record in developed economies over the last 30 years indicates that 90 per cent of failed institutions reported capital ratios at or near the regulatory minimum just prior to failure (BCBS 2004a). Nevertheless, Gup (2004a) argues that the operational risk profile of US banks (in 2004) is riskier than it was in 1988 so that Basel II regulatory capital is too low for banks in the United States. The increased risk profile is based on three sources: increased exposure of US banks to commercial property loans; an increased proportion of sub-prime lending; and greater exposure to derivatives markets. More specifically, Gup's concerns about

bank's sub-prime assets and credit derivatives were well founded and imply that the risk weights attached to these loans and contracts were inadequate.

Moreover, Acharya (2009) demonstrates that capital adequacy requirements which are based only on individual bank risk could be suboptimal since they do not mitigate the systemic risk incentive, even if they succeed in mitigating the individual risk-shifting incentive. Optimal regulation should be "collective" in nature and should take into account the joint failure risk of banks as well as their individual failure risk. In particular capital adequacy requirements should be increasing in the correlation of risks across banks as well as in individual risks. To give incentives to the banks to be less correlated and thus reduce systemic risk, prudential regulation should require that banks hold greater capital against general risks than against specific risks. (Acharya, 2009)

The effectiveness of disclosure requirements and market discipline described in Pillar III is also the subject of a lengthy literature. In assessing the potential effectiveness for market discipline to enhance bank regulation, Bliss & Flannery (2001) make an important distinction between the roles of *monitoring* and *influence*. Information which is monitored, correctly understood and acted upon by investors will result in effective bank discipline only if management responds to the changed market prices with modified risk-taking behaviour. They further point out that effective monitoring needs two requirements, which are that participants must have an incentive to monitor, and that the suppliers of funds must have the ability to accurately interpret disclosed information. They argue that depositors protected by a perceived safety net are unlikely to have the incentive to monitor, while equity

holders and holders of debt which ranks below deposits are more likely to have an incentive to monitor. In addition, most depositors are unlikely to have the ability to interpret disclosed information, while a greater proportion of equity and subordinated debt holders, especially institutional investors, could be expected to have it. They find little evidence to support the *influence* aspect of market discipline and argue that "it would be dangerous for regulators to rely on a market discipline mechanism in the absence of evidence that *supports* its existence". For this reason, many commentators (Gup 2004b, Kaufman 2004) argue that Basel II's Pillar III provisions contribute little to effective bank supervision.

### 2.5.4. The Impact of Risk Based Capital Requirements on Bank Risk Taking

As discussed in the previous section, the introduction of risk based capital standards is aimed at eliminating the possible unintended effects of risk unadjusted capital requirements. Unfortunately, as Keeton (1989) and Avery and Berger (1991) point out, Basel I capital requirements do not reflect bank risk-taking accurately. Altman and Saunders (2001) find flaws in the reformed Basel II capital requirements, and it should be noted that they have not been fully applied by international banks. If the risk weights are not adequately representing bank risk profiles, then they may have undermining effects. Banks constrained by the capital requirements can improve their capital ratio by decreasing the 'official' risk while business risk is actually increased.

Partial adjustment models developed by Shrieves and Dahl (1992) have been extensively used to study the effectiveness of risk-based capital standards. Using different definitions of capital and risk, Jaques and Nigro (1997) studied the impact of risk based capital standards on bank capital and portfolio risk during the first year of the risk-based capital standards. The results suggest that the risk based capital standards are effective in increasing capital ratios and reducing portfolio risk in commercial banks. Rime (2001) uses the Shrieves and Dahl model to analyse adjustments in capital and risk in Swiss banks as they approach the minimum regulatory capital level. The results indicate that in order to avoid the penalties of breaching the requirements, regulatory pressure effectively induces

undercapitalised banks to increase their capital, but that they do not change the level of bank risk. These results support the intended impact of capital requirements.

Other authors have investigated specifically the effort of undercapitalised banks to meet the risk-based capital standard. Haubrich and Watchel (1993) suggest that implementation of Basel II risk-based capital standards has caused undercapitalised banks to reconstruct their portfolios away from high-risk assets toward low-risk assets. The shift into low risk assets was an effort to avoid greater risk as bank asset portfolios weakened. On the contrary, Hancock and Wilcox (1994) find that undercapitalised banks shifted their portfolio toward high-risk assets.

### 2.5.5. Basel Accord II and The Global Financial Crisis in 2008

The Global Financial Crisis that began to take hold in 2007 originated from a boom in US housing prices between 2002 and 2005 and the rapid growth of *sub-prime* housing loans following a doubling of the amount of prime loans between 2001 and 2003. Sub-prime loans are loans made to borrowers with a weak capacity to make their loan payments. Sub-prime loans were initially encouraged in the US in order to provide loans to those who were not eligible for prime loans. Nevertheless, the business model of the loans was weak since it relied on continuously rising prices for the mortgaged properties (Claessens et al, 2010). The growth in housing lending, exacerbated by the high and rising rate of mortgagee sales from the sub-

prime loans, promoted an increase in the supply of housing which in turn resulted in the supply of housing exceeding the demand. The oversupply led to a fall in housing prices. The crisis immediately spread to the securities markets since most of the sub-prime loans were funded by securitisation through asset-backed commercial paper. The value of the highest-rated of these securities (which were mostly rated AAA) halved between July 2007 and March 2008. The drop in the mortgage-based securities' value created a major credit crisis as new issuers could not afford the resulting higher interest rate and investors wanted to sell the securities. As the result liquidity in both the primary and secondary markets for mortgage backed securities dried up (Claessens et al, 2010).

The crisis then spread to and dried up liquidity in the related markets for structured securities, such as collateralised-debt obligations, which are collateralised by sub-prime loans, and for credit-default swaps. The crisis affected large US investment banks that were not subject to prudential supervision, as well as commercial banks since it was revealed that they held large amounts of these securities on their balance sheets. As a consequence, the flow of funds by banks and between banks contracted. The global nature of the financial markets and a lack of information about banks' exposures resulted in the credit crisis quickly becoming global in scope.

The Basel Committee on Banking Supervision (BCBS) states that Basel II forms a fundamental part of the prudential supervision of individual banks in order to strengthen their individual stability through their capital buffer; nevertheless it

does not aim to *ensure* financial system stability (BCBS, 2008). Accordingly, BCBS states Basel II did not contribute to the emergence of the GFC (Knight 2008).

The involvement of the regulated commercial banks in either sub-prime lending or underwriting the issue of MBSs raised concerns as to why their capital requirement did not encourage them to act more prudently and why their prudential regulator tolerated their risk exposures. Kane (2008) and Ashcraft and Schuermann (2008) argue that the incentives provided by their capital requirement to act prudently was offset by the competition pressure to make profits.

The BCBS announced four amendments to Basel II in response to the GFC (Knight 2008):

1. The BCBS is examining the adequacy of the capital charge for structured securities given their highly correlated risk exposure, as they are backed by the same type of assets. The GFC proves that the value-at-risk method of assessing the capital requirement for such securities during periods of low volatility did not adequately reflect their credit risk when volatility suddenly increased.

2. A credit default risk charge on assets is being developed by the Committee to recognise the credit risk posed by structured credit products that do not have a liquid secondary market.

3. The BCBS is proposing that regulators widen their stress tests of banks' risk-management systems to include contingent credit exposures such as those that

arose when banks took back securitised (or collateralised) assets for reputation reasons.

4. The BCBS is also reviewing its disclosure requirements (under Pillar 3) in relation 'to securitisations, conduits and the sponsorship of off-balance sheet vehicles' (Wellink 2008; BCBS 2008b).

In conclusion, Basel II represents a substantial improvement on Basel I because of its more extensive integration of capital requirements through its greater risk-sensitivity and comprehensive coverage of banking risks. However, the GFC has revealed major weaknesses in Basel II, particularly in the modelling of credit risk.

The GFC also provides a major lesson for Basel II - that bank capital is a necessary but not sufficient requirement for a bank's stability and solvency. Vigilant prudential regulators are needed since the intended impact of the capital requirement on banks' risk-taking behaviour cannot be achieved when the banks gain from their greater risk taking appetite.

### 2.5.6. Capital and Risk Adjustment – Capital Buffer Theory

The traditional moral hazard theory described in the previous sections ignores illiquidity and adjustment costs. In these models, banks never hold capital in excess of the regulatory minimum. However, in reality, banks may not be able to adjust their capital and risk instantaneously due to adjustment costs or illiquid markets. Moreover, as Myers and Majluf (1984) argue, under asymmetric information,

raising equity capital could be interpreted as a negative signal with regard to the bank's value. Therefore, banks have an incentive to hold more capital (capital buffer) than required as an assurance against breaching the minimum regulatory capital requirements. This incentive increases with the increase in the probability of breaching the regulatory capital requirement. However, raising capital is relatively costly compared to raising deposits. This trade-off determines the optimal capital buffer (Marcus 1984, Milne and Whalley 2002).

Unlike the moral hazard theory, capital buffer theory suggests that bank attitudes toward capital and risk depend on the size of the capital buffer. Marcus (1983) suggests that banks with large capital buffers intend to maintain their capital buffers and increase risk when they increase capital; banks with low capital buffers intend to rebuild an appropriate capital buffer by raising capital while simultaneously lowering risk. Therefore, banks with high capital buffers have capital and risk adjustments positively related, while banks with low capital buffers have capital and risk adjustments negatively related.

In conclusion, the controversial nature of regulatory capital requirements has made them a challenging subject which attracts many studies. One thing that the studies have commonly concluded is that capital requirements could not prevent embezzlement. Miller (1995) indicates that bank capital requirements can be expected to continue as a source of inefficiency and a friction between banks and their regulators, but he acknowledges that enhanced capital requirements would be the cheapest solution within the existing regulatory framework.

## 2.6. Other Factors Affecting Capital Decisions and Bank Risk Taking Attitudes

Even though studies show that regulatory pressure has a significant impact on bank risk taking and capital decisions, they also reveal the view that risk-taking behaviour tends to be constrained by other factors as well (Shrieves and Dahl, 1992). The most influential of these factors are discussed in the following sections.

### 2.6.1. Impact of Bank Profitability on Risk and Capital Decisions

The negative association between capital ratios and earnings has been well accepted in the banking literature. The rationale for this hypothesis is consistent with models of perfect capital markets with symmetric information between a bank and its investors (Miller, 1995). High capital ratios reduce risk on equity and therefore lower the expected return required by investors. Moreover, high capital results in a lower tax shield from interest payments, hence reducing earnings after tax.

Despite this argument, after relaxing the perfect capital market assumptions, Berger (1995) finds a number of additional factors that may affect the capital-earnings relationship, making it either positively or negatively correlated. It is even possible to reveal causal relationships between capital ratio and earnings. Berger suggests that positive causality of earnings to capital occurs because banks tend to retain at least part of the marginal changes in their earnings, rather than paying

them as dividends to shareholders. On the other hand, positive causality of capital to earnings is explained using the bankruptcy costs hypothesis. The study shows banks that increase their capital in order to reduce the probability of bankruptcy costs brought on by uninsured debt, have better earnings through lower interest rates paid on insured debt.

The impact of asset risk on the capital-earnings relationship is studied by Gennote and Pyle (1991). Their study shows that under general conditions, the expected value of revenues will move in the same direction as portfolio risk. However, for banks that have monopoly power over their borrowers, asset risk and expected return could be either positively or negatively related since loan prices will not necessarily adjust to market prices (Berger, 1995).

### 2.6.2. Size and Bank Risk Taking Attitude

Size is a significant determinant factor on bank risk taking. Saunders et al (1990), who find a negative relationship between size and asset portfolio risk, argue that larger banks have the advantage of collecting more information from the market and therefore have the ability to diversify their asset risks. Boyd and Gertler (1994) support this finding, adding that even though larger banks tend to have riskier loans, they can diversify the risks better because of the larger scale of their operations. Berger (1995) finds that additional costs would be borne to cover the larger size of operations, but that these costs would be offset by the higher returns obtained from the riskier loans (Ennis 2001). Empirical evidence in the US from the

1930s and earlier shows that larger and geographically diversified banks survive economic downturns better than smaller banks. This suggests that larger and more diversified banks are also safer (Bernanke 1983). This is explained by the fact that banks with operations in many markets (integrated banks) are not only better diversified against local economic shocks, but are also able to use up financial resources better than smaller or local banks (Strahan, 2006). Local banks have limited investment opportunities that force them to be loyal to their customers during the up and downturn periods. Integrated banks, on the other hand, have the opportunity to lend elsewhere in order to offset any losses from local downturns.

Alternatively, Demsetz and Strahan (1997) show that following mergers and acquisitions, larger banks tend to be less risk averse by holding riskier loans and increasing their leverage (reducing equity capital). The increase in leverage offsets the diversification effect of reducing risk. Therefore they conclude that larger banks are not safer than smaller banks. Moreover, Stern and Feldman (2004) suggest that the widespread belief that regulators are unwilling to let larger banks fail (too-big-to-fail policy) also supports the positive relationship between size and risk. If uninsured depositors believe governments would apply the too-big-to fail policy, they will not discipline 'big' banks as they should, then banks would be inclined to become larger and riskier. Previous research on bank economies of scale and scope shows that increasing returns obtain only for small banks, while for larger banks, diseconomies of scale prevail (Berger, Hancock & Humphrey 1993). On the other hand, safety net subsidies including deposit insurance increase with size and

complexity, offsetting diseconomies of large banks. This provides an incentive for banks to become inefficiently large or complex to trade off diseconomies with the safety net subsidies (Kane 2009).

### 2.6.3 Type of Bank Ownership and Risk Taking Activities

A voluminous literature examines the relationship between type of bank ownership and risk taking activities. Banks with different types of ownership (state owned, private domestically owned and private foreign owned) pursue different goals that affect their risk taking attitude. The usual assumption that all shareholders agree on the goal of value maximization may not necessarily apply to state and foreign owners. State owners may be concerned with advancing social or political goals whilst foreign owners may be concerned with the value of the entire international organization, rather than an individual bank in a foreign nation (Berger et al 2005).

Andrews (2005) states that state-owned banks may be explicitly required or implicitly expected to finance loss-making state-owned enterprises, or provide financing on non commercial terms to regions or sectors, or extend credit based on political connections rather than risk assessment.

Supporting this argument, La Porta et. al. (2002) provide two broad views in explaining the objectives and focuses of state owned banks: they are the "development" and the "political" views. The development view focuses on the necessity of financial development for economic growth. They argue that unlike some industrial countries where private banks have been important vehicles for

channelling private savings into industrial development, the economic institutions of developing countries are not sufficiently developed to play this critical role. Therefore, in such countries the governments set up financial institutions to help both financial and economic development. Owning the banks enables governments to collect funds from private savings and channel them towards strategic projects. Through this financing, governments mitigate the institutional failures that weaken private capital markets and promote economic growth.

On the other hand, the political view emphasizes the political objectives of politicians in controlling investment in the economy. The political view states that state financing would fund politically desirable projects, even though the projects are not necessarily socially desired. Owning and controlling banks (and other enterprises) enables governments to provide employment, subsidies and other benefits to their political supporters who in turn will support politicians through votes and other political contributions.

In other words, ownership of bank allows governments to meet both developmental and political objectives; through bank ownership the government controls the choice of projects being financed while leaving the execution of the projects to the private sector. Megginson (2003) and La Porta et al (2002) support this view by looking at the political motivation behind the public provision of services, the inefficiency of state owned enterprises and the benefits of privatization.

Due to developmental and political objectives, the main issues regarding state ownership generally involve credit availability and portfolio allocation, as well as efficiency. Megginson (2003) shows that state-ownership may be inefficient because state institutions may be used to reward political supporters. Moreover, by acting as both owner and regulator of their banks, states create supervisory problems where state-owned banks may be more or less rigorously supervised compare to other types of banks. This could lead to a lower likelihood of detection of emerging potential problems and instigation of corrective measures by the supervisory authority (Andrews, 2005). However, some banks might be either too-big to fail or too important to fail, which would allow inefficient banks to survive, and thus compound agency problems (Williams and Nguyen, 2005). .

In addition, as these banks generally operate with government subsidies and their portfolios may also be allocated for political advantage, the portfolio allocations are not designed to maximize profits (Sapienza, 2002). State banks are exposed to greater risk of losses on loans and investments made for policy or political reasons rather than on pure commercial terms. Andrews (2005) states that government ownership of banks creates potential market distortion in which state-owned banks may operate with cost of fund advantages over private banks, arising from an implicit (or explicit) government guarantee of the deposits of state-owned banks. This may be more pronounced if the state-owned banks are exempted from meeting regulatory capital or other prudential requirements (Andrews, 2005).

Most of the studies on state ownership in developing nations find relatively low efficiency and high non -performing loans. As a result, large market shares for state owned banks are associated with reduced access to credit, diminished financial system development and slow economic growth (La Porta et al 2002; Barth et al 2004; Beck &Levine 2004; Berger et al 2008). In addition, Andrews (2005) also identifies other factors contributing to the weak performance of state owned banks, namely less competent management, overstaffing and other operational inefficiencies, and less well developed risk management.

On the other hand, much research on foreign banks finds that the risk profiles of foreign banks are on average higher than those of domestically owned banks. Berger et al (2005) argue foreign banks are comparatively less risk averse compared to domestic banks due to the fact that foreign owners may be concerned with the value of the entire international organization, rather than an individual bank in a foreign nation. International diversification allows foreign subsidiaries to be more risky since they are just a component of the risk profile of the parent companies. Also, there may be cross subsidies from the parent company which enable foreign subsidiaries to operate with very little financial capital, using the parent company to absorb risks. De Nicolò and Loukoianova (2007) support these arguments, adding that the higher risk taking activities of foreign banks are either because they are not familiar with local markets and/or the risk taking activities are encouraged by lower bankruptcy costs due to guarantees from their parents.

In contrast, some other studies show that foreign banks are less risky and more efficient than domestically owned banks, especially in emerging markets. Utilising East Asian banks, Laeven (1999) argues that foreign banks are disadvantaged by a number of restrictions in these countries, especially in comparison with state banks. Therefore foreign banks take the least risk compared to domestically owned banks. Moreover, foreign banks are expected to be more efficient than domestic banks, especially in emerging markets (Claessens et al, 2001; Leightner and Lovell 1997). Claessens et al (2001) argue that increasing foreign ownership in emerging market banking systems is expected to raise bank efficiency, productivity and technology levels because foreign banks are associated with superior management practices and technology. However Montreevat (2000) argues that the skills can be easily replicated, thus reducing the sustainability of the foreign banks' comparative advantage. Goldberg and Saunders (1981) find that, due to their size, foreign owned banks may have better access to capital markets, superior ability to diversify risks, and the ability to offer some services to multinational clients not easily provided by domestically owned banks.

Studies of private domestic banks show that they behave differently from foreign owned banks. A cross-sectional comparison study on 1600 banks in the emerging markets by Mian (2003) shows that private domestic banks are more aggressive in lending than foreign banks, and therefore they gain higher return on loans and hold significantly less liquid assets than foreign banks, and correspondingly hold more assets in the form of loans. Nevertheless, despite a more aggressive lending policy, default rates of private domestic and foreign banks are not significantly different;

this is also confirmed by risk ratings of loan portfolios provided by credit rating agencies. The similar default rates implies that private domestic banks have less non- performing loans hence are more profitable on the loan side than foreign banks. However interest rate expenses on deposits of private domestic banks are higher, and revenues from the sale of banking services are lower. As a result, the average profitability of private domestic and foreign banks in emerging economies is not significantly different.

Private domestic banks are able to generate higher returns on loans with the same default rates because of the safety support provided by government or shareholders in times of trouble. On the other hand private domestic banks pay a premium over foreign banks on deposits, due to the fact that in times of trouble, foreign banks are more likely to be bailed out by their shareholders or parent banks. This access to emergency liquidity enables foreign banks to lower their deposit cost.

### 2.6.4. Market Structure and Power and Their Impact on Capital and Risk Decisions

Empirical studies show that it is not possible to isolate capital and risk decisions from market structure. Utilising different definitions of market power, many studies analyse the impact of market structure and concentration on bank risk taking attitudes. Heggestad (1977) argues that the insignificant impact of market structure on bank profitability can be explained by the risk-taking attitude of banks

in a particular market structure. He finds that banks with monopoly power have greater risk aversion than banks in competitive markets since they may sacrifice some of their potential profits by choosing riskier portfolios. Similarly, using a simultaneous model, Graddy and Keeley (1979) show that market power is an important explanatory variable in explaining banking behaviour.

Keeley (1990) finds a positive relationship between market power and the market value of capital ratio, with banks with greater market power holding more capital relative to assets, and having a lower default risk. His study also shows that banks with more rapid asset growth have higher market power because rapid growth is associated with lack of competition or success due to other factors. He further suggests that increased competition may reduce bank incentives to act prudently with regards to risk taking.

### 2.6.5. Interest Rate Risk and Bank Risk

Banks raise funds by issuing liabilities with different maturities other than their assets. Therefore changes in the interest rates paid on liabilities relative to the interest rates received on assets will affect earnings which in turn will also affect capital. On the other hand, the role of bank capital is to provide a 'buffer' against losses caused by unexpected changes in the term structure of interest rates.

Bank portfolios are also affected by the interest paid on deposits. The impact of interest rates on bank portfolios is dependent on the type of restrictions (floor or

ceiling limitations) on deposit interest rates. In the case where there is no restriction on interest payments on deposits, the yields on assets would be positively related to the yields on deposits. Banks would adjust their assets portfolio towards higher yielding assets and reduce the capital ratios to offset the impact of increased interest payments on deposits (Silverberg, 1973). Banks are also willing to take additional risk to compensate for a decline in profit as a result of increases in deposit costs. This finding is supported by Marcus (1983) showing the fall in bank capital ratios during periods of high interest rates.

## 2.7. Gaps in the Literature

The literature on bank capital shows that there has been no definitive conclusion as to the impact of regulatory capital requirements on bank insolvency. Utilizing different approaches of mean-variance value maximisation and put option value of deposit insurance, the theoretical literature disagrees on whether capital requirements have a positive or negative impact on bank portfolio risk and insolvency. Empirical studies utilising both non risk-based, as well as risk-based capital requirements, whilst incorporating the concepts of agency and bankruptcy costs, also fail to achieve a common conclusion.

None of these studies formally estimate the impact of *changes* in capital regulation nor do they differentiate between the impact of changes in capital and changes in capital regulation. Furthermore, the studies that are undertaken on banks with

explicit deposit insurance do not consider capital shocks and uncertainty in demand for loans caused by economic instability.

# Chapter 3

# The Economic Crisis and Changes in Capital Regulations in Indonesia

## 3.1. Introduction

In common with most countries, Indonesia has experienced two major financial crises: the Asian financial crisis in 1997 and the global financial crisis (GFC) in 2008. However, the two crises affected Indonesia differently. Indonesia's economy and financial sector displayed resilience in the face of the GFC during the last quarter of 2008. The economy continued to grow in 2009 although at a slower pace and financial soundness indicators continued to improve. The strength of the economy was a result of its greater dependence on domestic consumption rather than exports (IMF, 2009).On the other hand, the impact of the 1997 Asian financial crisis on the Indonesian economy had been devastating.

Indonesia experienced remarkable economic growth for almost three decades before the Asian financial crisis, with an average economic growth of 7% from 1970 to 1989, and 8% from 1990 to 1996. This growth was supported by significant industrialization and structural change, as the share of the agricultural industry in the Gross Domestic Product declined from 55% in 1965 to 19.4% in 1990, while the share of the manufacturing industry increased from 8% to 20%by 1990 (Jomo,

2006). Moreover, the share of trade increased considerably from 14% in 1965 to 54.7% in 1990. As a result, the ability to accumulate savings increased; this was reflected in the increase of national savings of GDP from 7.9% in 1965 to 26.3% in 1990 (Sharma, 2000). In this period, the economic fundamentals looked strong, with the average current account deficit only 2.6% of GDP in the 1990s, while the average budget surplus was only 1% and the ratio of external debt to GDP was declining steadily. In addition, the government successfully increased per capita income from US$75 in 1966 to US$1,200 in 1996. As a result, the proportion of the population living below the poverty line declined from 64% to 11% between 1970 and 1996: this was considered to be one of the largest reductions in poverty worldwide during the period (Kenward, 1999).

The Asian financial crisis began in mid 1997, when the Thai baht sharply depreciated against the US dollar and the impact quickly intensified on other currencies in the region, including the Indonesian currency (rupiah). Even though at this time Indonesia's economy was stronger than Thailand, the rupiah was at risk because of the huge short term and unhedged foreign debt of the Indonesian private corporations. Moreover, the weak financial and banking sector restricted the government's ability to secure its currency (Sharma, 2001).

As a result of the crisis, Indonesia experienced an unstable "twin crisis" - a currency crisis and a banking crisis. There had been a deep recession and the costs of the crisis were over 50% of annual GDP, only second to the Argentinian crisis in the 1980s (Jiwandono, 1999). A noticeable impact of the economic crisis was the

government's attempt to restore the financial sector by closing down and merging the insolvent banks and changing bank capital regulations during the crisis as well as during the period of recovery from the crisis. The impact on the market structure of the Indonesian banking sector was quite significant, with the number of banks reduced by almost 37% in 2000 and dropping further by 48% in 2009 compared to the number in 1997 (see Table 3.1); this reduction strengthened the impact of the economic crisis on bank risk taking attitudes towards insolvency and portfolio risk.

**Table 3.1. Number of Commercial Banks**

| **Type of Bank** | **1988** | **1997** | **1998** | **2000** | **2001** | **2004** | **2005** | **2009** |
|---|---|---|---|---|---|---|---|---|
| State owned | 7 | 7 | 5 | 5 | 5 | 5 | 5 | 5 |
| Regional Development | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 |
| Private Domestic | 53 | 160 | 129 | 81 | 80 | 72 | 71 | 68 |
| Joint Venture | 16 | 34 | 34 | 29 | 24 | 20 | 18 | 15 |
| Foreign Owned | 10 | 10 | 10 | 10 | 10 | 11 | 11 | 10 |
| **Total** | **113** | **238** | **205** | **151** | **145** | **134** | **131** | **124** |

**Source : Bank of Indonesia, Annual Reports 1988 -2009**

This chapter focuses on the dynamics of capital regulations and changes in banks' risk taking behaviour in terms of their liabilities and assets portfolio compositions, as a result of the economic crisis. This chapter consists of two parts: the first part discusses the Indonesian banking system and the second part discusses the impact of both the economic crisis and changes in capital regulations on the shifts in

liability and asset portfolio composition in aggregate and for each type of bank ownership.

### 3.2. Indonesian Banking System

Law No. 7 of 1992 which was amended by Law No 10 of 1998 defines the Indonesian banking system as an instrument of national development for the improvement of economic growth and stability as well as the equitable distribution of wealth. According to the law, there are two types of banking license: (1) license to operate as a commercial bank, and (2) license to operate as a rural bank.

The law regulates permitted activities of commercial banks, including: mobilizing funds from the public in the forms of deposits - demand deposits, time deposits, certificates of deposit, savings - and/or other equivalent forms; extending credit, trading and guaranteeing bills of exchange, trading and issuing bonds as well as short term securities including commercial papers; investing in Certificate of Bank Indonesia (Sertifikat Bank Indonesia or SBI); conducting other business commonly undertaken by banks providing that the activities shall not be in contravention of the Act concerning banking and prevailing laws; engaging in foreign currency business activities with due observance of the regulations stipulated by Bank Indonesia; and finally, conducting equity participation in other banks or business entities in financial services. The law defines the prohibited activities of commercial banks, which include capital participation in business entities other than in

financial services, engaging in insurance business and undertaking business activities other than those stated in article 6 and 7 of Law No. 7.

Commercial banks dominate the Indonesian banking system in terms of total assets and total deposits. At the end of 2009, commercial banks' loans account for 98.47% of the total loans provided by both commercial and rural banks, whilst their deposits account for almost 99% of the deposit market (see Table 3.2)

**Table 3.2. Commercial and Rural Banks (2009)**

NOTE:
This table is included on page 71 of the print copy of the thesis held in the University of Adelaide Library.

**Source : Bank of Indonesia, Annual Report 2010**

On the other hand, rural banks are not involved directly in the payment system and are more restricted in their activities. They are permitted to mobilize funds in the form of deposits such as time deposits, savings, and/or other equivalent forms, to extend credit and financing, as well as the placement of funds in accordance with the provisions stipulated by Bank Indonesia. Activities that are not permitted for rural banks are: the receipt of deposits in the form of *giro* transfer and demand deposits; engagement in foreign currency business activities; conducting equity

participation; conducting business in insurance; and conducting other business activities other than those referred to in Article 13 of Law No. 7.

### 3.2.1. Commercial Banks

The enactment of the ownership of banks in Banking Act No. 7 of 1992 classifies commercial banks on the basis of two types of ownership: domestically owned banks which include state owned banks; private domestic banks and regional development banks; and foreign owned banks which include joint venture banks and foreign banks.

#### 3.2.1.1. Domestically Owned Banks

- **State Owned Banks**

State owned banks play a major role in the Indonesian economy – at times controlling over three-fourths of deposits and assets of the banking system – and they continued to control almost 38%of total assets and 40% of total deposits of the banking system by the end of 2009 (See Table 3.3).

**Table 3.3 Market Share of Total Assets, Total Loans, Total Deposits and Average ROAs in 2009 (in %)**

NOTE:
This table is included on page 73 of the print copy of the thesis held in the University of Adelaide Library.

**Source : Bank of Indonesia, Annual Report 2010**

The role of state owned banks has evolved over time. Initially, their primary role was as an agent for channelling subsidized credits to specific sectors of the economy, provided principally through rediscounting credit facilities from the central bank, Bank Indonesia (BI). Nevertheless, the economic reforms of 1988 have affected the focus of state owned banks; the focus is no longer purely on economic developmental activities. Many of these banks lend into sectors that are not their original focus areas. They involve themselves in corporate lending as well as in providing credit to state owned enterprises and politically connected private groups as instructed by the government (Srinivas (2004)). In addition, the 1992 Banking Law eliminates all legal distinctions between private banks and state owned banks other than the ownership status, while the Law requires the government to retain 51% of all state owned banks. The reform also approved state owned banks' role as fully fledged commercial banks, a situation which continues to the present day.

Weak governance and susceptibility to political pressures forces state owned banks to continue facing the usual problems associated with state ownership, which are high non- performing loans, low profitability and weak corporate governance, as discussed in the literature review (chapter 2). The existence of the implicit government too-big-to fail guarantee further weakens the incentives for these banks to improve their performance as reflected in their Returns on Assets (ROAs) which are lower compared with the industry average (Table 3.3). Despite efforts by the regulators, state owned banks also face the problems of weak implementation of regulation and supervision (Batunanggar, 2002).

Prior to the 1997 financial crisis, there were seven state owned banks :

- Bank Rakyat Indonesia (BRI)
- Bank Negara Indonesia (BNI)
- Bank Bumi Daya (BBD),
- Bank Dagang Negara (BDN),
- Bank Ekspor Impor Indonesia (Bank Exim),
- Bank Pembangunan Indonesia (Bapindo),
- Bank Tabungan Negara (BTN)

As a result of the 1997 Asian financial crisis, 4 banks (BDN, Bank Exim, Bapindo and BBD) were merged into Bank Mandiri, and Bank Expor Indonesia was established in 1999.

- **Private Domestic Banks**

Private domestic banks are the dominant players in the credit and deposit markets, providing 41 % of total loans and 40% of total deposits in 2009 (Table 3.3). Private domestic banks are categorised as Foreign Exchange Private banks (Bank Devisa) and Non Foreign Exchange Private banks (Bank Non Devisa). Foreign exchange private banks are allowed to take deposits, borrow and lend in foreign currencies as well as invest in foreign currency denominated securities. Non foreign exchange private banks concentrate on taking deposits and extending loans in the domestic currency as well as placing funds in domestic securities.

Private domestic banks were severely affected by the 1997 financial crisis; the number of banks has been nearly halved through closures or state takeover, dropping from 160 in 1997 to 81 in 2000 before further dropping to 68 in 2009 as shown in Table 3.1.

- **Regional Development Banks**

Regional development banks are partly or wholly owned by provincial governments. Their main objective focuses on promoting economic development in the regional areas by supporting infrastructure development, small and medium enterprises, the agricultural sector and other activities,

The number of regional development banks is quite stable; in 1998 there were 11 banks which reduced to 10 banks by 2009 as a result of the financial crisis. Their main source of funds is deposits, but unlike other types of banks, the majority of the deposits are from local governments, whilst savings and deposits of individuals are still relatively small reflecting the fact that regional development banks are struggling to compete with other banks in the deposit market. Local government deposits have dropped quite drastically over the years, which make it difficult for the banks to compete in the loan market and to invest in other productive assets. The banks' share of loans in the total provided by commercial banks is very low (8.4% of total loans in 2009), with personal loans dominating the banks total loans (Bank of Indonesia, 2010).

Nevertheless, the low level of loans extended by the banks has generated higher profitability compared to the average industry in 2009 as shown in Table 3.3.

#### 3.2.1.2. Foreign Owned Banks

- **Foreign Banks and Joint Venture Banks**

The 1999 banking act allows foreign banks to operate in the form of either a branch, a subsidiary, or a representative office. A branch is referred to as a foreign bank, while a subsidiary, either through a joint venture with a domestic bank or through merger and acquisition of a domestic bank through the divestment programs after the Asian financial crisis, is referred to as a joint venture bank (BI,

2005). The requirements for a foreign bank to open a branch office in Indonesia are that, it has to be granted a minimum A rating issued by a leading rating agency, as well as being ranked among the 200 largest banks in the world according to total assets.

While representative offices do not conduct business activities, branches (foreign banks) and subsidiaries (joint venture banks) play an active role in the domestic banking industry. Nevertheless, the 1998 Banking Act raised the maximum limit of foreign parties' ownership in domestic banks from 51% to 99% and set a requirement of operating funds of at least IDR 3 trillion (equivalent to USD 300 million) for new branches; this makes it more attractive for foreign parties/banks to acquire shares in existing domestic banks than to establish new branches. This preference is evident as indicated by the recent increases in the number of banks with foreign parties as the controlling shareholders (Bank of Indonesia, 2009). Until the end of 2009, the number of foreign banks was still the same as in 1988 (10 banks). On the other hand, the number of joint venture banks increased by 112% from 1988 to 1997, before it dropped by almost 56% after the crisis, to 15 banks in 2009.

Prudential regulations are uniformly implemented in all types of banks in Indonesia, either domestic, joint venture or foreign banks. Previous restrictions and special requirements for foreign banks, such as an export loan allocation and permitted number of branches, have been abolished. The only restriction for foreign banks is the geographic locations of their branches, as they are only allowed to have their branches in capital cities of the provinces.

The major difference between foreign banks and joint venture banks is the legal form of these banks and the recognition of capital. Foreign banks' legal forms are the same as their parent companies' overseas. On the other hand, joint venture banks are domestic entities which are limited corporations (or Perusahaan Terbatas (PT)) and are legally separated from their parent companies. The capital of domestic banks and joint venture banks is recognised on the balance sheet as paid up capital, whilst foreign banks' capital is recognized on the inter office balance sheet as operational capital.

Total assets of foreign owned banks (foreign banks and joint venture banks) was 15 % of the whole banking sector in 2009, which is almost double the assets before the 1997 financial crisis. The main reason for the significant increase is the sharp depreciation of the rupiah against the US dollar from Rp2.383 in 1996 to Rp9.210 for US$1 in 2009. As a consequence, total assets of foreign banks increased due to the large component of assets denominated in US dollars.

### 3.3. The Impact of Changes in Capital Regulations and the Economic Crisis on Banks' Assets and Liabilities

Based on the period of implementation of capital regulations, which also coincides with the pre and post Asian financial crisis periods, discussion about the impact of the financial crisis and capital regulations on Indonesian commercial banks' assets and liability composition is divided into three parts:

- Pre Asian financial crisis (pre 1997): Regulatory Leverage Ratio of 8%
- The Asian Financial Crisis and Rehabilitation Period (1998-2000): Regulatory Leverage Ratio of 4%
- Recovery and post Asian financial crisis period, beginning of the Global Financial Crisis (2001 -2009): Regulatory Risk Adjusted Capital Adequacy Ratio of 8%

The trend and breakdowns of assets and liabilities pre, during and post Asian financial crisis show that banks have shifted their holdings of risky assets and liabilities composition. The shifts that coincide with the beginning and the end of crisis period suggest that the changes in asset portfolio and liability composition are a result of large losses and increased uncertainty resulting from the Asian financial crisis, as well as banks' reactions to the new financial regulations that were imposed in order to stabilise the financial system.

### 3.3.1 Pre Asian Financial Crisis (pre 1997): Regulatory Leverage Ratio (Risk-Independent Capital Adequacy Ratio) of 8%

Before June 1983, the Indonesian banking sector was heavily regulated and restricted. The market was dominated by state banks, accounting for 40% of the total assets of the entire financial system, with the Indonesian Central Bank (Bank Indonesia) alone holding 35% of the total assets (Bank of Indonesia, 1998). The restrictions imposed included ceilings on bank credits for individual banks and instructions by Bank Indonesia for banks to finance certain types of investment, especially import substitution and backward integration of heavy industries. Bank Indonesia also channelled low-interest liquidity credits provided for "strategic" industries in the private sector. This "strategic" policy turned out to be one of the major causes of the subsequent high non performing loans in the banking sector (Sharma, 2001).

As oil revenues began to decline with the end of the second oil price shock, the government realised the need to reduce its reliance on oil revenues and to increase the contribution of manufacturing and financial services in the economy. Therefore, the government initiated major financial reforms which deregulated the financial system. The deregulation of the financial system was formulated in two packages. The first package, introduced in June 1983, was considered to be the cornerstone of Indonesia's financial development. It removed interest rate controls and credit ceilings for all banks, reduced liquidity credit, and replaced the ineffective credit ceilings with monetary tools and Bank Indonesia certificates. This resulted in

significant increases in the deposit rates and lending activities, especially in private banks (Sharma, 2001).

The second package, also known as PAKTO'88, was released in October 1988 and aimed to improve market competition and reduce restrictions on the establishment of private and foreign-owned banks. The reforms included a major reduction in the reserve requirements of commercial banks (from 15% to only 2%), and in the minimum capital requirement for new banks as well as licenses for new banks, including joint ventures. The policies encouraged the opening of many new banks and intensified competition between banks.

After the removal of most of the barriers to entry and restrictions in October 1988, the banking industry grew rapidly in terms of the number of banks as well as its total assets. By the end of 1996, commercial banks dominated the financial system in Indonesia with the number of banks increasing by 111% compared to 1988, and holding 84% of total assets (Soesastro and Basri, 1999).

The reforms successfully transformed the banking sector into a more competitive system. It became more diverse and more competitive, and was no longer dominated by a small number of state owned banks. The number of private and joint-venture banks increased from 77 in 1988 to 206 in 1993 and further increased to 238 in 1997, while the number of State owned banks remained at seven (Batunanggar,2002)). As a result, the state owned banks' share in total loans decreased drastically from over 52% in 1993 to 40% in 1997 with state owned

banks' loans accounting for about 67% of their assets. The share of state owned banks in total assets declined from 52% in 1993 to 40% in 1997. On the other hand, private domestic banks' share in total assets increased from 37% to 49% for the same periods (Table 3.4), whilst the shares of other types of banks in total assets and total loans were fairly stable.

**Table 3.4. Market Share of Total Assets, Total Loans and Total Deposits : 1993-1997**

**(in %)**

| | | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|
| **Market Share of Total Assets** | **State** | 52.31 | 48.05 | 45.22 | 42.01 | 40.22 |
| | **Private** | 37.09 | 40.97 | 43.38 | 48.00 | 49.32 |
| | **Regional** | 2.38 | 2.62 | 2.70 | 2.72 | 2.36 |
| | **Joint** | 4.78 | 5.08 | 5.22 | 4.02 | 3.77 |
| | **Foreign** | 3.45 | 3.28 | 3.47 | 3.61 | 4.33 |
| **Market Share of Total Loans** | **State** | 45.74 | 42.41 | 39.17 | 35.91 | 33.79 |
| | **Private** | 36.64 | 41.51 | 43.66 | 47.53 | 48.39 |
| | **Regional** | 1.73 | 1.79 | 1.82 | 1.86 | 1.96 |
| | **Joint** | 4.08 | 4.44 | 4.68 | 4.13 | 4.63 |
| | **Foreign** | 3.08 | 3.05 | 3.23 | 3.04 | 3.43 |
| **Market Share of Total Deposit** | **State** | 45.83 | 40.90 | 40.31 | 36.04 | 37.48 |
| | **Private** | 45.79 | 49.93 | 50.61 | 55.28 | 52.80 |
| | **Regional** | 2.98 | 3.29 | 3.32 | 2.81 | 2.29 |
| | **Joint** | 1.36 | 1.80 | 1.83 | 1.72 | 2.08 |
| | **Foreign** | 4.05 | 4.07 | 3.94 | 4.14 | 5.35 |

**Source : Bank of Indonesia, Annual Reports 1993-1997**

In addition, as a consequence of the implementation of the 1988 financial sector reforms, the state owned banks' privileged access to cheap funding from the Bank of Indonesia declined over time. As a result, state owned banks faced not only more

competition in providing banking services but also in obtaining their source of funds. State owned banks share of total deposits fell from 46% in 1993 to 37% in 1997, while private banks dominated the deposit market by increasing their share from 46% in 1993 to 53% in 1997. The other types of banks played a minor role in the deposit market, controlling less than 10% of total deposits during this period.

However, the new development exposed the banking sector to a systemic crisis, since the moral hazard of implicit government guarantees also increased with the more competitive market; banks were taking excessive risks, believing that the government would bail them out from insolvency. By the early 1990s, Indonesian banks faced a high level of exposure to the real estate market, with an unhedged funding mismatch between borrowing short-term from abroad in foreign currencies and lending long-term in rupiah. Short term bank foreign borrowing increased sharply as a percentage of total international bank (Radelet and Sachs, 1998). Foreign lenders may well have been more willing to lend to Indonesian banks because creditors believed these banks carried implicit government guarantees. The lack of hedging was partly due to complacency about exchange rate risk. Throughout the 1990s, Indonesia had enjoyed prolonged currency stability, supported by occasional central bank intervention (Pangestu, 2002). Failure to hedge most foreign debt increased the Indonesian banks vulnerability to capital flow reversal. To make it worse, the banking system was not supported by a required prudential supervisory, regulatory, and legal framework to mitigate the moral hazard of government guarantees (Soesastro and Basri, 1998).

In an effort to avoid bank failure and to limit the continuing increase in banks after 1988, the Indonesian government issued the Banking Law in 1992, which specified that all banks should meet the Bank of International Settlement (BIS) leverage ratio (risk unadjusted capital ratio) of 8% by 1993. The banking law also increased the capital required to set up new banks (Pangestu, 2003). The law included a quantitative and comprehensive Capital, Asset, Management, Equity and Liquidity (CAMEL) rating system, following the CAMEL system applied in the US and other developed economies. In determining the rating of a bank, the CAMEL system multiplies each criterion with the corresponding factor weight (25% for Capital, 30% for Asset Quality, 25% for Management, 10% for Earnings and 10% for Liquidity). Capital, asset quality, earnings, and liquidity factors are calculated using the banks' monthly report submitted to BI, while the management factor is derived from on-site examinations and updated by reference to the results of day-today supervision and prudential meetings. Ratings are classified as "Sound," "Fairly Sound," "Poor" and "Unsound" (Indonesian Banking Law, 1992).

The law also stated that new foreign entrants were obliged to establish joint ventures with a local equity of at least 15% and the minimum capital required for foreign exchange licences banks was tripled. The capital ratio for these banks, raised from 8 % to 12%, was to be implemented at the end of 2001.

Measures to ensure the soundness and safety of the banking systems had been established at this time; however enforcement of these measures was still generally inadequate. The Bank of Indonesia (BI) reported general compliance and few

violations of BI's prudential requirements, such as legal lending limit (LLL), loan to deposit ratio (LDR), and net open position (NOP) (Annual report Bank of Indonesia, 1997). Profitability, as measured by return on assets (ROA), has improved for most of the banks since 1993 (see Table 3.5).

**Table 3.5 Profitability and Risks :1993-1997 (in %)**

Profitability is measured by Return on Assets (ROA), Risks are measured by Loan to Deposit Ratio (LDR), Non Performing Loans (NPL) and Leverage Ratio

| | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|
| **ROA (%)** | | | | | |
| Industry | 1.43 | 1.48 | 2.34 | 2.42 | 2.70 |
| State | 0.95 | -0.30 | 0.50 | 0.90 | 1.14 |
| Private | 1.37 | 2.27 | 1.80 | 1.87 | 2.17 |
| Regional | 1.87 | 1.60 | 2.23 | 2.40 | 1.80 |
| Joint | 2.01 | 1.53 | 2.56 | 2.55 | 2.67 |
| Foreign | 0.96 | 2.30 | 4.62 | 4.40 | 5.71 |
| **LDR (%)** | | | | | |
| Industry | 154.73 | 144.77 | 148.11 | 140.96 | 149.84 |
| State | 127.91 | 135.69 | 127.31 | 127.09 | 125.07 |
| Private | 88.41 | 96.18 | 98.11 | 93.94 | 107.93 |
| Regional | 74.48 | 71.04 | 71.96 | 84.39 | 119.09 |
| Joint | 385.32 | 322.78 | 335.81 | 305.74 | 308.23 |
| Foreign | 97.54 | 98.17 | 107.33 | 93.63 | 88.89 |
| **NPL (%)** | | | | | |
| Industry | 8.20 | 10.90 | 9.38 | 7.80 | 8.70 |
| State | 14.00 | 18.60 | 16.60 | 13.40 | 11.10 |
| Private | 4.06 | 5.40 | 4.90 | 5.10 | 3.60 |
| Regional | 14.98 | 19.90 | 16.20 | 13.50 | 10.90 |
| Joint | 6.10 | 8.10 | 7.20 | 7.10 | 5.40 |
| Foreign | 1.88 | 2.50 | 2.00 | 2.80 | 3.30 |
| **Leverage Ratio (%)** | | | | | |
| Industry | 6.81 | 6.75 | 7.51 | 7.20 | 9.20 |
| State | 6.84 | 6.78 | 7.54 | 7.24 | 9.24 |
| Private | 7.46 | 7.39 | 8.22 | 7.89 | 10.07 |
| Regional | 5.62 | 5.57 | 6.20 | 5.94 | 7.59 |
| Joint | 8.37 | 8.29 | 9.23 | 8.85 | 11.30 |
| Foreign | 6.06 | 6.00 | 6.68 | 6.40 | 8.18 |

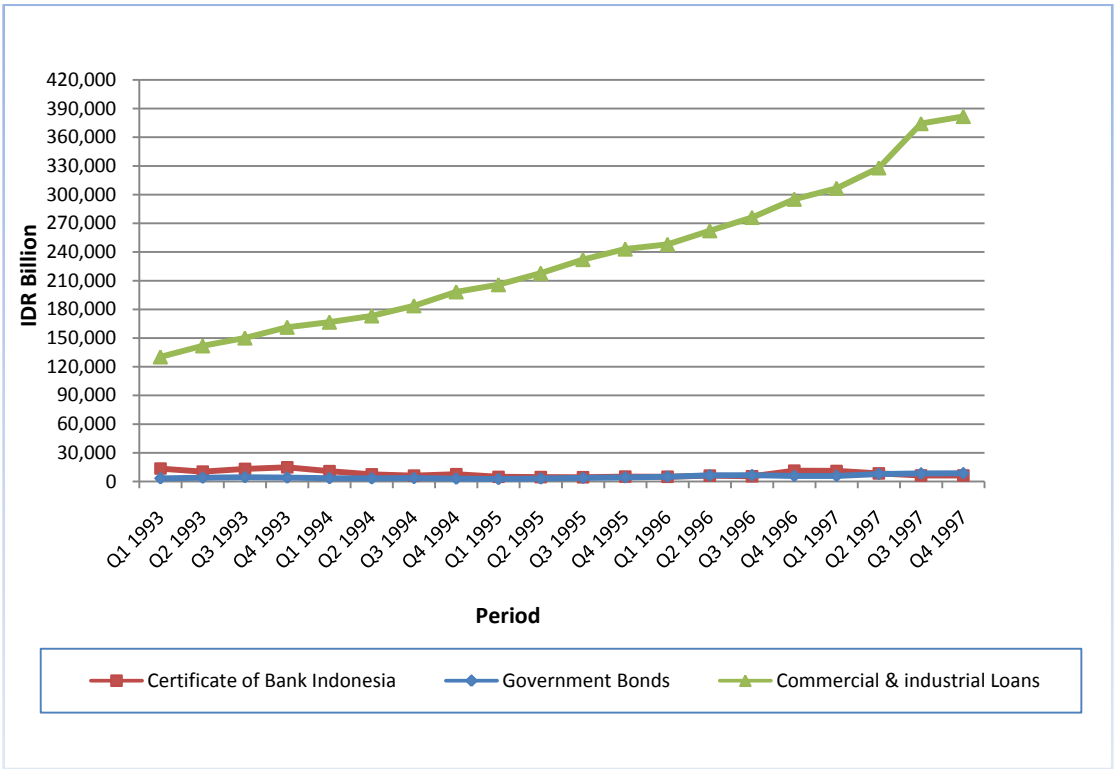
**Source : Bank of Indonesia, Annual Reports 1993-1997.**

Table 3.5 shows that state owned banks were the least profitable banks amongst the others with a negative ROA in 1994. Joint venture and foreign banks had much higher returns due to more efficient credit and liquidity management as well as a relatively higher-quality loan portfolio.

Nonetheless, the Annual Report of Bank Indonesia 1993-1997 showed that the average cost to income ratio was very high, indicating that despite years of liberalization, banks in Indonesia remained extremely inefficient. The report especially shows that state and private domestic banks have ratios above 90%, although a separate study of the top 17 banks puts the figure at 59% (Bank of Indonesia, 1993-1997).

Figure 3.1 shows that the main objectives of the banking deregulation in 1988, allowing banks to increase the supply of business loans to the economy, were achieved.

**Figure 3.1. : Commercial and Industrial Loans, Government Securities (Certificate of Bank Indonesia) and Government Bonds, 1993-1997**



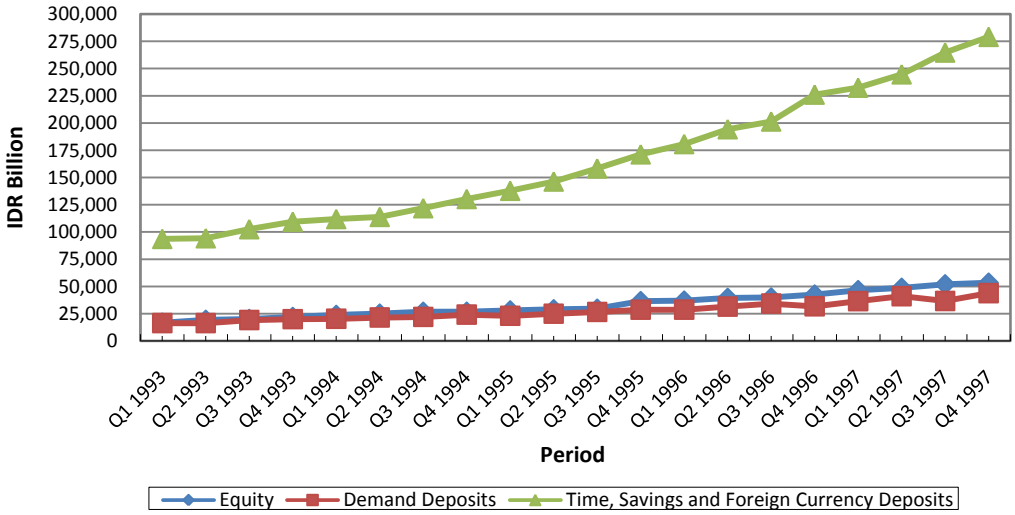

**Source : Bank Indonesia, Annual Reports, 1993-1997**

During this period banks channelled their commercial and industrial loans (C&I) more than their holdings in the government securities (Certificate of Bank Indonesia) and bonds. Bank loans expanded at the annual average rate of 26 percent, much higher than the growth in nominal GDP. In fact the growth of C&I loans exceeded lending capacity growth which was reflected in the high loan to deposit ratio (LDR) that reached an average of 150% in December 1997 (see Table 3.5). Strong loan growth helped the banks disguise deteriorating asset quality, as the sector's reported NPL fell from about 11% in 1994 to 8.7% in 1997. At the end of 1997 the sector continued to be dominated by a handful of large banks; the top

14 commercial banks (6 State banks and 8 private domestic banks) controlled 68% of total sector assets, with the rest (32%) split among 197 small banks (Annual report Bank Indonesia, 1997)

The rapid growth of C&I loans was accompanied by a high growth in Time, Savings and Foreign deposits (TSF). In this period, TSF deposits were the major sources of funds for the banks, as indicated in Figure 3.2. This might be because it is expected that TSF deposits provide sources of funds which are comparatively less sensitive to changes in interest rates than other sources. On the other hand, as also indicated in Figure 3.2, equity capital was the smallest source of funds used.

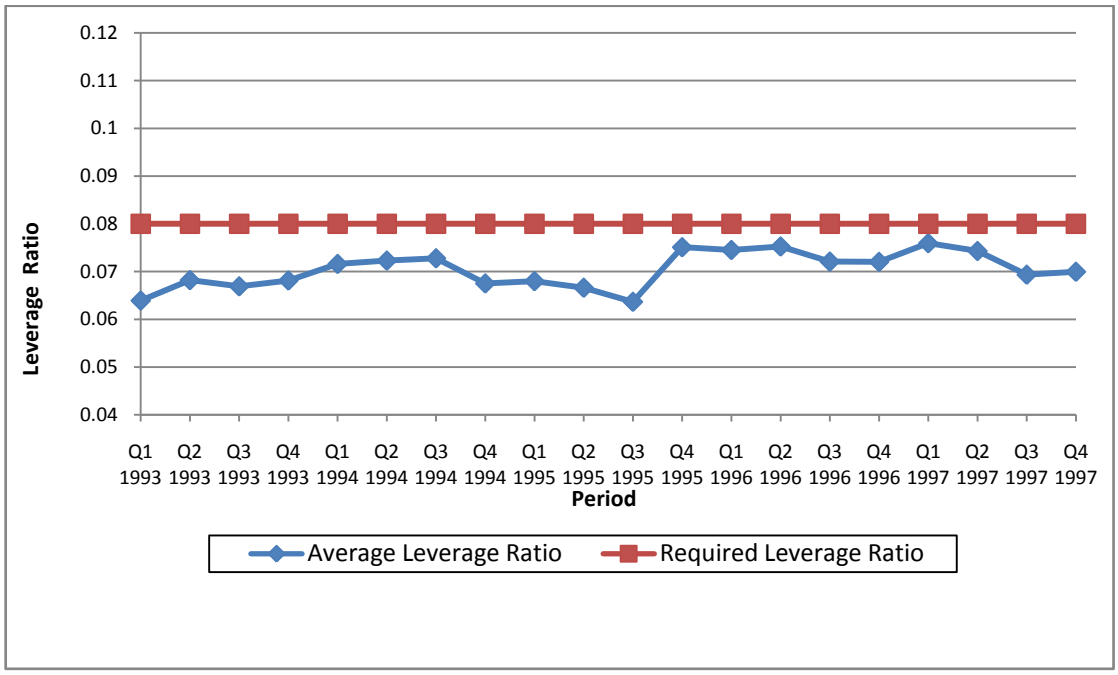
**Figure 3.2 Equity, Demand Deposits and Time, Savings and Foreign Currency Deposits (1993-1997)**




**Source : Bank of Indonesia, Annual Reports, 1993 – 1997**

Figure 3.3 shows that on average banks were undercapitalised, with the industry leverage ratio being lower than the recommended 8% minimum.

**Figure 3.3 Average and Required Leverage Ratio (1993-1997)**




**Source : Bank of Indonesia, Annual Reports 1993-1997.**

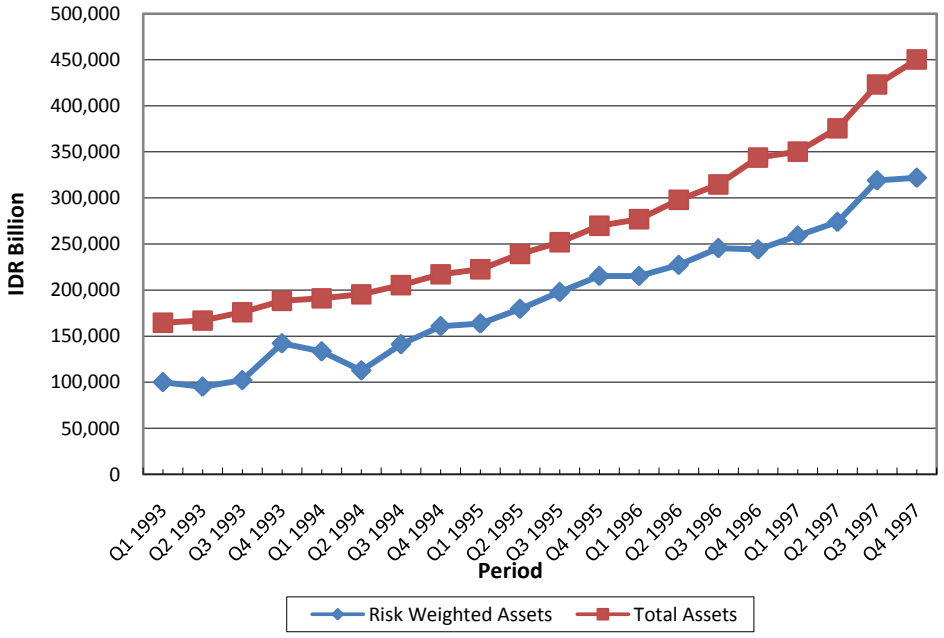
A significant number of banks, especially foreign banks and regional banks from 1993 to 1996, remained undercapitalized with an average leverage ratio of 7% and were not in compliance with the prudential rules as shown in Table 3.5. Private domestic banks were also undercapitalised but not as severely as foreign owned and regional banks.

The combined impact of greater competition from private banks and the newly imposed capital requirements exposed the weak state of the balance sheets of state owned banks. The government committed to recapitalizing these banks to bring them up to the full 8 per cent leverage ratio without adequately recognizing the extent of capital infusions that these banks would require (Cole and Slade (1996)). As the government was facing budgetary constraints at the time, the

recapitalization was funded through a World Bank loan to the government of US$ 300 million in 1994. During the investigation phase of the state owned banks prior to their recapitalization under the World Bank loan, it was revealed that the state owned banks were extensively funding politically connected projects and persons (Srinivas, 2004). As a result of the recapitalisation programs, state owned banks' average leverage ratio increased to 9.2% in 1997.

Furthermore, Figures 3.3 and 3.4 indicate the flaws in the risk unadjusted leverage ratio formulation; as discussed in the literature review (chapter 2), it failed to control banks' risk taking activities.

**Figure 3.4 : Risk Weighted Assets and Total Assets (1993 – 1997)**




**Source : Bank of Indonesia, Annual Reports 1993-1997**

Banks held riskier asset portfolios with lower capital. Implicitly the figures suggest the existence of the moral hazard of government guarantees provided during this period. The government guarantees induced banks to make risky loans that were not sufficiently backed up by capital, because banks believed that the government would rescue them from insolvency. The moral hazard was intensified with close relationship between the government and powerful business groups who also often controlled banks (Sharma, 2001).

The risky lending practices of the private banks involved lending to affiliated companies. As a result of the liberalisation of the economy, many of Indonesia's large business conglomerates opened one or more private banks which were managed so as to provide funds for the affiliated business. The banks extended loans to the businesses, following terms that were dictated by the affiliated businesses, instead of being based on diligent risk-assessment of the companies' creditworthiness (Shrinivas, 2004).

In order to solve these problems, the Banking Law of 1992 (known as Banking Act No. 7) was enacted. The Banking Law restricted the aggregate amount that a bank could lend to affiliated companies (20% of the bank's capital), as well as having a requirement that converted several state banks to limited liability companies. These banks were allowed to lend to non priority sectors.

### 3.3.2 The Asian Financial Crisis and Rehabilitation Period (1998-2000) : Regulatory Leverage Ratio (Risk- Independent Capital Adequacy Ratio ) of 4%

The exchange rate and interest rate shocks that triggered the crisis in mid 1997 had a damaging effect on banks' balance sheets and highly leveraged corporations. The shocks led to the insolvency of many Indonesian businesses and banks. As a result of the sharp depreciation of the rupiah against the US dollar, many Indonesian firms and banks previously thought to be sound could not service their external debt service obligations from their rupiah earnings at the prevailing exchange rate. Furthermore, the deterioration in confidence in the Indonesian banking system resulted in refusal of the international financial markets to rollover short-term debt and accept letters of credit. Market liquidity was further tightened as the government decided to limit access to foreign borrowings and adopted a tight monetary policy in order to reduce speculative attacks on the rupiah. The banking system soon faced a severe liquidity crisis. With banks suddenly not liquid, default by corporate borrowers increased. (Batunanggar, 2001)

The financial crisis forced the Indonesian government to enter its first crisis agreement with the IMF at the beginning of November 1997. It was considered at that stage that the problems in the banking sector did not have the characteristics of a systemic banking crisis. The IMF and the Indonesian government agreed on a comprehensive bank resolution package to intensify supervision, rehabilitate

severely under-capitalized private banks, transfer non-performing assets, create mergers for insolvent state-owned banks and organise the closure of sixteen small and deeply insolvent private banks with limited protection to small depositors. There were fifty banks (or 34.3% of the banking system) included in the agreement (Sharma, 2001).

However, the Indonesian government unexpectedly suspended and closed down the sixteen banks immediately after reaching the agreement with the IMF. This action triggered depositor panic and a bank run, and large numbers of depositors withdrew their funds even from banks that were healthy. As a result, there was a "flight to quality" as depositors moved their funds out of the private banks that were considered to be in trouble into the state banks, which were thought to be safer. In a very short time many banks faced serious liquidity problems because of the loss of their deposit base. (Sharma, 2001; Soesastro and Basri, 1998)

With a lack of transparency about the criteria for closures and lack of information on the soundness of the remaining banks, there was high uncertainty about which banks might be closed. The closing of the sixteen small and insolvent banks with only 2.5% of the total assets did not help to alleviate the crisis, but in fact intensified public loss of confidence. Moreover, because there was no explicit deposit insurance in place, the closure of banks generated panic that quickly became a financial crisis. The closures exacerbated the ongoing liquidity crisis in financial markets, making it much more difficult for all banks to continue their normal lending operations. The situation was worsened by the loss of confidence of

international financial markets in Indonesian banks, and the refusal to rollover short-term debt and to accept letters of credit.

The market's lack of confidence was reflected in the continued depreciation of the rupiah. The banking sector problems turned into a systemic crisis, with liquidity support from Bank Indonesia exceeding over sixty trillion rupiah (about 52% of 1998 GDP), with the risk of hyperinflation and complete financial sector meltdown (Soesastro and Basri, 1998, IMF 2000).

As the crisis broke and deepened in the first half of 1998, it became clear that the policy of closing down all insolvent banks would eliminate a large proportion of the Indonesian banking sector. The government and the IMF therefore prepared a three point plan to recapitalise some of the insolvent banks and merge or close down the rest. First, in order to restore public confidence, the government issued a blanket guarantee for all deposits and rupiah and foreign currency-denominated debts of all domestically incorporated banks (except equity and subordinated debt)[1]. Second, the plan reduced the regulatory leverage ratio from 8% to 4%, notionally to provide a breathing space for the banks and their borrowers. The minimum 4% of leverage ratio was expressed as a minimum ratio of Tier 1 capital to total average adjusted assets (defined as the quarterly average total assets less deductions that include goodwill, investments deducted from Tier 1 capital, and deferred taxes). It was determined based on the minimum leverage ratio of Tier I capital to total average assets applied in the US. A bank with a leverage ratio of less than 4% was

[1] At the time, the government guaranteed deposits only up to an amount of IDR. 20 million-then equivalent to about US$6,000. Prior to the crisis, Indonesia had no explicit deposit insurance (Bank of Indonesia, 2000).

considered seriously undercapitalized (Batunanggar, 2001). Third, the government set up The Indonesia Bank Restructuring Agency (IBRA) to carry out the financial sector restructuring and recapitalisation programmes for a period of five years. The IBRA's task was to take over and rehabilitate weak banks and administer the government's guarantee program for bank debts. All seven state banks had to be recapitalised. The banking sector's average leverage ratio dropped considerably to -15.70% in 1998, with leverage ratios of private and joint venture banks being the lowest among others (see Table 3.6)

**Table 3.6 Profitability and Risk 1998 – 2000 (in %)**
Profitability is measured by Return on Assets (ROA), Risks are measured by Loan to Deposit Ratio (LDR), Non Performing Loans (NPL) and Leverage Ratio

| | 1998 | 1999 | 2000 |
|---|---|---|---|
| **Leverage Ratio (%)** | | | |
| Industry | -15.70 | -8.10 | 12.30 |
| State | -15.77 | -8.14 | 5.13 |
| Private | -17.19 | -8.87 | 19.92 |
| Regional | -12.96 | -6.69 | 16.50 |
| Joint | -19.29 | -9.95 | 16.58 |
| Foreign | -13.96 | -7.20 | 16.38 |
| **ROA(%)** | | | |
| Industry | -18.80 | -6.10 | 0.90 |
| State | -21.90 | -7.11 | 1.47 |
| Private | -21.48 | -6.97 | 2.54 |
| Regional | -23.66 | -7.68 | 1.91 |
| Joint | -30.98 | -10.05 | 5.41 |
| Foreign | -23.36 | -7.58 | 3.14 |
| **LDR (%)** | | | |
| Industry | 81.14 | 54.94 | 38.50 |
| State | 81.39 | 39.20 | 26.40 |
| Private | 82.09 | 22.18 | 26.80 |
| Regional | 62.62 | 49.07 | 44.92 |
| Joint | 115.79 | 100.23 | 84.66 |
| Foreign | 63.81 | 64.05 | 64.28 |
| **NPL (%)** | | | |
| Industry | 48.60 | 32.80 | 18.80 |
| State | 82.93 | 55.97 | 17.40 |
| Private | 24.08 | 16.25 | 20.36 |

| | | | |
|---|---|---|---|
| Regional | 88.73 | 59.88 | 8.86 |
| Joint | 36.12 | 24.37 | 35.16 |
| Foreign | 11.15 | 7.52 | 28.92 |

**Source : Bank of Indonesia, Annual Reports 1998-2000**

In order to restore the soundness of the banking system, the government set up an integrated strategy by merging four of the weakest state owned banks into the newly created Bank Mandiri at the end of 1998. Bank Mandiri controlled about 25% of the banking system assets. The bank was recapitalized in late 1999 to meet the minimum requirement of the 8% leverage ratio. The NPLs of the component banks as well as other state banks were transferred to IBRA. Lack of credit analysis was the main problem for the state owned banks as credit decisions were largely made at the order of the government. Enforcement of the legal lending limit regulation was very weak from BI due to lack of independence (Pangestu and Habir, 2002).

In the case of insolvent or undercapitalised private and joint venture banks, the government had to choose between immediate sale to strategic investors, liquidation, or partial and full nationalisation. In order to identify those banks that were required to recapitalise and to estimate the amount of capital needed, the government audited all the surviving non state-owned banks and classified them into three categories based on their capital adequacy ratios. The categories and leverage ratio specifications were as follows (IBRA, 1998):

- Category A: Banks with leverage ratio above 4%; did not need to be recapitalised, and were allowed to continue business. IBRA classified 74 banks as category A banks, mainly are small foreign joint ventures, holding only 5% of total deposits.

- Category B: Banks with leverage ratio less than 4% but more than -25%; were considered to be potentially worth saving, but needed to be recapitalised. The private shareholders of category B banks could choose whether or not to participate in the recapitalisation program, but first their managers and principal shareholders had to pass the central bank's fit and proper test and have their business plans accepted. If they chose to maintain their ownership in their banks, they had to supply equity of at least 20% of the capital needed to increase the leverage ratio to 4%. The government injected the remaining amount required in the form of bonds. If the shareholders wished not to participate in the recapitalisation programs, their banks were nationalised and they received nothing in return.

  There were 36 banks classified as category B, all of them being private domestic banks. Of the 36 banks, 21 subsequently failed to meet the IBRA's sound management criteria and were liquidated. The IBRA took over a further seven banks; the Government and their private owners identified a further eight for merger and recapitalisation.

- Category C: Banks with leverage ratio less than -25% had to be liquidated. Their owners were required to repay their loans and their assets were transferred to the IBRA in March 1999. Seventeen private domestic banks, accounting for 0.9% of total banking assets, fell into category C and were liquidated immediately (East Asia Analytical Unit, 1999).

Overall, from the mid 1997 to 2000, the Indonesian banking sector had been considerably consolidated and the number of private domestic banks had been nearly halved through closures or state takeovers (see Table 3.1).

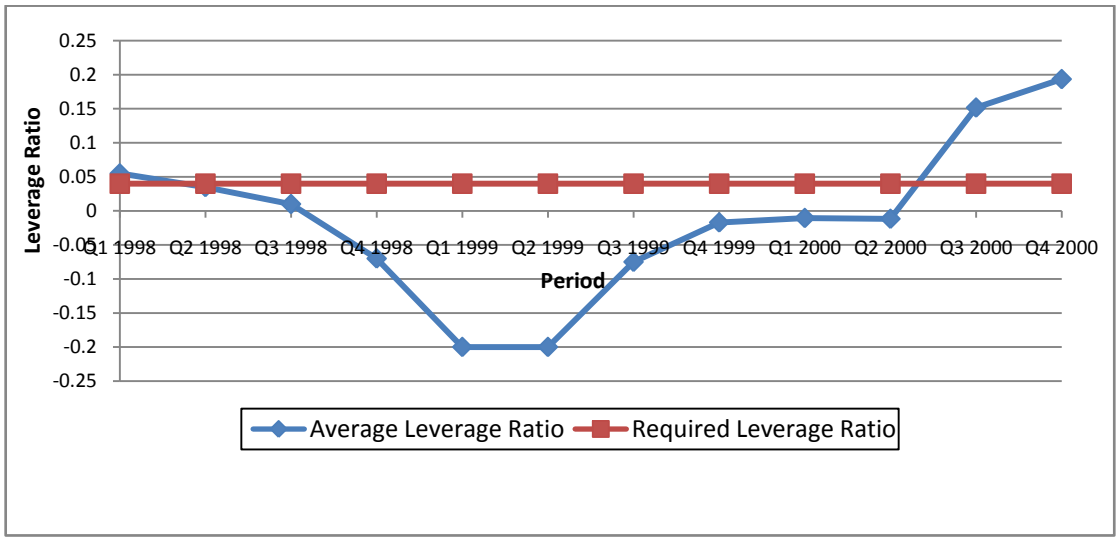
Audits conducted of all commercial banks as part of IMF program revealed that much of the banking system was insolvent and that NPL levels of both state owned banks and private banks were much higher than had been anticipated by the authorities. As discussed in the previous section, the main cause of the high NPLs of the state owned banks was state-directed lending to unviable projects. Also, the moral hazard of the too-big-to-fail principle resulted in little incentive for state owned banks to aggressively try to collect on loans. The gross NPL ratios for all banks reached almost 49% of outstanding loans at the end of 1998 with the state owned banks' NPLs standing at around 83% of outstanding loans in 1998 (Table 3.6). As a result of the weak state of their asset portfolios and the high NPLs with which state owned banks entered the crisis, state owned banks' recapitalization has been one of the most expensive aspects of Indonesian bank restructuring efforts. State owned banks' recapitalization cost the government Rp. 283 trillion as compared to private bank recapitalization of Rp. 147 trillion (Sharma, 2001).

Audits also revealed that most state owned banks were insolvent. Had the authorities adopted the same criterion for state owned banks as they did for the private banks, most state owned banks would have been classified in the weakest category of leverage ratio and would have had to be closed (Srinivas, 2004 ,

Pangestu and Habir, 2002) However, as they were considered to be too big and too important to fail they were recapitalized by the government after undertaking certain operational changes (Srinivas, 2004). The state owned banks' leverage ratios were below the requirements and had been declining from 9.24% in 1997 to -15.77 % in 1998 (see Table 3.6).

After the 1998 recapitalisation program, with the exception of a few banks, the average leverage ratio was still low, below the 4 % minimum, while the lowest were in Q1 and Q2 1999 as shown in figure 3.5 and Table 3.6. Joint venture banks were the most undercapitalised banks with the average leverage ratio of -9.95% , followed by private domestic banks with the average leverage ratio of -8.9%. The low leverage ratio was due to huge loss and low asset quality that diminished the banks' capital. The overall bank profitability as measured by ROA was -18.8% in 1998, improving to -6.1% in 1999 with joint venture and regional banks having the lowest ROAs.

**Figure 3.5 Average and Required Leverage Ratio (1998-2000)**

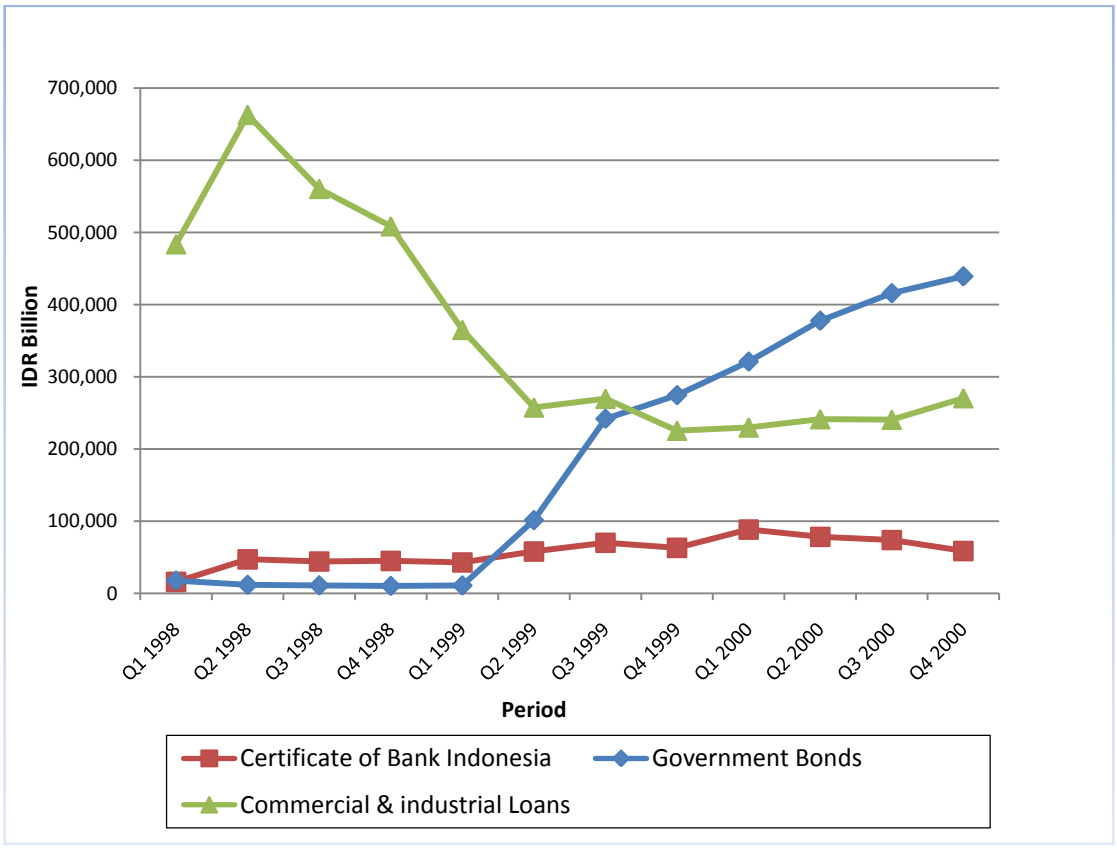


**Source : Bank of Indonesia, Annual Reports 1998-2000**

With the negative net worth, banks reduced the risks of their asset portfolios by reducing the proportion of commercial and industrial (C&I) loans and increasing the holding in government bonds and securities in order to meet the capital standards. Moreover, the high risk in the economy during this period, which was reflected in the high percentage of non-performing loans and worsened by lack of available funds, had increased the funding cost from 17 % in 1996 to 39 % in 1998, whilst the lending rate increased from 19.22% to only 32.15% (Bank Indonesia, 1999). The economic situation restricted the ability of the banks to pass the high funding costs to borrowers; this reduced the expected interest spread of loans, therefore making lending even less attractive relative to government bonds and securities.

The supply of C&I loans that initially increased at the end of 1997 dropped drastically at the beginning of the crisis in 1998, before it reached the lowest point in Q1 2000, following the reduction in the regulatory leverage ratio from 8% to 4% at the end of 1998 as shown in Figure 3.6. The government's decision to reduce the leverage ratio from 8% to 4% in 1998 did not motivate banks to increase portfolio risk by lending more; in fact banks reduced the risk even further.

**Figure 3.6 Commercial and Industrial Loans, Government Securities (Certificate of Bank Indonesia) and Government Bonds (1998-2000)**

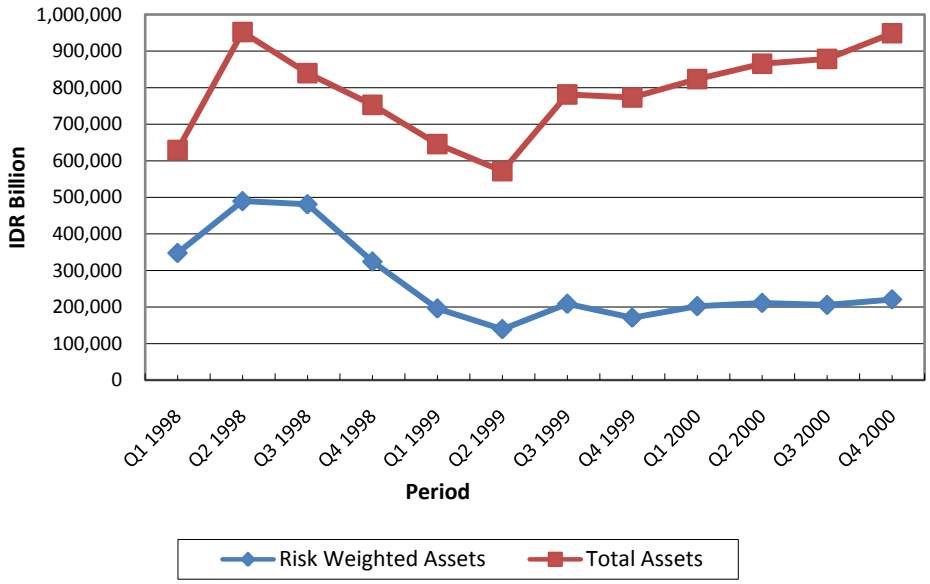



**Source : Bank of Indonesia, Annual Reports 1998-2000**

On the other hand, when bank loans were at the lowest point, holdings in government securities and government bonds increased drastically. The government bonds even exceeded the dollar volume of C&I loans in this period as shown in Figure 3.6. Figure 3.7 supports this, showing a change in the mean of the risk adjusted asset portfolios, which is consistent with the idea that there is a strong incentive for banks to immediately reduce the risk of asset portfolios particularly if they were capital constrained, by shifting from high risk and higher required capital

assets (such as C&I loans) to the low risk and lower required capital assets (such as government bonds and securities).

**Figure 3.7 : Risk Weighted Assets and Total Assets (1998 – 2000)**




**Source : Bank of Indonesia Annual Reports, 1998-2000**

In addition, the increase in government bonds was also due to the recapitalisation programmes. Part of the recapitalisation programme was to transfer the worst non performing loans from all state owned banks and many private banks to IBRA and to be replaced by government bonds. The cash would be realised when the government bonds are sold.

The total loans started to gradually increase again in 2000 even though the supply of loans was still lower than the pre crisis period (1996) while private domestic banks dominated the loan market with 42.3% market share and state owned banks

contributed 38.1% of the total loans (Table 3.7). Figure 3.6 and Figure 3.7 show that as banks reduced their risky assets and maintained a stable and low equity level in 2000, there was a significant increase of the average leverage ratio in 2000 (Table 3.6). Banks' refusal to hold risky assets in the form of loans was worsened by the government's decision to return the regulatory leverage ratio to 8% at the end of 2000.

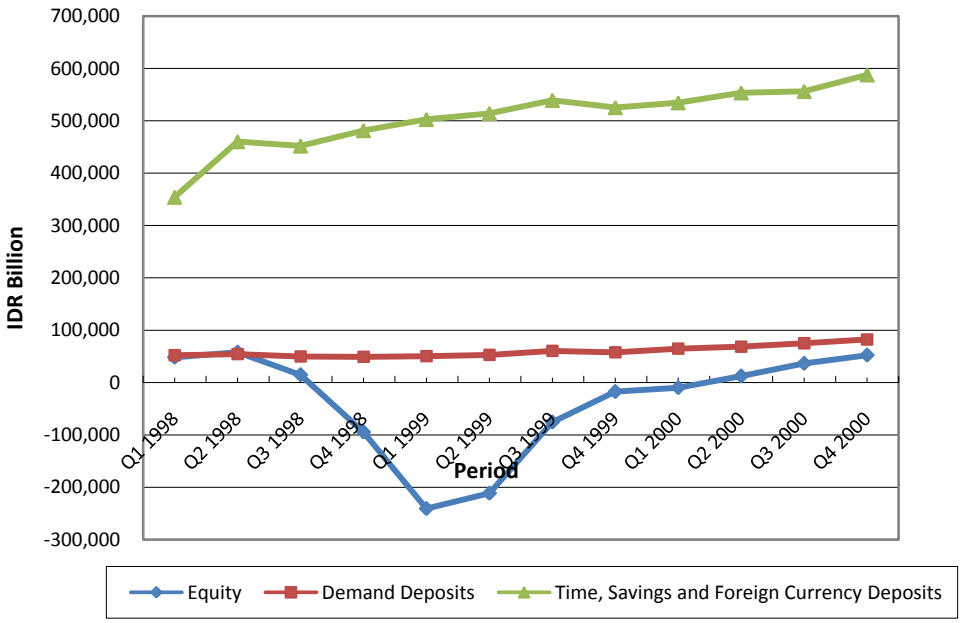
**Table 3.7. Market Shares of Total Assets, Total Loans and Total Deposits 1998-2000 (in %)**

| | 1998 | 1999 | 2000 |
|---|---|---|---|
| **Market Share of Total Assets** | | | |
| State | 43.05 | 51.76 | 51.82 |
| Private | 45.02 | 36.16 | 33.52 |
| Regional | 2.07 | 2.63 | 2.83 |
| Joint | 5.09 | 3.80 | 4.32 |
| Foreign | 5.03 | 6.02 | 7.51 |
| **Market Share of Total Loans** | | | |
| State | 42.32 | 40.03 | 38.10 |
| Private | 45.93 | 45.01 | 42.29 |
| Regional | 1.18 | 2.60 | 2.97 |
| Joint | 5.02 | 5.10 | 7.93 |
| Foreign | 6.01 | 7.20 | 9.15 |
| **Market Share of Total Deposits** | | | |
| State | 45.20 | 43.31 | 42.11 |
| Private | 45.51 | 44.01 | 43.65 |
| Regional | 2.08 | 2.49 | 2.65 |
| Joint | 3.11 | 3.01 | 2.94 |
| Foreign | 4.09 | 7.18 | 8.66 |

**Source : Bank of Indonesia, Annual Reports 1998 -2000**

On the liabilities side, as equity appeared to exhibit a "crash" in the mean of the series at the beginning of 1999 as a result of large losses during the crisis, time, savings and foreign currency (TSF) deposits experienced an unexpected increase in mean as shown in Figure 3.8

**Figure 3.8. Equity, Demand Deposits and Time, Savings and Foreign Currency Deposits (1998-2000)**




**Source : Bank of Indonesia Annual Reports, 1998-2000**

During this period, the market share of state owned banks in the deposit market had increased compared to the period before the crisis. When the crisis intensified, depositors initially shifted funds from private banks to state owned banks – perceiving them to be the safe havens. State owned banks share of deposits increased from 37.5% in 1997 to 45.2% in 1998 before it dropped to 42.1% in 2000 (Table 3.7). As a result, while Bank Indonesia's liquidity support was extensively used by the private banking system, the state owned banks needed almost no liquidity support throughout the crisis (Bank of Indonesia, 2001). After the announcement of the blanket guarantee of deposits, the government also used

the state owned banks as receivers of deposits of closed banks – with matching government bonds on the asset side (Bank of Indonesia, 2000).

During the crisis period, deposits had grown by 35% from 1999 to 2000 for the overall banking system (Bank of Indonesia, 2001). As a result of loans increasing less than deposits, the overall banking system's liquidity risk exposure measured by loan-to deposit-ratio (LDR) decreased from about 81.1% in 1998 to 38.5% in 2000 (Table 3.6). The highest drop in LDR was experienced by private domestic banks; their loan to deposit ratios (LDRs) fell from 82% in 1998 to 27% in 2000 as deposits rose more in proportion to loans. Subsequently, the recapitalization by the government further drastically reduced the LDRs hence improving the banks' liquidity. With the exception of foreign banks, other types of banks including state banks had also experienced lower LDR.

### 3.3.3 Recovery and Post Asian Financial Crisis and beginning of the Global Financial Crisis Period (2001 -2009): Risk Adjusted Capital Adequacy Ratio of 8%

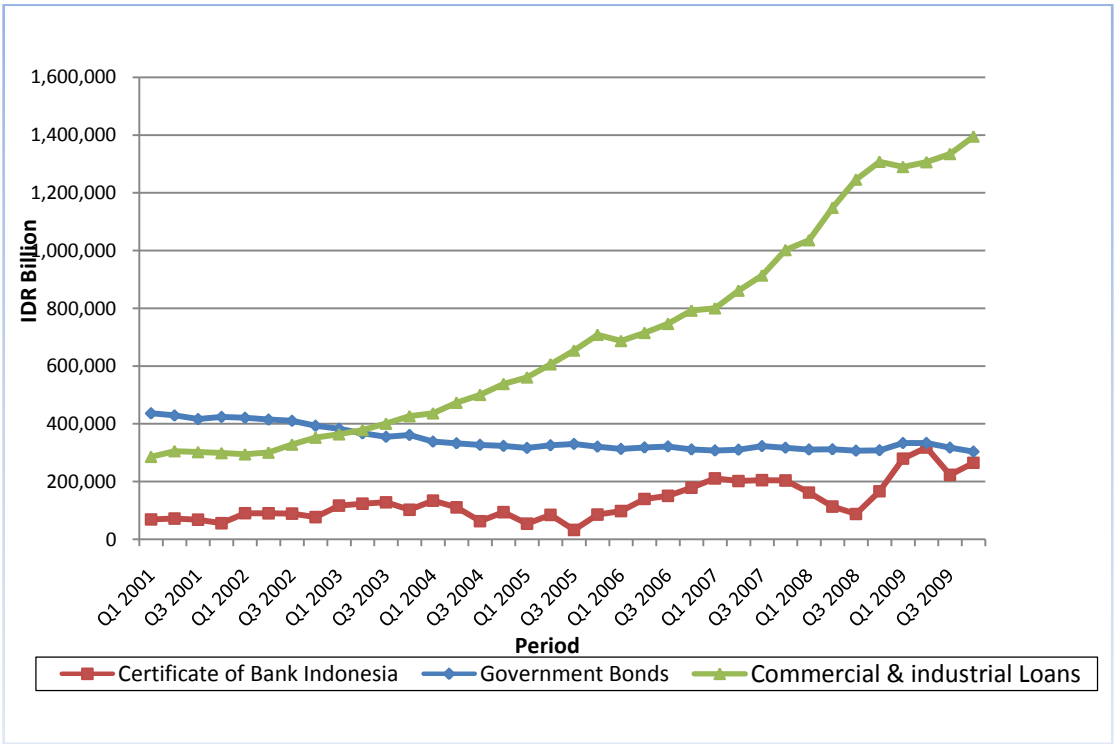
Most of the critical elements that could protect the core banking system and facilitate the revival of intermediation were in place at the end of 1999. Also, the inauguration of the newly elected president in December 1999 completed the political transition to a new government. As a result of the more stable political environment and restructuring and recapitalisation programs, the performance of the banking sector improved as indicated by the increase in leverage ratio and profitability (ROA) at the end of 2000 as shown in Table 3.6. Therefore, early 2001 is considered as the start of the recovery period. Moreover, the period also marked the beginning of the new risk adjusted minimum capital adequacy requirements of 8% imposed by the government to meet the Bank of International Settlement (BIS) Basel I requirement (Bank of Indonesia, 2000)

After 2001, economic performance has been continuing to improve. Economic growth averaged about 4.5% from 2001 to 2004 and 6 % from 2005 to 2009, with strong fiscal performance, while surplus current account and international reserves were at a relatively comfortable level (IMF, 2010). In its 2010 executive report, the IMF stated that the strong fundamentals were achieved as a result of sound macroeconomic policy implementation, including prudent debt management and the development of a sound financial sector.

The banking system's fundamentals strengthened and the process of establishing a robust financial infrastructure was progressing. The government overhauled bank supervision and gradually established a new financial safety net by establishing a deposit insurance agency and amended the central bank law to provide the central bank with an appropriate lender of last resort facility. Moreover, in its attempt to strengthen the banking structure, the central bank issued a requirement for banks to have a minimum capital of at least IDR 80 billion (or $ 9 million) by end-2007 and IDR 100 billion by end-2010 (or $ 11 million) (IMF, 2009).

The restructuring process of both the banking sector and the economy since the crisis has had a significant impact on the structure of banks' balance sheets. The revival of economic growth in the country provides the incentive for banks to start to lend again. Total loans from 2001 to 2009 had grown on average by 20% (Bank of Indonesia, 2009). However, as a contrast to the pre-crisis period when lending to large corporations dominated banks' total loans, the credit growth concentrated in the consumer loan sector (IMF 2009). Banks were initially still reluctant to channel the new lending to C& I loans as the credit risk of corporate borrowers was still high. Nevertheless, as shown in Figure 3.9 , C&I loans experienced a steady increase in mean and trend until the end of 2009. In fact, starting from Q1 2003 up to end of 2004, C&I loans reached a level which was almost the same as the level before the crisis and averaged about 19% on a gross nominal basis and started growing rapidly up to the end of 2009.

**Figure 3.9. : Commercial and Industrial Loans, Government Securities (Certificate of Bank Indonesia) and Government Bonds, 2001-2009**




**Source : Bank of Indonesia Annual Reports, 2001-2009**

The figure also shows that following the implementation of the regulatory risk adjusted CAR of 8% at the beginning of the recovery period in 2001, the patterns of the assets portfolio's trends and means were reversed. The commercial and industrial (C&I) loans and government bonds experienced both breaks in mean and trend of different magnitudes. Figure 3.9 shows banks' holdings in government bonds decreased in mean and trend immediately at the time of the change of capital standards in 2001. In contrast, the supply of C&I loans exceeded the investment government bonds at the end of 2004. On the other hand, investment in Certificate of Bank Indonesia (or Surat Berharga Bank Indonesia) short term securities issued by the central bank showed a break in mean but not in trend during this period.

Banks had gradually reduced their holdings of government bonds as a share of assets, while shifting their holdings in the trading portfolio into variable rate securities, and thus were less affected by the rise in interest rates.

In a breakdown of the total loans into shares of each type of bank, private banks contributed the highest with the average of 37% of the total loans from 2001 to 2003 and increased to the average of 42 % from 2004 to 2009, controlling 40% of the banking system's total assets in 2009. On the other hand, the market share of state owned banks in the loan market increased from around 21% in 2001 to 38% in 2009, controlling 38% of the total assets of the banking system in 2009. Other types of bank controlled about 3% to 9% of the total loans during this period, contributing about 23% of the total assets of the industry in 2009 (table 3.8).

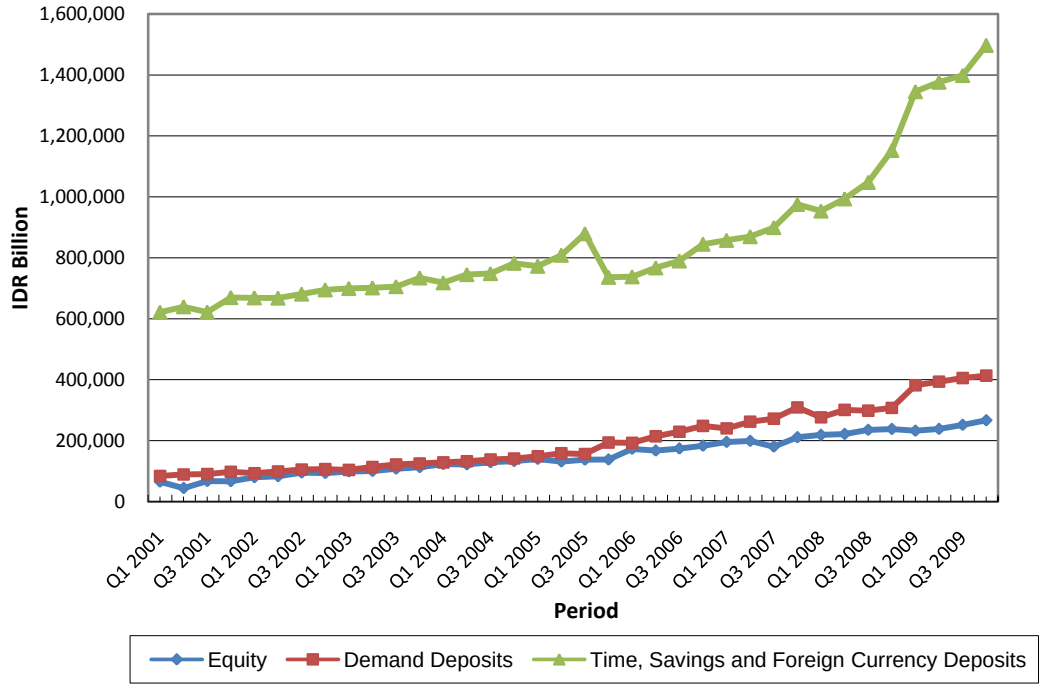
**Table 3.8 Market Shares of Total Assets, Total Loans and Total Deposits: 2001-2009 (in %)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|
| **Market Share of Total Assets** | | | | | | | | | |
| State | 49.08 | 47.64 | 45.53 | 40.80 | 38.48 | 36.67 | 37.35 | 36.68 | 37.86 |
| Private | 35.03 | 35.60 | 37.79 | 40.68 | 40.65 | 40.89 | 40.66 | 40.07 | 39.84 |
| Regional | 3.64 | 5.02 | 5.77 | 6.17 | 7.24 | 9.41 | 8.56 | 8.02 | 8.63 |
| Joint | 3.73 | 3.70 | 3.47 | 3.93 | 4.06 | 3.80 | 4.55 | 5.11 | 5.61 |
| Foreign | 8.52 | 8.04 | 7.44 | 8.42 | 9.57 | 9.21 | 8.87 | 10.11 | 9.39 |
| **Market Share of Total Loans** | | | | | | | | | |
| State | 20.82 | 24.89 | 25.99 | 39.94 | 36.86 | 36.34 | 35.54 | 35.99 | 37.89 |
| Private | 31.91 | 35.84 | 38.44 | 40.19 | 42.32 | 42.20 | 43.07 | 42.17 | 41.12 |
| Regional | 2.64 | 3.55 | 4.16 | 6.67 | 6.46 | 7.06 | 7.17 | 7.37 | 8.40 |
| Joint | 5.00 | 4.15 | 3.66 | 5.54 | 5.31 | 5.15 | 5.84 | 5.80 | 5.63 |
| Foreign | 7.66 | 6.00 | 5.22 | 7.66 | 9.05 | 9.24 | 8.37 | 8.67 | 6.96 |
| **Market Share of Total Deposit** | | | | | | | | | |
| State | 41.82 | 41.86 | 41.10 | 26.85 | 27.42 | 35.27 | 33.21 | 33.70 | 40.11 |
| Private | 43.40 | 43.79 | 43.33 | 30.23 | 30.81 | 40.35 | 37.07 | 36.98 | 39.96 |
| Regional | 4.24 | 5.17 | 5.77 | 11.93 | 9.86 | 14.98 | 19.95 | 19.02 | 6.02 |
| Joint | 2.68 | 2.42 | 2.43 | 25.65 | 26.06 | 2.64 | 3.19 | 3.84 | 4.85 |
| Foreign | 7.86 | 6.77 | 7.37 | 5.34 | 5.85 | 6.76 | 6.58 | 6.46 | 9.08 |

**Source : Bank of Indonesia, Annual Reports 2001 -2009**

On the other hand, deposits grew on average by 11% for the overall banking system, with Time, Savings and Foreign (TSF) deposits still being the major source of funds, exhibiting a stable increase in mean until 2009 as shown in Figure 3.10.

**Figure 3.10. Equity, Demand Deposits and Time, Savings and Foreign Currency Deposits (2001-2009)**




**Source : Bank of Indonesia, Annual Reports 2001-2009**

Private domestic banks' domination of the deposit market returned to the level before the crisis period, as depositors had regained their confidence in the private banks which had been eroded during the financial crisis. Private domestic and state banks dominated the deposit market with a 40% share each in 2009 (Table 3.8).

As a result of the higher percentage of loan growth compared to the deposit growth, the overall banking system's loan-to deposit-ratio (LDR) increased from about 39%

in 2001 to nearly 73% at the end of 2009 (Table 3.9). Private domestic banks were most exposed to liquidity relative to the other types of banks from 2004 to 2008 with their loan to deposit ratios being higher than that of the overall banking system, whilst the average state owned banks' LDR was gradually increasing from 27% in 2001 to around 70% in 2009. Nevertheless, overall liquidity conditions have improved, with overnight interbank market rates and banks' overall excess reserve holdings with BI back to pre-crisis levels (IMF, 2009).

**Table 3.9 Performance and Risk : 2001 – 2009 (in %)**

Profitability is measured by Return on Assets (ROA), Risks are measured by Loan to Deposit Ratio (LDR), Non Performing Loans (NPL) and Leverage Ratio

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|
| **CAR (%)** | | | | | | | | | |
| Industry | 19.30 | 22.44 | 19.43 | 19.40 | 19.30 | 21.27 | 19.30 | 16.80 | 17.42 |
| State | 19.39 | 21.71 | 18.21 | 20.71 | 19.43 | 21.20 | 17.85 | 14.31 | 13.81 |
| Private | 21.13 | 20.81 | 17.63 | 17.19 | 16.12 | 19.56 | 20.68 | 19.63 | 19.01 |
| Regional | 15.93 | 18.48 | 19.10 | 19.14 | 19.24 | 19.12 | 18.35 | 16.82 | 15.82 |
| Joint | 23.71 | 31.40 | 32.65 | 28.35 | 28.78 | 30.78 | 28.22 | 24.95 | 27.04 |
| Foreign | 17.16 | 18.19 | 17.58 | 16.51 | 21.94 | 24.48 | 24.01 | 29.06 | 32.11 |
| **ROA(%)** | | | | | | | | | |
| Industry | 3.03 | 3.16 | 3.32 | 4.31 | 3.05 | 3.62 | 3.63 | 3.33 | 2.88 |
| State | 0.99 | 2.00 | 2.67 | 3.46 | 2.54 | 2.22 | 2.76 | 2.72 | 2.71 |
| Private | 3.20 | 3.15 | 3.11 | 5.88 | 3.13 | 4.43 | 5.43 | 3.45 | 2.20 |
| Regional | 4.10 | 3.83 | 3.05 | 3.99 | 3.38 | 3.38 | 3.08 | 3.70 | 3.65 |
| Joint | 4.42 | 2.42 | 3.36 | 3.00 | 3.31 | 3.72 | 3.06 | 2.87 | 2.32 |
| Foreign | 2.45 | 4.41 | 4.40 | 5.22 | 2.90 | 4.35 | 3.83 | 3.89 | 3.54 |
| **LDR (%)** | | | | | | | | | |
| Industry | 38.60 | 38.24 | 43.52 | 50.00 | 55.02 | 61.56 | 66.32 | 74.60 | 72.88 |
| State | 26.56 | 34.46 | 41.59 | 49.90 | 51.04 | 59.93 | 62.37 | 70.27 | 69.55 |
| Private | 29.33 | 34.92 | 40.41 | 114.97 | 155.75 | 138.29 | 146.16 | 156.38 | 71.14 |
| Regional | 37.43 | 42.04 | 48.22 | 53.39 | 46.96 | 43.33 | 53.53 | 67.28 | 79.31 |
| Joint | 80.98 | 75.76 | 74.10 | 75.56 | 76.82 | 113.66 | 106.53 | 98.63 | 85.45 |
| Foreign | 55.50 | 52.73 | 47.28 | 49.56 | 54.89 | 79.56 | 74.09 | 88.31 | 85.05 |
| **NPL (%)** | | | | | | | | | |
| Industry | 12.10 | 7.50 | 6.78 | 4.50 | 7.56 | 6.07 | 4.07 | 3.20 | 3.31 |
| State | 7.27 | 6.03 | 7.31 | 5.88 | 14.75 | 10.70 | 6.50 | 3.74 | 3.46 |
| Private | 10.06 | 9.46 | 7.24 | 7.01 | 7.56 | 6.80 | 4.54 | 4.46 | 2.88 |
| Regional | 3.12 | 1.94 | 1.74 | 1.74 | 1.86 | 1.59 | 1.68 | 1.41 | 1.71 |
| Joint | 25.11 | 18.63 | 11.95 | 6.36 | 3.91 | 3.61 | 1.58 | 2.03 | 3.08 |
| Foreign | 26.27 | 16.14 | 11.47 | 6.06 | 4.50 | 3.64 | 5.23 | 5.83 | 7.40 |

**Source : Bank of Indonesia, Annual Reports 2001-2009**

With some exceptions, such as weak performance and the question of the accountability of state banks intending to pursue aggressive lending strategies (IMF, 2004), performance of the banking sector had been improving steadily from 2001 with non performing loans (NPLs) gradually decreasing as shown in Table 3.9. Most banks have been successful overall in reducing their non performing loans and returning to high levels of profitability post crisis. Profitability ratios reached their peak in 2004 (4.3%) and non performing loans were at a lower level (4.5%), even though the return on assets declined to 3.1% in 2005 reflecting largely reduced net interest margins.

The year of 2005 was a challenging year for the Indonesian economy. Global oil prices, which soared from about $40 in 2004 to US$60 per barrel forced the government to raise fuel prices by as much as 127% in October 2005; a decision that heightened pressure on macroeconomic conditions and financial system stability. This intensified the risks in the domestic economy and subsequently aggravated potential instability in the domestic financial system. The consequences were reflected by soaring inflation, which reached 17.11% in December 2005 ; significant increases in exchange rate volatility; and a drop in the performance of the balance of payments (Bank of Indonesia, 2006). The adverse impact, however, was contained in such a way that it did not trigger financial instability.

The higher risk in the economy intensified credit risks faced by banking sector, reflected by a higher rate of the industry average non-performing loans (7.56%) in 2005 (see Table 3.9). However, despite this pressure and the rising interest rate,

banks continued to expand their lending. Credit growth as year end of 2005 reached 22.7% with LDR of 55.02% (Bank of Indonesia, 2006). Banking profitability remained positive yet decelerated, as indicated by a decline in the return on assets (ROA)from 4.31% in 2004 to 3.05% in 2005 (Table 3.9).

Economic activities gradually regained as the oil price dropped to $54 in the second semester of 2006. Government's policy of not increasing fuel prices and basic electricity tariffs in 2006 was responded positively, reflected in a drop in inflation to 6.6% in December 2006 (Bank of Indonesia, 2007). The drop in inflation enabled Bank of Indonesia to cut its rate steadily and restored investors' confidence. Consequently, this promoted a surge in capital inflows to Indonesia, which resulted in rupiah appreciation. The banking sector continued to stabilise with steady but slow credit growth. Bank liquidity was adequate but concentrated on short-term deposits (Bank of Indonesia, 2007). Despite lower NPL compared to the previous year (see Table 3.9), high credit risk remained a main feature of the banking industry.

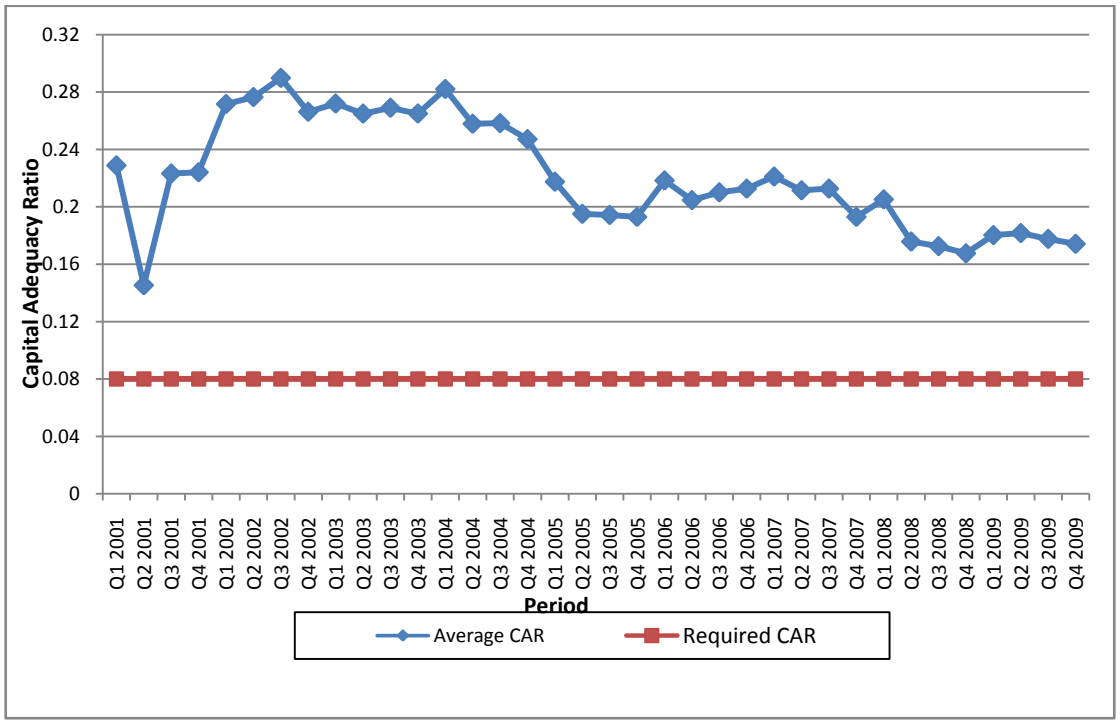
The banking sector profitability indicators strengthened further from 2006 to 2007, in line with the performance of the economy before they dropped slightly in 2009 (Table 3.9). The profitability of banks was strengthened with BI's rate cuts and widening net interest margins.

Nevertheless, state owned banks, which represent over a third of the banking sector's assets, were still unable to improve their nonperforming loans (NPLs)

despite the reported increase in lending (IMF, 2004). State owned banks still have a high share of NPLs; they increased from 7.3% in 2001 to 14.8% in 2005 before they dropped to 3% in 2009 (Table 3.9). Srinivas (2004) highlighted the importance of interpreting such state owned banks' reported NPL numbers with some caution as they are likely to be overstating the true quality of their asset portfolios. Two of the State owned banks – Bank Mandiri and BNI - carried a considerable portion of "restructured" assets on their balance sheets bought from the IBRA at steep discounts. The structured assets were originally taken over by the Indonesian Bank Restructuring Agency (IBRA) from troubled banks as part of the restructuring programs, in return for which banks obtained government bonds. These loans are permitted to be considered as performing for one year from the date of purchase by BI loan classification rules (Srinivas, 2004). Srinivas (2004) also shows that the NPLs for state owned banks would be substantially worse if these types of loans were reclassified as NPLs. With non performing loans, low earnings and liquidity of state owned banks still comparatively high, it appears that, even though C&I loans increased, this did not lead to higher loan repayments.

As profitability steadily increased and the capital base strengthened further, banks retained a larger share of their profits and increased capital. The steady increase in equity capital accompanied the increase in C&I loans resulting in higher average CAR than the requirements from 2001 to end of 2009 (see Figure 3.11). The banks were generally well capitalized as measured by the Basel I Total Capital Adequacy Ratio.

**Figure 3.11 Average and Required Capital Adequacy Ratio (2001-2009)**




**Source : Bank of Indonesia Annual Reports 2001-2009**

The average capital adequacy ratio during the period was 18.7% and stood at about 17.4% at the end of 2009. The largest Indonesian banks were generally healthy due to their larger capital and liquidity cushion, so they were able to resist adverse shocks in the economy without major problems. Nevertheless, as a result of rapid expansion of loans, the high capital ratios had fallen in the period 2003 to 2008, to around 19% from around 22% in 2002 (Table 3.9) although they were still above the capital ratio requirement. This indicated that, even though banks started to lend more and reduced their holdings in government securities, they maintained their capital buffer above the requirements, at the level they perceived to be safe. This suggests banks have learned from the crisis, become more risk averse in respect to insolvency risk and hence maintain a buffer above the required level. Private

domestic and joint venture banks that were two of the most undercapitalised banks during the crisis period raised their capital levels considerably, holding the average CAR of 19% and 28.6% respectively (Table 3.9). In fact, on average joint venture banks were the most capitalised banks, followed by foreign banks.

However, stress tests conducted by the IMF indicated that some of the smaller banks (accounting for 6% of assets) would exhibit a material decline in their CAR and Tier 1 ratios. These banks were more exposed to liquidity risk given their narrow funding base and difficulties accessing the interbank market in times of stress. On the other hand, stress tests conducted by the IMF from 2006 to 2008 on the 15 largest banks (accounting for 68% of banking sector assets) showed that during this period the banking sector was resilient to a range of adverse shocks. Banks were most vulnerable to a sharp deterioration in credit quality and less exposed at this stage to market risk given the underlying shifts in their portfolios. The low market risk was primarily due to the banks generally having a positive net open foreign exchange position, whilst the exposure to equities in their trading book was restricted by regulations (IMF, 2009).

On the institutional side, bank supervision has improved to bring it closer to the Bank for International Settlement standards, and risk-based supervision has been introduced. Several prudential regulations have been modified in order to stimulate credit growth. The Bank of Indonesia reduced capital requirements in several areas, such as lending to small and medium enterprises and investing in corporate bonds, while establishing caps on corporate bond holdings. The modification was due to

previous regulations being considered as overly restrictive, which resulted in limited lending and investments in these areas. All these measures are consistent with Basel II and international best practices, with credit concentration limits raised above international standards.

### 3.5. **Impact of the 2008 Global Financial Crisis (GFC)**

The financial crisis that started in the US in 2008 and then spread to the rest of the world has been momentous to its severity and the degree to which it threaten the stability of the global financial system. Also noteworthy was how Asian countries, especially the emerging economies including Indonesia, weathered the crisis relatively well compared to the US and Europe. This is especially relevant given that the Asian financial crisis caused systemic risks despite the outstanding economic performance of the region in preceding decades.

Unlike during the Asian financial crisis, when the Asian weak and backward financial systems caused the systemic crisis, the GFC affected Asian economies, especially the export oriented ones, not by internal financial problems but by the external financial shocks from Western economies with more advanced financial systems. The GFC transmitted to Asia through the collapse of external demand for Asian exports and a sudden stop of private- capital inflows (Ahn, 2010).

Fortunately, the measures taken to strengthen the financial system and reshape the economy since Asian financial crisis helped Indonesia withstand the GFC much

better than the US and Europe. Various major financial indicators and banking sector data suggest that Indonesia's financial system was well prepared for the crisis. Relatively high profitability and capitalisation, which is indicated by an increasing ROA and a high average CAR over this period, as well as strong balance sheet positions as a result of comfortable level of liquidity and relatively low non performing loans, enabled the economy to absorb the impact of the GFC.

Benefiting from strong initial conditions and timely policy responses, Indonesia's financial sector has displayed resilience in the face of the global financial turmoil during the last quarter of 2008. The economy has continued to grow, although at a slower pace, and financial soundness indicators continued to improve during 2009. The IMF indicated that the ability to survive the crisis was due to Indonesia's greater dependence on domestic consumption than on exports, unlike many of its regional peers. The Bank of Indonesia and the IMF identified several factors that limited the impact of the global financial shocks (IMF, 2009):

- Overall, Indonesia's financial sector succeeded in reducing its external vulnerabilities by maintaining the international reserves at a level that exceeded 150% of short-term external debt with both external and domestic debt ratios following a declining trend.

- Indonesia's financial sector limited its utilization of alternative risky sources of funds and investment in high yields, and hence risky instruments, such as structured credits and derivative products. This is because of the accessibility

and profitability of bank lending and local bond market investments. The IMF indicated that domestic lending to the private sector has been growing by almost 30% due to the increase in economic activity and low real interest rates.

- The banking sector was not only well capitalized and highly liquid but also profitable, which strengthened its ability to absorb any losses due to the GFC.

- Domestic credit was highly profitable and sufficient**,** and has enabled Indonesian corporations to continue to finance their investments locally, reducing their reliance on external funds with their higher cost of funds.

### 3.5. Conclusion

The investigation of the trends and composition of the asset portfolios and liabilities shows that both average capital ratios and portfolio risk were affected by the 1997 economic crisis. Before the crisis, the average leverage ratio was lower than the requirements (Figure 3.3), and risky assets dominated the banks' total assets (Figure 3.4). The fact that banks were undercapitalised before the crisis with an average leverage ratio of only 7.5% shows that not only were they generally heavily leveraged and high in portfolio risk, but also supports the evidence that the adverse impact of imposed risk-unadjusted capital requirements and the moral hazard of government blanket guarantees did not, as a result, effectively protect banks from insolvency. The situation was worsened by the fact that regulators did

not enforce the capital requirements. No pre-emptive actions were taken for undercapitalised banks until they collapsed and were liquidated.

Figure 3.6 shows that during the crisis banks reduced their holdings on risky assets and increased their holdings on riskless assets, such as government bonds and Certificate of Bank Indonesia (SBI). The figures show that the regulators' decision to reduce the leverage ratio requirements to 4% during the period of high uncertainty about the economy reduced the risk taking attitude even further. With negative net worth, banks reduced the risk of their portfolio assets by reducing the C&I loans and increasing government securities.

After the recapitalisation program until the third quarter of 2000, the average leverage ratio was still low, below the 4% minimum, with the exception of a few banks (Bank of Indonesia, 2000).

The banks' refusal to hold risky assets in the form of loans surprisingly was alleviated by the government's decision to increase the minimum leverage ratio to 8% at the beginning of 2001. It appears that banks met the new leverage ratio requirements by offsetting the increase in portfolio risk with increasing equity, so that the average of the leverage ratio reached 22.4% in 2002. Even though the average leverage ratio dropped in the period from 2003 to 2008, banks maintained their leverage well above the requirements. It seems that the increase in the leverage ratio to 8% and the crisis experience have increased banks' risk aversion, especially with respect to portfolio and insolvency risk. The more stable political

environment and restructuring and recapitalisation programs after the crisis resulted in the improvement of the performance of the banking sector as indicated by their increase in profitability (ROA). Relatively high profitability and capitalisation, as well as strong balance sheet positions due to an adequate level of liquidity and relatively low non performing loans, enabled the banking sector and hence the economy to absorb the impact of the GFC in 2008

In conclusion, the economic crisis and changes in capital regulations that were undertaken to restore the economy and banking sector have changed the banks' risk taking attitude. Banks shifted their portfolios away from risky assets to safer assets during the crisis when the capital requirements were low, and increased their holdings in risky assets with higher capital after the crisis when the capital requirements were also raised. The questions are whether the decisions in adjusting asset portfolios and capital are interrelated, and whether the adjustment process was a precautionary reaction to the unstable economy, or whether it was a reaction to the changes in the regulatory capital requirements.

# Chapter 4

# Data

## 4.1. Introduction

The data employed in this thesis is a quarterly aggregate and balanced panel of financial data of all Indonesian commercial banks existing in 2009 (124 banks) and Indonesian economic indicators. The data was collected from the Central Bank of Indonesia (Bank of Indonesia), the Indonesian Ministry of Finance as well as the International Monetary Fund .

Some of the required variables are not available prior to 1993, so the period of observation for this study has been chosen to run from the first quarter of 1993 to the last quarter of 2009. The period of observation contains data from before, during and after the financial crises that occurred at the end of 1997 and the last semester of 2008, as well as three capital regulation regimes, as discussed in chapter 3:

1. 1993 – 1997: Prior to the Asian financial crisis period
   Regulatory Leverage Ratio of 8%
2. 1998 - 2000: During the Asian financial crisis period
   Regulatory Leverage Ratio of 4%
3. 2001 – 2009: Following the Asian financial crisis and beginning of the global financial crisis : Regulatory risk-based Capital Adequacy Ratio of 8%.

## 4.2. Aggregate Data

Time series of the banks' aggregate asset and liability components are used in stationary tests in order to investigate the permanent impact of the financial crises on the risk and capital decisions as well as to identify any important events that have caused breaks in the series discussed in chapter 5. The aggregate data was collected from International Financial Statistics, International Monetary Fund and Bank of Indonesia quarterly from 1993 to 2009.

## 4.3 Firm Level Panel Data

Firm level balanced panel quarterly financial data of all commercial banks existing in 2009 is used to investigate the simultaneous relationships between changes in capital and asset portfolio credit risk and the impact of the explanatory factors on both changes in capital and asset portfolio credit risk discussed in Chapter 6. The panel consists of:

- State owned banks (5 banks),
- Regional banks (26 banks)
- Private national banks (68 banks)
- Joint Venture banks (15 banks)
- Foreign Owned banks (10 banks)

The data was collected from Bank of Indonesia and the banks' financial reports quarterly from 1993 to 2009. As a result of the Asian financial crisis in 1997, some banks disappeared post-crisis due to merging and liquidation. Mergers typically produce sudden and large shifts in bank size and portfolio composition. Liquidations result in a shift of market power. To maintain the stability and representative nature of the sample, mergers are adjusted for by merging the balance sheets of banks that had merged or been acquired by other banks into the balance sheets of the surviving banks. The use of panel data minimises the effect of imbalances in the number of banks from year to year. Nevertheless, it is noted that using a balanced panel data has the potential of creating a survivorship bias since the excluded banks are the failing and poorly performing banks. However, by eliminating failed banks due to extreme credit risk taking and inadequate solvency, this provides conservative analysis on bank credit risk and capital decision (Hovakimian and Kane, 2000)

# Chapter 5

# The Impact of Adverse Shocks in the Economy on a Bank's Decision as to Funding Sources and Asset Portfolio Management.

## 5.1. Introduction

This chapter discusses the permanent impact of economic crises and regulations that may have caused structural breaks in the composition of assets and liabilities including equity capital. The chapter consists of two parts. The first part outlines the stationary tests with multiple breaks that were undertaken in order to identify the significant impacts of any exogenous shocks, such as the economic crisis, on the asset and liability components. Moreover, the tests were also used to identify the financial regulations that created structural breaks in the liability and asset trends following the economic crisis. Examining the shifts in asset and liability compositions shows that banks adjust their funding sources as well as their holdings of risky assets. Analysis of the shifts in the sub-sample periods shows that there are both shifts in series mean and trend, especially during and after the crisis periods. Nevertheless, the analysis does not confirm whether the shifts are permanently caused by the economic crisis. Moreover, the existence of multiple changes to financial regulations during the recovery from the crisis warrants further investigation in order to determine whether the new regulations affect decisions about the composition of bank assets and liabilities.

The second part discusses the results of the stationary tests with endogenously determined breaks. The stationary series has significant implications. If the series is stationary (unit root is absent) this implies that the series fluctuates around a constant long-run mean and random shocks have transitory effects. On the other hand, the non stationary series follows a random walk since random shocks have permanent effects (Phillips and Xiao 1998). Therefore, the stationary tests are carried out to address the first question of this thesis: whether or not the economic crisis has had a permanent impact on the components of bank liabilities and assets.

The tests extend Jacques (2003) methodology, including not only bank holdings in aggregate commercial loans, government short term securities and government bonds but also the two most important sources of funds for a bank: deposits (demand deposits and time, savings, foreign deposits or TSF deposits ) and equity capital. Jacques draws specific conclusions about the different effects on bank portfolios under various time series characterisations as a result of regulatory changes. A unit root bank portfolio composition contradicts the hypothesis that changes in aggregate asset holdings of the banks fluctuate stationarily around deterministic trends. If bank portfolio variables are non-stationary, the exogenous shocks will have a permanent effect on the level of assets in the portfolio. On the other hand, an observed stationary bank portfolio suggests that exogenous shocks will only have a transitory effect and that any distortion caused by a shock would disappear over time (Jacques, 2003). By examining the behaviour of the time series,

this part also identifies the breaks in the series which might coincide with the release of financial regulations.

## 5.2. Methodology

Time series of the quarterly banks' major asset and liability components from 1993 to 2009 are used in stationary tests. The asset components are commercial and industrial (C&I) loans, government short term securities (*Certificate of Bank Indonesia*) and government bonds. The liability components are demand deposits; time, savings and foreign deposits and total equity. The aggregate data was collected from International Financial Statistics, International Monetary Fund and Bank of Indonesia quarterly from 1993 to 2009.

Stationary test models are used to examine the permanent impact of the economic crisis on the components of Indonesian banks' assets and liabilities. Furthermore, multiple break stationary tests are used to identify the monetary and banking policies which created shifts or structural breaks in the components of liabilities and asset portfolios following the economic crisis.

### 5.2.1. Stationary tests

For almost three decades, stationary tests with unit root tests have served a basis for testing and estimating economic relationships and modelling fluctuations in economic activity. The stationary test has become a common practice for testing a

time series in economic models before model estimation is conducted using the estimation method of the standard regression model, Ordinary Least Square (OLS) method. The test of stationary is required since the basic underlying assumption of the OLS method is that means and variances of all variables in the model are constant or stationary over time. The standard asymptotic distribution theory hardly applies to regression of equations that incorporate non-stationary or unit root variables. Therefore estimating the regression equations with non stationary variables using OLS provides misleading inferences (Campbell and Perron 1991). Regression equations with non stationary variables should be estimated based on the cointegration method with the Augmented Dickey-Fuller (1979) testing of the unit roots as a prerequisite to the existence of the cointegration relationship (Phillips and Xiao 1998).

The presence or absence of unit roots explains the features of a series. If the series is stationary (unit root is absence), this implies that the series has a time independent finite variance as the series fluctuates around a constant long-run mean and random shocks have transitory effects. On the other hand, if the series is non-stationary, the variance of the series is time dependent and does not return to a long-run deterministic path. Non-stationary series follow a random walk since random shocks have permanent effects. If the series is non-stationary and the first difference in the series is stationary, the series contains a unit root (Phillips and Xiao (1998).

The widely used methods to test for the unit roots are the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1979 and 1981). The ADF model focuses on the estimate of α . In the following equation, the null hypothesis is α = 0 against the alternative hypothesis of α < 0:

$$y_t = \mu + \beta t + + \alpha y_{t-1} + \Sigma\, c_i\, \Delta y_{t-k} + e_i \qquad (1)$$

where

Δ denotes the first difference,

$y_t$ is the time series being tested,

$t$ is the time trend variable, and

$k$ is the number of lags which are added to the model to ensure that the residuals, $\varepsilon_t$ are white noise.

In order to determine the optimal lag length of $k$ , Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) are used . If the null hypothesis is not rejected, this implies that the series is non-stationary; on the other hand the time series is stationary if the null hypothesis is rejected.

Research utilising the unit root is mainly aimed at investigating whether random shocks have transitory or permanent impacts on a time series which can be tested using the ADF model. The ADF model was made popular by Nelson and Posser (1982) who studied fourteen macroeconomic US-based time series and proved that the null hypothesis of a unit root cannot be rejected for all fourteen series. The most important implication of the findings is that the fluctuations are not transitory, that is the random shocks have permanent impacts on the long-run level of

macroeconomics. The findings contradict the traditional view of the unit root hypothesis, which is that the current shocks only have a temporary effect and the long-run movement in the series is unaffected by such shocks. Utilising different methods, a number of subsequent studies (Phillips and Xiao (1998) and Maddala and Kim (2003) confirm this result. The results suggest that most macroeconomics series are characterised by stochastic processes instead of trend stationary processes, confirming the conclusions of Nelson and Posser. An important implication from these results is that random shocks have a permanent impact on the system.

### 5.2.2. Stationary Tests with Structural Breaks

Further studies on stationary tests suggest that the stationary test should take into account the presence of structural breaks as a result of shifts in the time series trend and slope. If structural breaks are not incorporated in the specification of an econometric model, the results may be biased toward the incorrect non-rejection of a non-stationary hypothesis (Perron, 1989; Perron, 1997; Leybourne and Newbold, 2003).

Structural breaks create problems in testing the null hypothesis of structural stability against the alternative of one structural break. Perron (1989) suggests a conventional way of dealing with structural breaks, by assuming the potential break a priori under the underlying asymptotic distribution theory. In constructing the relevant test statistics, Perron extended the standard Dickey Fuller procedure

by adding dummy variables to represent different intercepts and slopes. Due to concern about the validity of the assumed exogeneity of the breaks, Christiano (1992) argues that the method creates endogeneity or sample selection problems which invalidate the distribution theory underlying conventional testing. He suggests the use of data-based procedures to determine the potential breaks. Other studies (Banarjee, Lumsdaine and Stock 1990, Zivot and Andrews 1992) modify Perron's (1989) model by endogenously determining the break date. The break point is chosen so that it minimises the value of the t-statistics for which the null hypothesis of a unit root is to be rejected.

In order to analyse whether exogenous shocks (such as the economic crisis and changes in financial regulation) have a permanent impact on the shifts in trend and slope of the asset portfolio and liability components, in this thesis modified stationary tests with single and multiple structural breaks are conducted. Stationary testing is conducted using the IO and AO models of Perron (1997), which allow a single break in mean and trend, as well as the multiple structural breaks approach of Lumsdaine and Pappell (1997), as explained in the following sections.

### 5.2.3. Stationary Test with One Structural Break

Modifying Perron's (1989) model, Perron and Vogelsang (1992) propose a test statistic which incorporates structural break in the mean. For a series with a sudden change in the mean or 'crash' models, the Additive Outlier (AO) model is utilised. The Innovational Outlier (IO) model is more relevant for series which

exhibit changes more gradually through time. Perron (1997) modifies his 1989 models by endogenously determining break dates. These results were consistent with, and supportive of, his previous findings.

### 5.2.3.1. Innovational Outlier Model

The Innovational Outlier 1 (IO1) Model allows for gradual changes in the intercept whereas the Innovational Outlier 2 (IO2) Model accommodates gradual changes in both the intercept and the slope of the trend:

***Innovational Outlier 1 (IO1):***

$$Y_t = \mu + \theta DU_t + \beta t + \delta D(TB)_t + \alpha Y_{t-1} + \Sigma\, c_i\, \Delta Y_{t-1} + e_i \qquad (2)$$

***Innovational Outlier 2 (IO2):***

$$Y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta\, D(TB)_t + \alpha Y_{t-1} + \Sigma\, c_i\, \Delta Y_{t-1} + e_i \qquad (3)$$

Where $TB$ is the unknown time break ($1 < TB < T$),

$DU = 1$ if $t > TB$ and zero otherwise,

$DT_t = T_t$ if $t > TB$ and zero otherwise,

$D(TB) = 1$ if $t = TB+1$ and zero otherwise,

$Y_t$ is any ARMA process and $e_t$ is the residual term assumed white noise.

The null hypothesis of a unit root is rejected if the absolute value of the t-statistic for testing $\alpha = 1$ is greater than the critical value. The time of the structural break

(*T*B) is determined by either sequentially estimating equation 1 or 2, assuming different TB with TB chosen to minimise the t-ratio for $\alpha$ = 1, or by choosing TB which minimises the t-ratio on the estimated slope coefficient ($\gamma$) (Perron (1997).

Lumsdaine and Papell (1998) show that the data-dependent methodology suggested by Perron (1997) is superior in determining the truncated lag parameter (k). The method suggests choosing the optimal k (or k*) which ensures the coefficient of the last lag in an autoregression of the order k* is significant, and that the last coefficient in an autoregression of order greater than k* is insignificant. Lumsdaine and Papell (1998) further suggest that for quarterly data the maximum value of k ($k_{max}$) is 8.

### 5.2.3.2 Additive Outlier Model

The AO model assumes instantaneous structural changes. Perron (1994) extends the conventional test for a unit root by using a two-step procedure. First, the trend is removed from the series with an assumption that a structural break only affects the slope coefficient:

$$y_t = \mu + \beta_t + \gamma DT^*_t + \check{y}_t \qquad (4)$$

To test for a change in the slope coefficient, the following equation is estimated:

$$\check{y}_t = \alpha \check{y}_{t-1} + \Sigma c_i \Delta y_{t-1} + e_i \qquad (5)$$

where $\check{y}_t$ is the de-trended series.

These equations are estimated sequentially to minimise the t-statistics (for $\alpha = 1$) for all possible values of $T_b$ ($T_b = k+2,\ldots, T-1$). The break date is assumed to be unknown and endogenously determined by the data. In determining the lag length, the data-determined method is used. The null hypothesis of a unit root is rejected if the t-statistic for $\alpha$ is larger in absolute value than the corresponding critical value. This thesis uses Harris and Sollis' (2003) approach to select $T_b$ which, over all possible break dates, minimises (or maximises) the value of the t-statistic for $\gamma=0$.

Applying Perron's Additive Outlier (AO) and Innovational Outlier (IO) on a bank's aggregate business lending and government securities, Jacques (2003) specifically concludes that regulatory changes by bank regulators might have different effects on the aggregate bank portfolios under various time series characterisations. A unit root bank portfolio composition contradicts the hypothesis that changes in aggregate asset holdings of the banks fluctuate stationarily around deterministic trends. If the bank portfolio variables are non-stationary, the exogenous shocks will have a permanent effect on the levels of bank assets. Alternatively, if a bank's portfolio is stationary, exogenous shocks will have a transitory effect on the portfolio and any distortion caused by the shock would disappear over time.

This thesis extends Jacques' (2003) study by including components of bank liabilities in the models. By regulation, banks have to compensate for the high risk in their asset portfolios by holding more equity in their capital composition, thus minimising their risk of insolvency. Therefore, asset portfolio decisions should not be separated from the capital composition decision. Recognising the existence of

multiple changes to financial regulations during the recovery from Indonesia's financial crisis, this thesis extends previous studies on bank asset portfolio composition by conducting stationary tests with single and double structural breaks in the series of asset and liability components. This is done to correctly identify the break periods following the economic crisis.

### 5.2.4. Stationary Tests with a Two-Break Alternative Model

Acknowledging the fact that some economic series may contain more than one structural break, Lumsdaine and Pappell (1997) and Ben-David et al (2003) propose a unit root test which allows for more than one structural break. Their results show more cases of the null hypothesis being rejected under this procedure than when only one structural break is allowed.

To accommodate two breaks in the deterministic trend at distinct unknown dates, this thesis uses models developed by Lumsdaine and Papell (1997) that extend single structural break models A and C of Zivot and Andrews (1992). Zivot and Andrews modify the models developed by Perron (1989) by treating the structural break as an endogenous occurrence instead; their models are as follows :

**Model A** allows an exogenous change in the level of series :

$$\Delta Y_t = \mu + \beta t + \theta DU_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t \qquad (6)$$

**Model B** permits an exogenous change in the rate of growth :

$$\Delta Y_t = \mu + \beta t + \gamma DT_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t \qquad (7)$$

**Model C** allows both changes in the level of series and the rate of growth :

$$\Delta Y_t = \mu + \beta t + \theta DU_t + \gamma DT_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t \quad (8)$$

Where

$DU_t$ = 1 if ($t > TB_1$), and zero otherwise

$DT_t$ = ($t-TB_1$) if ($t>TB_1$), and zero otherwise

With the null hypothesis : $y_t = \mu + y_{t-1} + e_t$

Lumsdaine and Papell's (1997) modified models are referred as Model CC and Model AA

**Model CC**

Model CC allows for breaks in both the intercept and the slope of the trend function. It is called model CC because it is an extension of model C of Zivot and Andrews, that is, the model adds DU2 and DT2 to model C to permit the two shifts in mean and trend.

$$\Delta Y_t = \mu + \beta t + \theta DUI_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t \quad (9)$$

Where DU1 and DU2 are dummy variables for a mean shift occurring at times TB1 and TB2, and DT1 and DT2 are the corresponding trend shift variables.

That is,

$DU1_t$ = 1 if ($t > TB_1$), and zero otherwise

$DU2_t$ = 1 if ($t > TB_2$), and zero otherwise

$DT1_t$ = ($t-TB_1$) if ($t>TB_1$), and zero otherwise

$DT2_t$ = ($t-TB_2$) if ($t>TB_2$), and zero otherwise

**Model AA:**

Model AA is the extension of Model A of Zivot and Andrews, adding DU2 to the model, allowing mean-shift dummy variables for two breaks. Therefore both breaks in the trend function are restricted to the intercept . Similarly, model AA is basically Model CC with $DT_1$ and DT2 omitted.

$$\Delta Y_t = \mu + \beta t + \theta DUI_t + \omega DU2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t \quad (9)$$

These models exclude the possibility of two breaks occurring on successive dates. In these models the occurrence of a positive shock followed by a negative shock (or vice versa) is not considered as two distinct episodes.

These models are estimated over distinct pairs of values ($k_1$,$k_2$) with $k_1 \neq k_2$ and $k_1 \neq k_2 \pm 1$. In the absence of a statistically accepted procedure for selecting among models, this thesis uses the least restrictive model (CC). If the *t*-statistic of the relevant parameters is significant at the 5 percent level or better, then the results are reported. Otherwise, the more restrictive model is used.

After estimating the break periods, it is determined whether the estimated break dates coincide with the economic and financial regulation events. The detection of structural breaks within these time series presents clear evidence of the impact this important period of institutional and regulatory change had for the banks of Indonesia

## 5.3. Empirical Results

The discussion of the empirical results consists of two parts. The first part discusses the descriptive statistics of all series used in the models. The second part discusses the results for the stationary tests with multiple structural breaks as well as identification of possible economic and regulatory events causing the first and second breaks

### 5.3.1. Descriptive statistics

Descriptive statistics of the series provided in Table 5.1 are given for the major asset and liability components over the period of 1993 to 2009. The statistics are calculated from quarterly data.

**Table 5.1. Descriptive Statistics (in Billion Rupiah)**

NOTE:
This table is included on page 138 of the print copy of the thesis held in the University of Adelaide Library.

Sources : International Financial Statistics, International Monetary Fund and Bank of Indonesia (1993 to 2009)

The descriptive statistics show that among the major asset and liability components, Commercial and Industrial Loans are the main type of asset whilst Time, Savings and Foreign Deposits are the major source of funds for the banks.

### 5.3.2. Results for the Stationary Tests and Identification of Possible Economic and Regulatory Events

Determining the breaks endogenously, the stationary test utilises the *Innovational Outlier (IO),* which allows a single break with gradual changes in the intercept only (*IO1*), or in both the intercept and slope of the trend (*IO2*) and the *Additive Outlier (AO),* which accommodates a single break in the slope with instantaneous structural changes. Moreover, the stationary test includes two-break models ; model CC which allows for breaks in both the intercept and slope of the trend function, and model AA which allows breaks in the intercept only. The procedure for selecting among models is to first use the least restrictive model, (CC). If the *t*-statistic of the relevant parameters is significant at the 5 percent level or better, then the results are reported. Otherwise, the more restrictive models are used.

Details of the tests are presented in Appendix 1 whilst a summary of the results is presented in table 5.2. The results in Table 5.2 show that structural breaks exist in all of the series, and all the series are I(1) non-stationary. This suggests that exogenous shocks such as the economic crisis will have a permanent impact on the asset portfolios of banks as well as the components comprising their funding sources.

**Table 5.2. Summary Results for the Stationary tests with Multiple Structural Breaks**

| | Unit Root with Endogenous Structural Breaks | | | |
|---|---|---|---|---|
| **Series** | **Model** | **Inference** | **Break 1** | **Break 2** |
| **Asset Components** | | | | |
| Certificate of Bank Indonesia | CC | Non-Stationary | Q4 1998 | Q1 2006 |
| Government Bonds | CC | Non-Stationary | Q4 1998 | Q1 2001 |
| Commercial &Industrial Loans | AA | Non-Stationary | Q4 1998 | Q1 2006 |
| **Liability Components** | | | | |
| Demand Deposits | IO2 | Non-Stationary | Q2 1998 | |
| Time, Savings and Foreign Deposits | AA | Non-Stationary | Q4 1997 | Q3 2000 |
| Total Equity | AA | Non-Stationary | Q2 1998 | Q3 1999 |

Model IO2 : Single break model with gradual changes in both the intercept and slope of the trend
Model CC : Two-break model, allows for breaks in both the intercept and slope of the trend
Model AA : Two-break model, allows breaks in the intercept only

On the asset side, Commercial and Industrial (C& I) loans exhibit two breaks in intercept whilst Government Short Term Securities (Certificate of Bank Indonesia) and Government Bonds exhibit multiple breaks in both intercept and trend slope. On the liability side, Demand Deposits exhibit a single break in the intercept and slope whilst Total Equity and TSF deposits demonstrate multiple breaks in the intercept only.

The possible economic and regulatory events causing each break are shown in Tables 5.3 and 5.4.

**Table 5.3. Identification of Possible Economic and Regulatory Events Causing the First Break**

| Series | First Break | Possible Causes |
|---|---|---|
| **Assets** | | |
| Certificate of Bank Indonesia | Q4 1998 | Mid 1998 : Bank Restructuring and Recapitalisation Programs :<br>o Announcement of Blanket Guarantee<br>o Application of new regulatory leverage ratio 4%<br>o Bank Indonesia regulations on asset quality |
| Government Bonds | Q4 1998 | |
| Commercial and Industrial I Loans | Q4 1998 | |
| | | |
| **Liabilities** | | End 1997 : The Asian Financial Crisis |
| Demand Deposits | Q2 1998 | |
| Time, Savings and Foreign Deposits | Q4 1997 | |
| Total Equity | Q2 1998 | |

Table 5.3 shows that the first break in the asset components (Q4 1998) coincides with the release of the Restructuring and Recapitalisation package in mid 1998. This package included the closing of insolvent banks, reducing the leverage ratio from 8% to 4% and the announcement of a blanket guarantee to depositors aimed at reducing the costs of recapitalisation programs. On the other hand, the first breaks in the liability components coincide with the Asian financial crisis or immediately after the crisis (Q4 1997 and Q2 1998). The results suggest that the Asian financial crisis and recapitalisation and restructuring programs released in mid 1998 had created shifts in bank liability and asset portfolio compositions. As discussed in chapter 3, prior to the Asian financial crisis the Indonesian banking industry was characterised by high levels of C&I loans with comparatively low levels of equity (when average leverage ratio was only 7%). The break in intercept

for total equity (crash) during Q2 1998 is due to the huge losses resulting from the combination of high proportions of non-performing loans (which reached 48% in 1998), weak credit demand from the real sector and high funding costs (which rose from 17% in 1996 to 39% in 1998). On the other hand, the lending rate increased from 19.22% to only 32.15% (Bank of Indonesia, 2000). This economic situation limited the ability of banks to pass increases in loan funding costs on to borrowers, thus reducing the expected profitability of loans making lending even less attractive relative to government bonds and securities. The closure of insolvent banks and the release of the bank recapitalisation and restructuring package in 1998 resulted in an increase in bank risk aversion. The increased risk aversion resulted in banks improving their capital ratios and reducing investments in risky assets such as C&I loans.

The second break in the series is presented in table 5.4. On the asset side, the release of the new capital regulation requiring a risk based capital adequacy ratio (CAR) of 8% at the end of 2000 matches only with the second break in government bonds (Q1 2001).

**Table 5.4. Identification of Possible Economic and Regulatory Events Causing the Second Break**

| Series | Second Break | Possible Causes |
|---|---|---|
| **Assets:** | | |
| Government Bonds | Q1 2001 | End 2000: application of new CAR: 8% |
| Certificate of Bank Indonesia | Q1 2006 | August 2005 : Regulations on the intraday liquidity facility |
| Commercial and Industrial I Loans | Q1 2006 | |
| | | |
| **Liabilities:** | | |
| Total Equity | Q3 1999 | Mid 1998 : Bank Restructuring and Recapitalisation Programs |
| Time, Savings and Foreign Deposits | Q3 2000 | October 1999 : Regulations on Foreign Exchange Flows |
| | | |

This observation most likely results from the banks reducing their holdings of government bonds and beginning to increase their C&I loans (as shown by the increase in the C&I series and decrease in government bonds series in Figure 3.9) during this period. On the liability side, the second break on total equity at Q3 1999 indicates that the rehabilitation and recapitalisation programs have come into effect, resulting in the improvement of total bank equity. This is consistent with the findings described in chapter 3, that banks increase their holdings of risky assets alongside increases in capital requirements.

The other breaks in the asset and liability components correspond to other financial regulations, such as regulation on the liquidity facility (the second breaks in Certificate of Bank Indonesia and Commercial and Industrial Loans series). The regulations on foreign exchange transactions and the liquidity facility created additional breaks in the mean of Time, Savings and Foreign deposits in Q3 2000.

## 5.4. Conclusion

In order to identify the significant impacts of any exogenous shocks, such as the economic crisis, on the asset and liability components, stationary tests with multiple breaks have been undertaken. Time series of the components of banks' assets and liabilities were used for the tests. The tests were also used to identify the financial and economic regulations that have created structural breaks in the liability and asset trends following the economic crisis.

The empirical models based on the modified stationary tests which accommodate single and multiple breaks show that the Asian financial crisis had a permanent impact on bank asset portfolio and funding source components (except for TSF deposits).

This thesis' findings also support the modelling of the breaks and shifts in asset and liability portfolio components resulting from the Asian financial crisis and the release of capital regulations during the capital-constrained condition. The breaks in mean and trend in the liability and asset portfolio components support the proposition that changes in capital regulations give incentives for banks to immediately adjust their capital and asset portfolios, especially if they were capital constrained.

It is of interest that the considerable change in capital regulations which occurred in 2001 (the shift from risk independent leverage ratio of 4% to risk based capital

adequacy ratio of 8%) only created a break in government bonds and not in other asset components or total equity. This suggests that in order to meet the new capital requirements, banks gradually but steadily adjusted either their level of capital, or the risk of their assets portfolio. The gradual adjustments of capital and portfolio risk and the relationship between them will be discussed in more detail in the next chapter.

# Chapter 6
# The Interrelationship between Capital and Credit Risk of Asset Portfolio Decisions and the Impact of Changes in Capital Regulations and Economic Uncertainty on the Relationship

## 6.1. Introduction

This chapter addresses the second objective of the thesis, which is to analyse the interrelationships between changes in capital and asset credit risk, the impact of the economic crises and changes on capital regulations, as well as the explanatory variables on the changes in capital and asset credit risk. This chapter also investigates how economic crises and changes in capital regulations affect the relationships between different types of bank ownership.

The first part of the chapter discusses the simultaneous equations used to test the interrelationships of capital and asset credit risk decisions, in order to investigate how they are affected by the explanatory variables, including both the economic and regulatory exogenous shocks. The model extends Shrieves and Dahl's (1992) model with different definitions of capital and risk, as well as modified explanatory variables.

The second part of the chapter discusses the empirical results of the changes in capital and asset credit risk, the explanatory factors and the way in which capital

and asset portfolio decisions are interrelated. The part also discusses the impacts of the type of bank ownership on the simultaneous relationship between changes in capital and credit risk and the explanatory factors.

This part also investigates how the economic crisis and changes in capital regulations affect the relationships between changes in capital and asset credit risk by analysing the results of the full period from 1993 to 2009 as well as of each sub-sample period. The results provide an indication of whether the motivation behind the decisions on capital and credit risk is driven by regulatory or market discipline. The results also provide evidence about the efficacy of the new capital regulations imposed as part of the restoration of stability and safety for the banking sector after the Asian financial crisis of 1997 in Indonesia.

## 6.2. Methodology

As discussed in Chapter 3, during and after the crisis Indonesian banks generally became more risk averse. The banks shifted their portfolios away from risky assets to safer assets while maintaining their capital levels. The second objective of this thesis is to study whether the banks' decisions in adjusting their capital and asset portfolios are interrelated and whether the changes in capital regulation and economic uncertainty had an effective impact on such decisions.

Therefore, the specific research objectives of this part of the study are:

1. To investigate the dynamic bank responses (in terms of capital composition and asset portfolio decisions) to changes in regulatory capital requirements,

hence testing the efficacy of regulatory capital requirements in reducing insolvency risk.

2. To investigate the impact of economic uncertainty on bank capital decisions and credit risk.

### 6.2.1. Research Questions and Hypotheses Development

The research questions and hypotheses on the relationships between capital and credit risk were developed based on the theories discussed in Chapter 2. All theories support the idea that changes in capital and asset credit risk are interdependent and that they are affected by both endogenous and exogenous characteristics (such as economic uncertainty and capital regulation). Some theories suggest a positive relationship between changes in capital and credit risk. For regulators this relationship is considered to be an unintended effect of changes to capital regulation. Banks complying with changes to capital requirements create the observed positive relationship by simultaneously increasing their asset risk to minimize the effects of increased capital levels (moral hazard theory). Nevertheless, the positive relationship is not necessarily linked with serious negative impacts. Regulation allows a bank whose capital level has increased to pursue riskier investment, and to avoid regulatory and market discipline as well as bankruptcy costs. Thus, a bank with a higher risk level will increase its capital level (and vice versa).

Alternatively, other theories support a negative relationship between changes in capital and credit risk. The existence of deposit insurance ensures that banks do not increase their asset credit risk as a result of increased capital standards, because increasing capital reduces the value of the deposit insurance put option. Therefore, it reduces the incentives for a bank to increase credit risk. Nevertheless, as discussed in Chapter 2, other theories contradict this argument by asserting that unless a deposit insurance premium is appropriately priced to reflect banks' risk profiles deposit insurance creates a moral hazard for banks to undertake excessive risk taking. Therefore banks will increase credit risk as a result of a deposit insurance guarantee, as they increase their capital.

The capital buffer theory suggests that generally banks tend to maintain more capital than required (in proportion to their asset risk) in an attempt to avoid market discipline and supervisory intervention. Moreover, the theory suggests that bank attitudes toward capital and risk depend on the size of the capital buffer. Banks with high capital buffers increase their risk when they increase their capital so that the capital and risk adjustments are positively related, while banks with low capital buffers have negatively related capital and risk adjustments.

Therefore, the null hypotheses of this study are that changes in capital and credit risk are not related and that they are not affected by endogenous and exogenous variables such as economic uncertainty and capital regulations. The alternative hypotheses are:

Hypothesis 1A: Changes in capital and credit risk are positively related and they are affected by endogenous and exogenous variables.

Hypothesis 1B: Changes in capital and credit risk are negatively related and they are affected by endogenous and exogenous variables.

### 6.2.2 The Models

Acknowledging the contemporary interrelationship between capital and risk, the simultaneous model developed by Shrieves and Dahl (1992) is utilised in this thesis. The model is adjusted and modified by incorporating the adjustment process in bank capital and risk level due to the pressure of the economic crisis and application of the new capital requirements. The discretionary adjustment process of a capital and risk level needs to be recognised, as Hester and Pierce (1975) find that in response to unexpected events, banks typically make systematic but steady adjustments to their holdings of both financial assets and liabilities.

The model recognises the decomposition of changes in both capital and risk into two components, a discretionary adjustment and a change resulting from exogenous factors:

$$\Delta CAP_{j,t} = \Delta^{d} CAP_{j,t} + E_{j,t} \quad (1)$$

$$\Delta RISK_{j,t} = \Delta^{d} RISK_{j,t} + U_{j,t} \quad (2)$$

Where:

- $\Delta CAP_{j,t}$ and $\Delta RISK_{j,t}$ are the observed changes in capital and risk for bank *j* in period t,
- $E_{j,t}$ and $U_{j,t}$ are the exogenously determined variables. Capital exogenous shocks occur mainly as a result of unanticipated changes in earnings, while asset credit risk exogenous shocks occur mainly as a result of unanticipated economic developments such as changing assets or loan quality (Hart and Jaffee,1974 and Marcus, 1983).
- $\Delta^d CAP_{j,t}$ and $\Delta^d RISK_{j,t}$ are endogenously determined adjustments (discretionary changes) in capital and risk.

Market illiquidity and various adjustment costs prevent banks from adjusting instantaneously to achieve desired capital and risk levels. Therefore, the discretionary changes in capital and risk ($\Delta^d CAP_{j,t}$ and $\Delta^d RISK_{j,t}$) are modelled using the partial adjustment framework. In this framework, banks are assumed to aim for optimal capital and risk levels (or target levels). Banks adjust their capital and risk to meet their target level since the exogenous shocks force actual levels away from target levels. Full adjustment might be too costly or unfeasible. Subsequently, banks may be observed making only partial adjustments towards their target levels. The discretionary changes in capital and risk are proportional to the difference between the target levels and the levels existing in period t-1.

$$\Delta^d CAP_{j,t} = \alpha(CAP^*_{j,t} - CAP_{j,t-1}) \quad (3)$$

$$\Delta^d RISK_{j,t} = \beta(RISK^*_{j,t} - RISK_{j,t-1}) \quad (4)$$

$CAP^*_{j,t}$ and $RISK^*_{j,t}$ are bank j's target capital and risk level, respectively. They are affected by many variables and are not directly observable. The $\alpha$ and $\beta$ are the rates of adjustment. Therefore, the observed changes in capital ($\Delta CAP_{j,t}$) and risk ($\Delta RISK_{j,t}$) can be written as:

$$\Delta CAP_{j,t} = \alpha(CAP^*_{j,t} - CAP_{j,t-1}) + E_{j,t} \quad (5)$$

$$\Delta RISK_{j,t} = \beta(RISK^*_{j,t} - RISK_{j,t-1}) + U_{j,t} \quad (6)$$

Based on the existing theories explained in chapter 2, the target capital and credit risk are functions of:

$CAP^*_{j,t} = f(\Delta RISK_{j,t}, SIZE_{j,t}, PROF_{j,t}, MPWR_{j,t}, TYPE, PRESSREG_{j,t}, PRESSPEER_{,t}, ECVAR_t)$

$RISK^*_{j,t} = f(\Delta CAP_{j,t}, SIZE_{j,t}, PROF_{j,t}, MPWR_{j,t}, TYPE, PRESSREG_{j,t}, PRESSPEER_{,t}, ECVAR_t)$

Where:

SIZE: Size of a bank

PROF: Profitability

MPWR: Market Power

TYPE : Type of ownership (government, regional, private domestic or foreign owned)

PRESSREG: Regulatory Pressure

PRESSPEER: Peer Group Pressure

ECVAR: Economic Uncertainty

Theoretically bank capital and risk are interdependent. Therefore both variables are included in the right part of the capital and risk equations as well as other explanatory variables affecting target capital and risk level.

Substituting the explanatory variables of target capital and target risk into the models defined in equations 5 and 6 results in the following models:

$$\Delta CAP_{j,t} = \alpha_0 + \alpha_1 PRESSREG_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 TYPE + \alpha_6 \Delta RISK_{j,t} + \alpha_7 PRESSREG_{j,t} \times \Delta RISK_{j,t} + \alpha_8 ECVAR_t - \alpha_9 CAP_{j,t-1} - \alpha_{10} PRESSREG_{j,t} \times CAP_{j,t-1} + E_{j,t} \quad (7)$$

$$\Delta CAP_{j,t} = \alpha_0 + \alpha_1 PRESSPEER_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 TYPE + \alpha_6 \Delta RISK_{j,t} + \alpha_7 PRESSPEER_{j,t} \times \Delta RISK_{j,t} + \alpha_8 ECVAR_t - \alpha_9 CAP_{j,t-1} - \alpha_{10} PRESSPEER_{j,t} \times CAP_{j,t-1} + E_{j,t} \quad (8)$$

$$\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESSREG_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 TYPE + \beta_6 \Delta CAP_{j,t} + \beta_7 PRESSREG_{j,t} \times \Delta CAP_{j,t} + \beta_8 ECVAR_t - \beta_9 RISK_{j,t-1} - \beta_{10} PRESSREG_{j,t} \times RISK_{j,t-1} + U_{j,t} \quad (9)$$

$$\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESSPEER_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 TYPE + \beta_6 \Delta CAP_{j,t} + \beta_7 PRESSPEER_{j,t} \times \Delta CAP_{j,t} + \beta_8 ECVAR_t - \beta_9 RISK_{j,t-1} - \beta_{10} PRESSPEER_{j,t} \times RISK_{j,t-1} + U_{j,t} \quad (10)$$

The models (7 to 10) estimate changes in capital and risk as functions of the target capital and risk levels, the lagged capital and risk levels and other exogenous variables. Bank capital and risk level targets are not observable and are affected by exogenous variables as well as discretionary bank behaviour (endogenous variables).

#### 6.2.2.1 Model Specification

The historical background of Indonesian banks and banking regulations discussed in Chapter 3 provides a basic understanding of the nature of insolvency and credit risks in the banking sector. Moreover, it highlights the endogenous and exogenous variables affecting the credit risks and capital decisions. The proxies for the variables in the models are as follows:

- **Proxy for Capital**

Berger (1995) states that instruments used as capital should meet the following criteria:

- Should be junior to those of the deposit insurer so that they serve as a buffer to absorb losses before the government
- Should be a stable source of funds during a possible panic run on the bank by creditors. This means that it cannot be redeemable without certain refunding by creditors or shareholders during the same time period needed to evaluate a significant shock.
- Should reduce bank moral hazard incentives to exploit deposit insurance protection by taking excessive portfolio or leverage risk.

Based on these criteria, and among other instruments that can be considered as regulatory capital (for example, uninsured deposits), equity and subordinated debt seem to be the most satisfactory instruments. This is the case despite the fact that theoretically equity may not always meet the third criteria, viz., that it does not necessarily reduce the bank's excessive risk taking as Koehn and Santomero (1980), Keeton (1988) and Kim and Santomero (1988) find using the utility maximization model.

Following Basel I capital requirements, which required a specific percentage of Tier 1 capital (equity) and Total Capital on risk weighted assets to be held by banks, the ratio of total capital to total risk weighted assets is used as the proxy for capital in this thesis. Tier 1 capital is equity capital which includes common stock, perpetual preferred stock, capital surplus, undivided profits, capital reserves and cumulative foreign currency translation adjustments.

- **Proxy for Credit risk**

Previous studies state that bank risk should reflect a bank's risk exposure, or variability of the bank's net worth. But there are contradictory arguments about which measure of net worth is most appropriate (Berger et al, 1995). In reality, as has already been proven by many studies, it is difficult to develop an accurate risk measurement which reflects the variability of net worth or economic risk, and which can be applied across banks.

The existing literature shows that bank portfolio composition is a good measurement of risk. Therefore in this thesis, the *risk-weighted total assets to total assets* ratio is used as the proxy for risk. Consistent with the measurement of capital adequacy ratio used in Indonesia, Basel I's risk weights are assigned to bank assets.

- **Explanatory Variables**

Theoretically, the target capital of bank j at time t ($CAP^*_{j,t}$) and the credit risk of bank j at time t ($RISK^*_{j,t}$) are explained by bank specific and other variables as discussed in the literature review (chapter 2). The variables and their proxies are as follows:

- **Size (SIZE)** is measured by Total Assets
- **Profitability (PROF**) is measured by Return on Assets (ROA)

- **Market power (MPWR)** is measured by the Herfindahl-Hirschman Index for market share of total loans
- **Economic uncertainty (ECVAR)** is measured by the variance of the interest rate on government securities (Central Bank Securities or Serifikat Bank Indonesia).

Market interest rates are included in the models to capture economic uncertainty. They affect changes in the returns of assets and costs of raising capital, which in turn affect bank capital and credit risk decisions. Also, market interest rates are included to identify whether the changes in capital and credit risk are made to avoid regulatory discipline or to reduce the high cost of capital and deposit risk. This is consistent with the findings of Calomiris and Wilson (2004) in their study on bank capital and the portfolio management of US banks during the Great Depression.

- **Regulatory Pressure ($PRESSREG_{j,t}$) and Peer Group Pressure ($PRESSPEER_{j,t}$)**

These variables describe the behaviour of banks that fell short of the minimum regulatory capital requirements or industry average capital adequacy ratio. For these banks, not meeting the regulatory standards or being below industry standards is potentially threatening, as it not only implies exclusion from international business, but these banks are now exposed to market and regulatory

discipline.. Thus, undercapitalized institutions should have increased their capital to assets ratio and/or decreased their credit risk more than well-capitalized institutions if capital regulations are effective in controlling bank risk.

PRESSREG is the regulatory pressure for banks with capital adequacy ratio below the capital requirement. The capital requirement has changed over the period of observation. The regulatory capital requirement is 8% in period I, 4% in period II and 8% in period III.

- PRESSREG = 1 if a bank has leverage ratio or capital adequacy ratio less than the regulatory capital requirement
- PRESSREG = 0 if a bank has leverage ratio or capital adequacy ratio equal to or more than the regulatory capital requirement

One important shortcoming of the PRESSREG variable is that the behaviour of banks with capital below the regulatory minimum is likely to be influenced by other factors, such as market pressure from peer banks, private investors or credit rating agencies, rather than regulatory pressure from prudential authorities (VanRoy, 2004). Therefore, it may be difficult to isolate the effects of capital regulations from increased market discipline (Basel Committee, 1999). In order to minimize this problem, a dummy variable which measures market pressure from peer banks (PRESSPEER) is utilised. PRESSPEER is the average of the capital adequacy ratio of the whole banking industry which is calculated monthly by the central bank (Bank of Indonesia). The information is released by the central bank and put on the central bank's website, and so it is observable by the market and industry

participants. Market participants may use the information in order to assess the solvency risk of a bank and impose market discipline accordingly.

- PRESSPEER = 1 if a bank has leverage ratio or capital adequacy ratio less than the peer group average capital level
- PRESSPEER = 0 if a bank has leverage ratio or capital adequacy ratio equal to or more than the peer group average capital level

Theoretically, the capital level maintained by a bank affects its response to capital shocks. Banks which hold more capital than required (overcapitalised banks) may respond less strongly to changes in capital requirements than banks with capital below the requirements (undercapitalised banks). Therefore, in measuring the adjustment process in bank capital and risk level under regulatory pressure, $PRESSREG \times \Delta RISK_{j,t-1}$ and $PRESSREG \times \Delta CAP_{j,t-1}$ are included in the capital as well as credit risk equations. The coefficients of these variables allow the rate of adjustment of capital and risk level to vary according to the regulatory regimes. The adjustment process under peer pressure, PRESSPEER $x \times \Delta RISK_{j,t-1}$ and $PRESSPEER \times \Delta CAP_{j,t-1}$ is also included for the same arguments.

- **Type of Ownership Dummy (TYPE)**

As discussed in Chapter 2, theoretically the type of bank affects a bank's decision on capital and risk. This is due to different roles and objectives of different types of banks imposed by their owners. To capture the difference in changes in capital and

credit risk for each type of bank, dummy variables for type of ownership are added in the model with state owned banks are used as the benchmark, considering their dominant roles in the banking sector as discussed in Chapter 3. Since there are 5 types of banks (state owned, regional, domestic private, joint and foreign banks), 4 dummy variables are used as follows :

- D1 = D2= D3 = D4=0 if the bank is a state owned bank
- D1= 1 if the bank is a regional bank

  = 0 otherwise,
- D2 = if the bank is a private domestic bank

  = 0 otherwise
- D3 = 1 if the bank is a joint venture bank

  = 0 otherwise
- D4 = 1 if the bank is foreign bank

  = 0 otherwise

### 6.2.4. Model Estimation

The capital and credit risk models with the contemporary interrelationship between capital and risk are estimated simultaneously by using a system procedure. The simultaneous equations are subject to several estimation problems. First, the models include lagged dependent variables ($CAP_{j,t-1}$ and $RISK_{j,t-1}$), which means that it is likely they may be correlated with past and current values of the idiosyncratic component of disturbances. The first-difference transformation to eliminate this introduces a correlation between the differenced lagged dependent

variables ($\Delta CAP_{j,t-1}$ and $\Delta RISK_{j,t-1}$) and the differenced errors, through lagged dependent variables and disturbance errors.

Another estimation problem arises because the explanatory variables do not satisfy exogeneity conditions. Some of the explanatory variables are endogenous, as the models assume the contemporary interrelationship between capital and risk. That is, credit risk is endogenous in equation 7 and capital ratio is endogenous in equation 8. Hence Ordinary Least Squares will not be able to estimate the coefficient parameters consistently (Hsiao, 1985).

The problems outlined above support the use of System Instrumental Variables based on the Generalised Method of Moments (GMM) dynamic system of estimation developed by Arellano and Bond (1981) and Arellano and Bover (1995).

- **Generalised Method of Moments (GMM)**

The GMM estimation was developed by Hansen (1982), and because of its unique features has become one of the most widely used estimation methods in economics and finance. Several important features unique to GMM estimation make it preferable for use here. First, the distribution of the data does not need to be fully known, hence GMM can be utilised with no complications even if the distribution of the data is unknown. GMM only requires specified moments derived from an underlying model. Second, GMM estimation provides an uncomplicated way to test model specification in models with more moment conditions than model parameters.

For example, consider the following linear regression model:

$y_t = z'_t\delta_0 + \varepsilon_t,\ t = 1, \ldots, n$ (11)

Where $z_t$ is an L × 1 vector of explanatory variables, $\delta_0$ is a vector of unknown coefficients and $\varepsilon_t$ is a random error term.

There is a possibility that some or all of the variables of $z_t$ may be correlated with the error term $\varepsilon_t$ (i.e. for some k, $E[z_{tk}\ \varepsilon_t] \neq 0$), or in other words, that $z_{tk}$ may be an endogenous variable. There is also the possibility that the error terms may be conditionally heteroskedastic. In this case (with the endogenous variable and heteroskedastic error terms) OLS would not be able to estimate the $\delta_0$ in (9) consistently.

It is assumed that there is a K ×1 vector of instrumental variables $x_t$ associated with the model which may include some or all of the variables of $z_t$ and satisfy the set of K orthogonality conditions. The generalized method of moments (GMM) estimator of δ in (9) is constructed by exploiting the orthogonality conditions. The objective is to create a set of estimating equations for δ by making the sample moments match the population moments.

The sample moments for an arbitrary value of δ are

$g_{n=}\frac{1}{n}\sum_{t=1}^{n} g(w_t, \delta) = \frac{1}{n}\sum_{t=1}^{n} x_t(y - z_t'\ \delta)$ (12)

Equating these sample moments to the population moment $E[x_t\varepsilon_t] = 0$ gives the estimating equations $S_{xy} - S_{xz}\,\delta = 0$

where $S_{xy} = \frac{1}{n}\sum_{t=1}^{n} x_t\, y_t$ and $S_{xz} = \frac{1}{n}\sum_{t=1}^{n} x_t\, z_t$ are the sample moments.

If K = L ($\delta_0$ is just identified), the GMM estimator of $\delta$ is

$$\acute{\delta} = S'_{xz}\, S_{xy} \qquad (13)$$

If K > L ($\delta_0$ is over identified), then the GMM estimator of $\delta$ is $\acute{\delta}(\acute{W})$ where $\acute{W}$ is an arbitrary positive definite and symmetric weight matrix. The asymptotically optimal GMM estimator is obtained by using an optimal weighting matrix, $\widehat{W}$, where:

$$\widehat{W} = [\tfrac{1}{n}(\textstyle\sum_{t=1}^{N} x_t x'_t\, \varepsilon_t^2\; x_t\;)]^{-1} \qquad (14)$$

- **GMM Dynamic System of Estimation**

Arellano and Bond (1991) developed the GMM dynamic system of estimation to allow for the exogeneity of explanatory variables. The dynamic system of estimation is used on panel data with a lagged dependent variable employing simultaneous estimation of the equations. The instrument variables are a lagged level of the explanatory variables for equation in differences, and differences of the explanatory variables for equation in levels.

Arellano and Bond suggest the use of GMM procedures in estimating the dynamic panel data equations. GMM procedures use all available lagged values of the

dependent variable and lagged values of the exogenous variables as instruments. Arellano and Bond show that the performance of GMM estimators results in smaller variance than the Anderson and Hsiao (1981) estimator which only uses one lag of the dependent variable as an instrument.

- **Test statistics**

To test the consistency of the estimator, the assumptions of validity of the instruments and the absence of serial correlation in the error terms need to be tested.

- **The First Order and Second Order Serial Correlation of Residuals**

The consistency of estimates is subject to an optimal choice of instruments where the validity of instruments depends on the absence of higher-order serial correlation in the idiosyncratic component of the error term. Therefore a test for the first and second order serial correlation in the first difference residual is undertaken under the null hypothesis of no serial correlation. The test of first order serial correlation of the differenced residuals should be significantly negative, and the second order test should be insignificant (Arellano and Bond, 1991).

- **The Sargan Test**

Sargan statistic is a test statistic of over-identifying restrictions under the null hypothesis that the instruments are exogenous (Sargan, 1958). In a well specified overidentified model with valid moment conditions, the Sargan statistic is asymptotically distributed with a chi-square random variable with degrees of freedom equal to the number of overidentifying restrictions. If the model is mispecified and/or some of the moment conditions do not hold, then the Sargan statistic will be large relative to a chi-square random variable with K − L degrees of freedom (Arellano and Bond, 1991).

- **Sub-sample Estimation**

Subsample estimations were undertaken utilising two models, the original model without the inclusion of the type of bank ownership dummy variables, and the model with type of bank ownership dummy variables added.

To provide additional insight regarding the changes of risk attitude for different explanatory factors in different regulatory regimes, the models are estimated for the entire sample as well as for categorical sub-samples. This approach allows all the coefficients in the models to vary according to the category.

## 6.3. Empirical Results

This part discusses the empirical results of the examination of the changes in capital and asset credit risk, the explanatory factors and how the capital and asset portfolio decisions are interrelated. This part also investigates how the economic crisis and changes in capital regulations affect the relationships, by analysing the results of the full period as well as of each sub-sample period. The results provide an indication of whether the motivation behind the decisions on capital and credit risk is driven by regulatory or market discipline. The results also provide evidence about the efficacy of the new capital regulations imposed as part of the restoration of stability and safety to the banking sector after the economic crisis.

The discussion of the empirical results in this part consists of four parts. The first part discusses the descriptive statistics of all variables used in the models. The second part discusses the explanatory variables affecting the target capital and credit risk, which in turn also affect changes in capital and credit risk for the full sample period as well as each sub-sample period. The third part analyses the simultaneous relationship between the changes in capital and credit risk as well as the impact on the relationships of changes in capital regulation. The final part discusses the impact of type of bank ownership on the changes in capital and credit risk.

### 6.3.1. Descriptive statistics of the Variables

Tables 6.1 and 6.2 show the mean, median, standard deviation and correlation coefficients of all independent variables with the dependent variables for the full sample period, as well as for the sub-sample periods.

**Table 6.1: Descriptive Statistics of Variables**
CAR = Total Capital (Tier I + Tier II)/ Credit Risk Weighted Assets, RISK = Credit Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance.

| | CAR | RISK | ΔCAR | ΔRISK | Ln Size | PROF | MPOWER | ECVAR |
|---|---|---|---|---|---|---|---|---|
| **Full Period: 1993 – 2009** | | | | | | | | |
| Mean | 0.118 | 0.491 | 0.0004 | 0.004 | 13.49 | 0.031 | 0.063 | 0.267 |
| Median | 0.095 | 0.426 | 0.0003 | 0.003 | 13.29 | 0.034 | 0.063 | 0.24 |
| Std. Dev. | 0.019 | 0.0211 | 0.0002 | 0.0001 | 0.051 | 0.046 | 0.007 | 0.001 |
| Observations | 7936 | 7936 | 7936 | 7936 | 7936 | 7936 | 7936 | 7936 |
| **Period I: 1993-1997** | | | | | | | | |
| Mean | 0.071 | 0.718 | 0.0006 | 0.005 | 12.44 | 0.033 | 0.063 | 0.105 |
| Median | 0.072 | 0.74 | 0.0007 | 0.004 | 13.25 | 0.023 | 0.064 | 0.131 |
| Std. Dev. | 0.003 | 0.07 | 0.0006 | 0.001 | 0.851 | 0.02 | 0.009 | 0.002 |
| Observations | 2480 | 2480 | 2480 | 2480 | 2480 | 2480 | 2480 | 2480 |
| **Period II:1998-2000** | | | | | | | | |
| Mean | -0.092 | 0.338 | -0.0006 | -0.004 | 13.59 | 0.003 | 0.063 | 0.47 |
| Median | -0.028 | 0.257 | -0.0005 | -0.006 | 12.55 | 0.031 | 0.063 | 0.49 |
| Std. Dev. | 0.0275 | 0.0138 | 0.0003 | 0.001 | 0.07 | 0.078 | 0.008 | 0.001 |
| Observations | 1488 | 1488 | 1488 | 1488 | 1488 | 1488 | 1488 | 1488 |
| **Period III:2001-2009** | | | | | | | | |
| Mean | 0.227 | 0.327 | 0.0005 | 0.006 | 14.108 | 0.052 | 0.062 | 0.285 |
| Median | 0.265 | 0.332 | 0.0004 | 0.005 | 10.413 | 0.046 | 0.062 | 0.322 |
| Std. Dev. | 0.036 | 0.059 | 0.0009 | 0.0009 | 0.06 | 0.022 | 0.003 | 0.001 |
| Observations | 3968 | 3968 | 3968 | 3968 | 3968 | 3968 | 3968 | 3968 |

**Source: Bank of Indonesia, Annual Reports 1993 -2009 and IMF, 2009**

As summarised in Table 6.1 , the average Capital Adequacy Ratio (CAR) for the full period was 11.8%. Most of the banks were undercapitalised in period I (before the Asian financial crisis) and period II (during the Asian financial crisis), with average CARs of 7%, and -9.2% respectively. During period I, the average credit risk-weighted assets (RISK), which serve as a proxy for credit risk, was the highest compared to other periods.

The high levels of risk inherent in the economy during this crisis are reflected in the high variance of the interest rate, which reached as high as 47%. As a result of the crisis, the banks experienced huge losses and shifts in their portfolio composition. This not only negatively affected their profitability, but also their average CAR in period II. The profitability during period II dropped to only one-tenth of that for period I (only 0.3%).

During period III all of the banks were overcapitalised, with the average CAR of 22.65% being far greater than the 8% of average credit risk weighted assets required. This indicates the greatest degree of risk aversion by bank managers seen in comparison to other periods. Interestingly, in the presence of lower credit risk and a higher average capital ratio, the profitability during this period increased to 5%. Period III signifies the beginning of the recovery period from the crisis, where banks are safer, better capitalised and more profitable.

Correlation matrix among variables are shown in table 6.2 :

**Table 6.2. Correlation Matrix among Variables**

CAR = Total Capital (Tier I + Tier II)/ Credit Risk Weighted Assets, RISK = Credit Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance.

| | **CAR** | **RISK** | **Ln SIZE** | **PROF** | **MPWR** | **ECVAR** | **ΔCAR** |
|---|---|---|---|---|---|---|---|
| RISK | -0.016 | | | | | | |
| Ln SIZE | 0.357 | -0.825 | | | | | |
| PROF | 0.385 | -0.138 | 0.093 | | | | |
| MPWR | -0.032 | 0.062 | 0.017 | -0.192 | | | |
| ECVAR | -0.123 | 0.079 | 0.117 | -0.626 | 0.065 | | |
| ΔCAR | -0.199 | 0.035 | 0.0321 | 0.143 | -0.028 | -0.176 | |
| ΔRISK | 0.129 | -0.259 | -0.025 | -0.0376 | 0.076 | 0.146 | 0.152 |

Table 6.2. shows that the correlation coefficients between the variables are mostly negligible. Only the correlation coefficients between the natural log of size (LnSize) and the ratio of credit risk weighted assets to total assets (RISK), and between the interest rate variance (ECVAR) and return on assets (PROF) are comparatively high at 0.825 and 0.626 respectively. The table indicates a negative correlation between levels of CAR and RISK (-0.016) supporting the utility maximizing mean-variance framework of Kim and Santomero (1988). They suggest that a negative cross-sectional correlation between the level of asset risk and bank capital ratios is simply due to cross-sectional variation in risk preferences. The negative correlation simply shows that banks with low levels of risk aversion will hold low capital and invest in high risk assets. On the other hand, the correlation between the changes in capital (ΔCAR) and credit risk (ΔRISK) is positive. This supports the theory discussed in the literature review in Chapter 2 that the way banks change their holdings in capital and credit risk might be different from the way they decide on

their levels of capital and credit risk. Therefore, as highlighted by Shrieves and Dahl (1992), in investigating the dynamics of the various bank risk and capital relationships, it is important to use the first difference instead of actual levels of capital and risk.

Tables 6.3.to 6.6 present the full and sub-sample estimation results of the *capital equation* (ΔCAR) and *credit risk equation* (ΔRISK) respectively.

As discussed in Chapter 4, the GMM dynamic system of estimation was utilised because of its important features, including its ability to allow for the exogeneity of the explanatory variables which exists in the models.

The consistency of the GMM estimation relies on the disturbances in the equations being uncorrelated and the validity of the instruments. Tests for first order and second order serial correlation in the residuals as well as the Sargan test statistics of over-identifying restrictions are reported in the tables. The Sargan test statistics show that all models of the *capital equation* and *credit risk equation* cannot reject the hypothesis that the instruments of over identifying are satisfied, uncorrelated with the error term. The first order serial correlations for models 1 and 2 of both the capital and credit risk equations for the full sample (see Tables 6.3 and 6.4) are negative and significant with no evidence of second order serial correlation. The first order serial correlations in model 3 for both the capital and credit risk equations are negative and insignificant. There is no evidence of second order

correlations for both the capital and credit risk equations. Therefore, the evidence generally shows a lack of both first and second order serial correlation. This is consistent with Arellano and Bond (1991), suggesting that the residuals follow a random walk.

**Table 6.3. Full Sample Estimates: Capital Equation**

The simultaneous equations are estimated with the Generalised Method of Moments (GMM) dynamic system. The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable: $\Delta CAR_{j,t}$** | | | |
|---|---|---|---|
| **Independent Variab;le** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.797 | 0.658 | -0.074 |
| | 1.058 | 0.319 | -0.444 |
| $\Delta RISK_{j,t}$ | 0.157* | 0.367* | 0.286* |
| | 1.772 | 1.872 | 1.874 |
| $CAR_{j,t-1}$ | 0.094** | 0.041* | 0.085* |
| | 2.185 | 1.651 | 1.662 |
| $SIZE_{j,t}$ | -0.265* | -0.041* | -0.037* |
| | -1.736 | -1.679 | -1.757 |
| $PROF_{j.t}$ | 0.088** | 0.1638* | 0.186* |
| | 2.126 | 1.667 | 1.66 |
| $MPWR_{j,t}$ | 0.0406* | 0.071* | 0.0444* |
| | 1.663 | 1.778 | 1.687 |
| $ECVAR_t$ | 0.0096*** | 0.001*** | 0.00051* |
| | 4.971 | 3.083 | 1.843 |
| $PRESS\ REG_{j,t}$ | | 0.104*** | |
| | | 4.24 | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | 0.630*** | |
| | | 2.938 | |
| $PRESS\ PEER_{j,t}$ | | | 0.006*** |
| | | | 2.694 |
| $PRESSPEER_{j,t}* CAR_{j,t-1}$ | | | 0.008* |
| | | | 1.642 |
| **Sargan test statistic** | 3.292 | 10.079 | 3.643 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1) test** | -0.016* | -0.005* | -0.047 |
| **AR(2) test** | -0.004 | -0.003 | -0.036 |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively.

## Table 6.4. Full Sample Estimates: Credit Risk Equation

The simultaneous equations are estimated with the Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_t + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_t + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable: $\Delta RISK_{j,t}$** | | | |
|---|---|---|---|
| **Independent Variable** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.871** | 0.132** | 0.441 |
| | 5.615 | 1.978 | 2.326 |
| $RISKj_{,t-1}$ | 0.11*** | 0.38*** | 0.103*** |
| | 3.204 | 6.086 | 3.251 |
| $\Delta CAR_{j,t}$ | 0.221*** | 0.379** | 0.262* |
| | 10.582 | 1.986 | 1.657 |
| $SIZE_{j,t}$ | -0.047*** | 0.013* | -0.0325 |
| | -4.109 | 1.703 | -1.361 |
| $PROF_{j.t}$ | -0.651** | -0.921* | -0.632* |
| | -2.124 | -1.717 | -1.711 |
| $MPWR_{j,t}$ | -1.726*** | -1.489*** | -1.43** |
| | -2.441 | -2.798 | -1.75 |
| $ECVAR_t$ | -0.0016*** | -0.023* | -0.028** |
| | -3.106 | -1.678 | -2.505 |
| $PRESS\ REG_{j,t}$ | | -0.288 | |
| | | -0.73 | |
| $PRESSREG_{j,t}\ xRISKj_{,t-1}$ | | 0.353** | |
| | | 2.192 | |
| $PRESS\ PEER_{j,t}$ | | | -0.393* |
| | | | 1.728 |
| $PRESSPEER_{j,t}xRISKj_{,t-1}$ | | | 0.088*** |
| | | | 3.905 |
| **Sargan test** | 8.37 | 10.28 | 7.322 |
| **Wald Joint test (p-value)** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.439*** | -0.480*** | 0.005 |
| **AR(2)** | -0.189 | -0.194 | 0.003** |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively.

The full sample estimations also show that the regression coefficients of all models are consistent in sign (see Tables 6.3 and 6.4). Additionally the sign consistency is also observed across the sub-sample periods as shown in Tables 6.5 and 6.6. Thus the Sargan tests statistics provides robust support in terms of estimators' consistency.

**Table 6.5. Sub-period Estimates: Capital Equation**

| | **Dependent Variable: $\Delta CAR_{j,t}$** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Independent** | **Model 1** | | | **Model 2** | | | **Model 3** | | |
| **Variable** | **1993-1997** | **1998-2000** | **2001-2008** | **1993-1997** | **1998-2000** | **2001-2008** | **1993-1997** | **1998-2000** | **2001-2008** |
| Constant | -0.761* | -0.611* | -0.591 | -0.572 | -0.195 | -0.67* | -0.717* | -0.181* | -0.178 |
| | -1.707 | -1.87 | -1.571 | -1.395 | -1.08 | -1.736 | -1.869 | -1.716 | -1.611 |
| $\Delta RISK_{j,t}$ | 0.236* | 0.126* | -0.134* | 0.346* | 0.291* | -0.210* | 0.145* | 0.153* | -0.184* |
| | 1.76 | 1.648 | -1.66 | 1.767 | 1.905 | -1.653 | 1.74 | 1.822 | -1.655 |
| $CAR_{j,t-1}$ | 0.096** | 0.082* | 0.057 | 0.048*** | 0.044** | 0.043 | 0.074*** | 0.112** | 0.055 |
| | 2.056 | 1.731 | 0.608 | 2.743 | 2.369 | 0.765 | 2.678 | 2.553 | 0.599 |
| $SIZE_{j,t}$ | 0.011* | -0.054* | -0.0461 | 0.053** | -0.008* | -0.041* | 0.048* | -0.013* | -0.002 |
| | 1.681 | -1.738 | -1.358 | -2.367 | -1.653 | -1.679 | 1.756 | -1.673 | -0.902 |
| $PROF_{j.t}$ | 0.100** | 0.149*** | -0.143*** | 0.527* | 0.526* | 0.726* | -0.033 | 0.032* | 0.011 |
| | 2.234 | 2.612 | -2.941 | 1.743 | 1.761 | 1.673 | -1.071 | 1.703 | 1.074 |
| $MPWR_{j,t}$ | 0.021* | 0.034 | 0.042* | 0.082* | 0.069 | 0.080* | 0.038 | 0.058* | 0.004 |
| | 1.658 | 1.624 | 1.757 | 1.793 | 1.752 | 1.832 | 1.511 | 1.863 | 1.338 |
| $ECVAR_t$ | 0.0002* | 0.00006* | 0.002** | 0.0002* | 0.00005* | 0.00007 | 0.0003** | 0.0003* | 0.00007* |
| | 1.663 | 1.74 | 2.032 | 1.704 | 1.817 | 1.003 | 1.991 | 1.796 | 1.927 |
| $PRESS\ REG_{j,t}$ | | | | 0.072** | 0.105** | 0.136 | | | |
| | | | | 1.995 | 1.961 | 1.588 | | | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | | | 0.793** | 0.242** | 0.201* | | | |
| | | | | 2.123 | 2.517 | 1.839 | | | |
| $PRESS\ PEER_{j,t}$ | | | | | | | 0.030* | 0.013* | 0.079* |
| | | | | | | | 1.795 | 1.656 | 1.834 |
| $PRESSPEER_{j,t}*CAR_{j,t-1}$ | | | | | | | 0.102* | 0.055* | 0.091* |
| | | | | | | | 1.837 | 1.869 | 1.649 |
| **Sargan test** | 3.597 | 4.021 | 3.794 | 2.757 | 5.928 | 6.027 | 5.339 | 3.128 | 6.087 |
| **Wald test (p-value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.505*** | -0.481*** | -0.427*** | -0.222*** | -0.378*** | -0.31888 | -0.346*** | -0.580*** | -0.379*** |
| **AR(2)** | -0.03 | -0.031 | -0.045 | -0.0019 | -0.034 | -0.167 | -0.05 | 0.090 | -0.019 |
| **Chow F-stat** | | | 6.972*** | | | 3.403** | | | 9.606*** |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively.

## Table 6.6. Sub-period Estimates: Credit risk Equation

| Independent Variable | Dependent Variable: ΔRISKj,t | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Model 1 | | | Model 2 | | | Model 3 | | |
| | 1993-1997 | 1998-2000 | 2001-2008 | 1993-1997 | 1998-2000 | 2001-2008 | 1993-1997 | 1998-2000 | 2001-2008 |
| Constant | 0.052 | 1.894*** | -8.265*** | -0.625*** | -0.076 | -3.876*** | 1.144*** | 1.630*** | 2.196*** |
| | 0.774 | 2.737 | -14.613 | -9.915 | -0.608 | -20.205 | 27.864 | 8.579 | 5.982 |
| $RISKj_{,t-1}$ | 0.234*** | 0.278*** | 0.934*** | 0.233*** | 0.294** | 0.459*** | 0.139*** | 0.226** | 0.337*** |
| | 2.833 | 3.897 | 4.127 | 4.298 | 2.535 | 3.919 | 2.717 | 2.09 | 3.03 |
| $\Delta CAR_{j,t}$ | 0.678*** | 0.411** | -0.29* | 0.1481** | 0.083* | -0.473*** | 0.302*** | 0.435*** | -0.346*** |
| | 2.718 | 1.993 | -1.804 | 1.982 | 1.705 | -3.404 | 3.892 | 3.986 | 3.452 |
| $SIZE_{j,t}$ | 0.013 | -0.17 | -0.679* | 0.063* | -0.029* | -0.312*** | 0.093 | -0.089* | -0.171** |
| | 1.491 | -1.56 | -1.825 | 1.751 | -1.69 | -2.701 | 1.279 | -1.845 | -1.969 |
| $PROF_{j.t}$ | -0.551** | -0.462** | -0.986*** | -0.127* | -0.1607 | -1.041*** | -0.691** | -0.507 | -0.910** |
| | -2.063 | -2.016 | -2.621 | -1.829 | -1.059 | -2.789 | -1.972 | -1.511 | -2.014 |
| $MPWR_{j,t}$ | 0.651 | 0.175 | -1.659* | -1.125* | -1.568* | -1.602** | 1.51** | -1.556*** | -1.305** |
| | 1.057 | 1.014 | -1.778 | -1.808 | -1.899 | -2.036 | 2.285 | -2.69 | -2.455 |
| $ECVAR_t$ | -0.0012 | -0.0002 | -0.008 | -0.0001* | -0.0005* | -0.0002 | -0.0003* | -0.0005* | -0.0001* |
| | -1.511 | -1.457 | -1.522 | -1.660 | -1.702 | -1.538 | -1.861 | -1.703 | -1.649 |
| $PRESS\ REG_{j,t}$ | | | | -0.152** | -0.169*** | 0.064* | | | |
| | | | | -2.141 | -2.729 | 1.937 | | | |
| $PRESSREG_{j,t}x\ RISKj_{,t-1}$ | | | | 0.502** | 0.674** | 0.743** | | | |
| | | | | 2.305 | 2.543 | 2.243 | | | |
| $PRESS\ PEER_{j,t}$ | | | | | | | 0.023** | 0.052*** | 0.002 |
| | | | | | | | 2.551 | 3.127 | 0.352 |
| $PRESSPEER_{j,t}xRISKj_{,t-1}$ | | | | | | | 0.020*** | 0.007** | 0.124 |
| | | | | | | | 4.481 | 2.213 | 1.474 |
| **Sargan test** | 3.597 | 4.021 | 3.794 | 2.757 | 5.928 | 6.027 | 5.339 | 3.128 | 6.087 |
| **Wald Joint test (p-value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.303*** | -0.562*** | -0.091*** | -0.401** | -0.217** | 0.0149 | -0.685*** | -0.473*** | -0.887 |
| **AR(2)** | -0.178 | -0.229 | -0.002 | -0.296 | -0.148 | -0.003 | -0.006 | -0.028 | -0.485 |
| **Chow F-statistic** | | | 5.727** | | | 3.282** | | | 3.013** |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively.

### 6.3.2. Explanatory Variables Affecting Changes in Capital and Credit risk

This part discusses the impacts of the explanatory variables on changes in capital and credit risk. The discussion covers the full period of analysis (reported in Tables 6.3 and 6.4) as well as the sample periods consisting of those before the crisis (period I) , during the crisis (period II) and after the crisis (period III) (reported in Tables 6.5 and 6.6).

It is worth noting that since all banks were undercapitalised before and during the crisis, the discussion of the variables in those periods is relevant when analysing the behaviour of undercapitalised banks.

#### 6.3.2.1. Lagged Capital Level and Lagged Credit Risk Level

Lagged credit risk ($RISK_{t-1}$) positively and significantly affects changes in credit risk for all models during all periods at least at the 10% level (see Tables 6.4 and 6.6) . Similarly, lagged capital adequacy ratio ($CAR_{t-1}$) positively and significantly affects the changes in capital for all models in periods I and II at least at the 10% level (see Table 6.5). On the other hand, the coefficients of lagged capital are insignificant in period III for all models of capital equation. Period III covers the timeframe when the banks recovered from the unprecedented losses experienced during the economic crisis. Therefore, the results suggest that when the banks determined their capital adequacy ratio during period III, the adjustment rate from the last period's capital adequacy ratio was very low and insignificant.

#### 6.3.2.2. Size

The estimation results suggest rejecting the hypothesis that bank size does not affect changes in capital and credit risk. The results of the full sample show that size significantly and negatively affects both changes in capital and credit risk (see Tables 6.3 and 6.4). Smaller banks tend to increase their capital adequacy ratio to avoid regulatory and peer group punishments. However, they also increase their holdings in riskier assets to compensate for the costs of holding capital and in order to maximise their returns. Conversely, large banks reduce risky asset holdings, therefore maintaining the required capital adequacy ratio they are obligated to hold.

Tests of mean equality are conducted providing an in-depth analysis on the differences in risk attitudes between banks of different sizes and under different capital regulation regimes. For test purposes, the sample is divided into three categories. The categories are based on the value of total assets at the end of the period of analysis, following the classification used by the Central Bank of Indonesia. The categories segregate the percentages of total industry assets controlled by each institution size class as follows:

- Large Banks: Banks with a minimum value of total assets equivalent to IDR 50 Billion (US$5 Million): 49% of the total industry assets.
- Medium Banks: Banks with a value of total assets between IDR 10 - 50 billion (US$1-US$5 Million): 13% of the total industry assets.

- Small Banks: Banks with a value of total assets of not more than IDR 10 Billion (US$1 Million): 20% of the total industry assets.

Table 6.7 provides the ANOVA results for the capital adequacy ratio (CAR) and credit risk (RISK) tests for the different bank categories. Moreover, Table 6.7 contains additional information on bank profitability (PROF), and loan to deposit ratios (LDR).

**Table 6.7. ANOVA test of mean equality for each size of bank**

CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, LDR = Loan to Deposit

| Variables | Size | 1993-1997 | 1998-2000 | 2001-2008 |
|---|---|---|---|---|
| **CAR** | **Large** | **0.076** | **-0.092** | **0.226** |
| | t-test of Means Equality | | -6.539*** | -4.218*** |
| | **Medium** | **0.072** | **- 0.095** | **0.158** |
| | t-test of Means Equality | | -2.919** | -3.022*** |
| | **Small** | **0.068** | **-0.07** | **0.256** |
| | t-test of Means Equality | | -6.757*** | -2.987*** |
| **RISK** | **Large** | **0.769** | **0.317** | **0.440** |
| | t-test of Means Equality | | 11.835*** | -4.073*** |
| | **Medium** | **0.682** | **0.325** | **0.461** |
| | t-test of Means Equality | | 9.512*** | -4.394*** |
| | **Small** | **0.731** | **0.531** | **0.543** |
| | t-test of Means Equality | | 6.518*** | -0.362 |
| **PROF** | **Large** | **0.022** | **0.050** | **0.031** |
| | t-test of Means Equality | | -2.008** | 1.967** |
| | **Medium** | **0.047** | **-0.003** | **0.017** |
| | t-test of Means Equality | | 6.039*** | -3.557*** |
| | **Small** | **0.025** | **0.017** | **0.005** |
| | t-test of Means Equality | | 1.413 | 0.847 |
| **LDR** | **Large** | **1.178** | **0.250** | **0.470** |
| | t-test of Means Equality | | 15.855*** | -4.405*** |
| | **Medium** | **1.230** | **0.392** | **0.504** |
| | t-test of Means Equality | | 20.018*** | -2.442** |
| | **Small** | **0.025** | **1.020** | **3.754** |
| | t-test of Means Equality | | 0.443 | -2.272** |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively.

The GMM estimation results in Tables 6.5 and 6.6 show that size positively and significantly affects changes in capital (with the coefficients ranging from 0.011 to 0.053) and credit risk (with the coefficients ranging from 0.013 to 0.093) only in period I. These results are significant at least at the level of 5%. During this period smaller banks tend to reduce their capital and credit risk while larger banks tend to increase their capital and credit risk. The ANOVA results support the findings of the GMM estimations. In period I most of the banks, regardless of their size, were undercapitalised. Large banks held greater capital adequacy ratios with riskier portfolios than medium and small banks. This suggests that large banks protect themselves from insolvency by increasing their capital buffer (even though it is still under the regulatory requirements) when they increase their credit risks. It also suggests that large banks are unable to diversify more than smaller banks despite the opportunities, which increase with size, to diversify, These results might reflect the markets served and type of assets held by large banks. Large banks concentrate on high risk products and hence have risky assets, which may result in a higher level of non-performing loans. In turn, this adversely affects their profitability as shown by relatively lower return on assets (PROF) compared with other banks. Large banks also have higher loan to deposit ratios which suggests not only that they have higher credit risk, but also that they are less liquid compared to smaller banks.

On the other hand, the GMM estimations show the impact of size on changes in capital and credit risks changes in periods II and III. Size negatively affects changes in capital and credit risk during these periods. In period II the coefficients range

from 0.008 to 0.053 in the capital equation, and from 0.029 to 0.170 in the portfolio equation. ANOVA results show that during period II, as regulators reduced the regulatory capital adequacy ratio (CAR) from 8% to 4%, most banks adjusted their capital adequacy ratio and credit risk significantly. The huge losses resulting from the economic crisis significantly decreased the average CAR with small banks holding the highest CAR and medium banks the lowest. Also, there was a significant decrease in credit risk with large banks holding the lowest credit risk and small banks holding the highest credit risk. Banks reduced their CAR significantly, reconstructing their credit risk by reducing their supply of loans to the economy as indicated by significantly lower credit risks (RISK). Not only did small banks have the highest credit risk, but they were also the most illiquid type of bank as indicated by the higher loan to deposit ratios they maintained in comparison to larger banks. The reversed risk attitudes of small banks coupled with the high levels of uncertainty in the economy led to higher quantities of non-performing loans, which subsequently resulted in lower profitability for small banks during this period. However, medium banks suffered the most. Their average profitability plunged to just -0.3% as they held higher capital ratios and lowered their credit risk.

In period III the GMM estimation results show that size insignificantly affects the changes in capital. The coefficients range from 0.002 to 0.046 in the capital equation. On the other hand, it significantly and negatively affects changes in asset credit risk, with coefficients ranging from 0.171 to 0.679. While large banks continue to pursue less risky investments, small banks increase their investment risk. The results suggest that during the period when the risk adjusted capital

adequacy requirements were set back to 8%, size did not have as great an impact on the adjustments in capital as during other periods. During the period of economic recovery from the crisis, all banks regardless of their size tried to improve their capital and restructure their portfolio in order to gain confidence and to avoid regulatory pressure and market discipline.

The ANOVA results in Table 6.7 show that in period III, the banks' average capital adequacy ratio was greater than the new 8% capital standard. This increase in capital adequacy ratios was accompanied by higher credit risks for all banks, with the increase in credit risks significant only for large and medium banks. Small banks still held the highest credit risks and capital adequacy ratios compared to other larger banks. The results suggest that after experiencing the severe economic crisis, there was a significant change in bank risk taking behavior. All banks increased their capital holdings more than the respective increases in credit risk. The economic recovery from the crisis failed to instill confidence. Large banks especially remained reluctant to channel loans to the levels observed prior to the crisis period. Large banks seem more risk averse compared to the smaller banks since they were more liquid and with the lowest loan to deposit ratios when compared to other banks.

This observation indicates that there was a change in the risk taking attitudes of large and small banks as a result of the economic crisis and changes in capital regulations (periods II and III). Large banks, which are known to be politically connected with the centre of power, are subject to less regulatory pressure to

increase their capital. Nevertheless, they changed their attitude toward portfolio and insolvency risks. They increased their capital adequacy ratios by holding high capital levels and reducing their credit risk so that the average capital adequacy ratio was still in excess of the required level. On the other hand, small banks continued to invest in riskier investments by making more loans but protected themselves from insolvency by holding greater capital, while medium banks held the lowest capital level with moderate credit risk.

#### 6.3.2.3. Profitability

The GMM estimations reject the hypothesis that profitability does not affect the changes in capital and credit risk. The results show that current earnings (ROA) significantly and positively affect the changes in capital and negatively affect the changes in credit risk; this indicates that profitable banks increase their capital through retained earnings and generate their returns by investing in less risky assets. The sub sample results show the consistency of the impacts over the sample periods.

#### 6.3.2.4. Market Power

The GMM results reject the hypothesis that bank market power does not affect capital and credit risk changes. The results show the positive impact of market power on changes in capital and the negative impact on changes in credit risk at least at the 5% confidence level. The findings suggest that banks with greater

market power increase their adjustments of the capital adequacy ratio and reduce their adjustments of credit risk. They reduce leverage by financing with more equity and choose to invest in safer portfolios even though this means they sacrifice some of their potential profits. The findings support previous studies on market structure and bank risk. That is, when banks can generate monopoly rents, in order to protect the valuable banking charter, they become risk averse (Boyd and Nicolo, 2005).

The impact of market power on changes in capital and credit risk is consistent across the sub-sample periods. The impact of the economic crisis on banking market structure is quite severe. The number of banks was reduced by almost 40% as a result of the mergers and liquidations which followed the crisis. Naturally, this produced sudden and large shifts in bank size and portfolio composition as well as shifts in market power.

#### 6.3.2.5. Economic Uncertainty

The interest rate variance is used as a proxy for economic uncertainty. The results reject the hypothesis that economic uncertainty does not affect the changes in capital and credit risk in favour of the alternative hypothesis that economic uncertainty affects the changes in capital ratio and credit risk. The results support the findings from unit root tests with structural breaks in Chapter 3, suggesting that economic shocks have a permanent impact on most of the asset and liability components.

The results show that economic uncertainty negatively affects credit risk changes, suggesting that banks offset the impacts of uncertainty by reducing their credit risk, thus adjusting their asset portfolios towards lower yielding assets.

Theoretically, banks adjust and use capital to provide a "buffer" against loss caused by unexpected changes in the term structure of interest rates. Therefore the expected sign of the interest rate variance coefficients in the capital equation should be positive and significant. The results support this theory and show that the coefficients of variance of interest rate are significant and positive in the capital equation. The risk in the economy forces banks to increase their capital adequacy ratio. As an increase in economic uncertainty causes banks to lower the credit risk, the increase in capital adequacy ratio is achieved by increasing total capital. The decision to use less leverage and more capital is motivated by the uncertainty of the cost of funds during high economic uncertainty.

The sub-sample results show consistent relationships across periods. The impact of the uncertainty in the economy on changes in capital adequacy ratio and credit risk is the highest after the crisis, as shown by the large interest rate variance coefficients during that period.

#### 6.3.2.6. Regulatory & Peer Group Pressure on undercapitalised banks

To investigate whether undercapitalised banks behave differently to other banks in terms of capital and portfolio allocations, regulatory and peer group pressure

dummy variables were included in the models. The GMM estimation results find that regulatory and peer group pressure significantly affect undercapitalised banks when they change their capital adequacy ratio and credit risk. The results reject the hypothesis that both regulatory and peer group pressures do not significantly affect undercapitalised banks in changing their capital adequacy ratio and credit risk.

Regulatory and peer group pressures positively affect undercapitalised banks in changing their capital and negatively affect changes in credit risk. They are generally significant at the 1% and 5% levels. The results imply that banks with capital below the regulatory requirements and below the average of the peer group increase their capital ratio by reducing the risk of their asset portfolios.

When the results are analysed for each sub-sample period, it is found that there is a change in risk taking behaviour by undercapitalised banks. The sub-sample results show that before and during the economic crisis, when risk-independent capital standards were imposed (period I) and when the risk independent capital standards were lowered (period II), undercapitalised banks under regulatory pressure increased their capital ratio by lowering the risk of their portfolios. After the crisis (period III), when the new risk-based capital standards were adopted, undercapitalised banks increased their capital ratio as well as their credit risk. This suggests that during period III, undercapitalised banks increased their credit risk in an attempt to recover the losses arising from the crisis. In other words, stringent capital regulations after the economic crisis encouraged undercapitalised banks to protect themselves with greater capital in response to increases in their credit risk.

The observed increases in credit risk may be due to attempts by the undercapitalised banks to generate higher expected returns which in turn increase their retained earnings and hence capital, or "gambling for resurrection" as Calem and Rob (1996) put it. This also suggests that after the crisis, regulatory and peer group pressures are effective in controlling insolvency risk by forcing undercapitalised banks to hold more capital when they increase their credit risk.

### 6.3.2.7. The Speed of Adjustment of Undercapitalised Banks

The interactive terms of the lagged capital adequacy ratio and lagged credit risk with the regulatory (***$PRESSREG_{jt}$*$CAR_{j,t-1}$*** and ***$PRESSREG_{jt}$*$RISK_{j,t-1}$*****)** and peer group pressures (***$PRESSPEER_{jt}$*$CAR_{j,t-1}$*** and ***$PRESSPEER_{jt}$*$RISK_{j,t-1}$*****)** estimate the rate of adjustment of the lagged capital adequacy ratio and lagged credit risk for undercapitalised banks. The results in Table 6.3 show that the adjustment rate of lagged capital adequacy ratio for banks under regulatory pressure (0.63) is significantly positive at the 1% significance level whilst the adjustment rate of lagged capital adequacy ratio under the peer group pressure (0.008) is also significantly positive at the 10% significant level . With respect to credit risk, the results in Table 6.4 indicate that the adjustment rate is significantly positive for banks under regulatory pressure (0.353) and under the peer group pressure (0.088). This suggests that both regulatory capital requirements and industry pressures are significant in coercing banks to set their capital and credit risk at desired levels.

These results are consistent with the conclusion that banks with capital below the regulatory required level and industry's average behave differently in meeting their target capital and credit risk levels. Their decision to increase capital when they increased credit risk following the economic crisis is consistent with the objectives of imposing capital requirements by regulators.

#### 6.3.2.8. Summary

In summary, the important findings regarding the impacts of these factors on changes in capital and credit risk that warrant emphasis are:

- Banks gradually adjust both their capital and credit risk to the desired level with a very slow adjustment rate. After the crisis the adjustment rate is insignificant.

- There is a change in attitude to risk of both small and large banks. Before the crisis, large banks hold more capital and risky assets than smaller banks. However, during and after the crisis, small banks tend to hold higher capital and increase their holdings in riskier assets whilst large banks tend to be more risk averse, holding less risky assets and therefore also holding less capital to maintain the minimum required capital adequacy ratio.

The risk taking attitude is negatively correlated with profitability. Before the crisis, medium sized banks are the most profitable banks, but during the crisis they suffer the most. During and after the crisis, large banks with the lowest credit risk are the most profitable whilst small bank profitability is found to be continuously declining until after the crisis period when they are the least profitable banks.

- Profitable banks increase their capital through retained earnings and generate returns by investing in low risk assets.

- The findings on market power suggest that as banks with greater market power become more risk averse, they protect their valuable banking charter by financing with more equity and choosing safer investment portfolios. This occurs despite the potential that they might sacrifice some of their profits.

- The results on the economic stability variable suggest that banks are more risk averse during periods of high economic uncertainty. Banks minimise the adverse impact of increases in economic uncertainty by reducing their credit risk and increasing their level of capital (resulting in increased capital adequacy ratios). Increased economic uncertainty causes banks to be more risk averse as they are willing to forgo additional returns by investing in low risk investments whilst reducing leverage (as a result of the uncertainty in funding costs).

- When the risk independent capital standards were adopted (before the crisis) and when the risk independent capital standards were lowered (during the crisis), undercapitalised banks increased their capital adequacy ratio by lowering the risk of their portfolio. Large losses incurred during the crisis motivated undercapitalised banks to increase their credit risks after the crisis to generate higher expected returns. Consequently, undercapitalised banks protected themselves from insolvency by holding more capital, thus raising the capital ratio above the minimum required level. The experience from the crisis combined with the regulatory and peer pressure observed afterward resulted in all banks being overcapitalised after the crisis.

### 6.3.3. The Relationship between Changes in Capital Adequacy Ratio and Credit risk

The empirical results reject the hypothesis that changes in capital adequacy ratio and credit risk do not affect each other. Therefore the alternative hypothesis is retained, namely that changes in capital adequacy ratio and credit risk affect each other. The results are discussed for the full sample and each sub-sample.

#### 6.3.3.1. Full Sample

GMM estimation results of the full sample show a positive and significant impact of asset credit risk on changes in the capital adequacy ratio at the 10% level for all models with the coefficients ranging from 0.157 to 0.367. Whilst in the credit risk equation, changes in the capital adequacy ratio also significantly and positively affect changes in credit risk at the 10% level in all models with the coefficients ranging between 0.221 and 0.379 (see Tables 6.3 and 6.4).

Banks generally increase their capital (asset credit risk) as a result of an increase in asset credit risk (capital) whilst maintaining their capital adequacy ratio. The result of this positive association supports Buser et al (1981) who argue that, with regulation, banks whose capital level has increased are allowed to pursue riskier investments, whilst banks with risky investment are forced to increase their capital. Similarly, to maintain their capital ratios as required, banks with a low capital level are forced by regulators to pursue less risky investments whilst banks with less risky investment are not required to increase their capital level.

On the other hand, the positive impact of changes in capital ratio on credit risk also supports the regulatory capital ratio unintended effect arguments explained by the mean-variance utility maximisation model (Koehn and Santomero, 1980 and Kim and Santomero, 1988) and the utility maximisation model (Keeton, 1980; Gennotte and Pyle 1991). They conclude that an increase in credit risk is quite possible as a result of the increase in the capital standard. The compulsory increase in capital

ratio forces banks to increase their credit risks with the higher return intended to compensate for the diminished expected returns arising from relatively expensive equity and vice versa.

#### 6.3.3.2. Sub-Period

The estimation results for the sub-sample periods show that there are positive and significant interrelationships of changes in capital ratio and credit risk (at least at the 10% level) in periods I and II, and that the interrelationships change to significantly negative in period III (see Tables 6.5 and 6.6).

The positive impact of changes in credit risk on changes in capital ratio during period I – when the flat (risk independent) leverage ratio of 8% was imposed – supports the arguments about regulatory costs and the intended effect of regulatory capital requirements. The compulsory increase in leverage ratio forces banks to increase their capital when they increase their credit risk, as shown in the capital equation. On the other hand, the capital standards encourage banks to increase their credit risk as they increase their capital ratio. This is shown by the positive impact of changes in capital ratio on credit risk found in the credit risk equation. The positive impact of the capital ratio on credit risk is the unintended effect of the risk independent regulatory capital requirements. By increasing capital the banks systematically reduce insolvency risk, but at the same time, they also increase credit risk which in effect would increase their total risk. Considering that most of the banks were undercapitalised in period I ( the average CAR is 7.1%,

see Table 5.1), the increases in credit risk put the banks at significant risk since they were not backed up by adequate capital to absorb any losses arising from adverse moves in market yields.

In period II, as part of the bank restructuring programs, regulators reduced the risk-independent leverage ratio to 4%. During this period the average levarage ratio dropped significantly, especially at the beginning of the application of the new capital standards, to -9.2% as shown in Table 6.1. This is partly because of the huge losses experienced by most of the banks due to the crisis. Estimation of the capital equation shows that changes in credit risk positively and significantly affect changes in capital, with the coefficients ranging from 0.126 to 0.291 (see Table 6.5). The positive impact of changes in credit risk on changes in capital ratio during this period suggests that banks reduce their capital ratios not only because of operational losses from the previous year, but also because they reduce the risk of asset portfolios. The high risk in the economy forced banks to reconstruct their portfolios toward lower risk investments and the regulatory decision to reduce the compulsory capital requirement. This allowed banks to reduce their capital level with the lower asset credit risk.

In the credit risk equation, changes in capital ratio affect credit risk significantly and positively at the 10% level. The positive impact of changes in capital ratio on changes in credit risk during this period also suggests that bank decisions reducing credit risk (in the presence of lower capital levels) are made mostly to avoid the increasing probability of bankruptcy during a time of high economic uncertainty.

Moreover, undercapitalised banks were required to exchange some part of their equities for government bonds as part of the restructuring programs, thereby further reducing credit risk.

In period III, when the risk based capital standards were set to 8%, the relationships change. Changes in credit risk (capital ratio) negatively and significantly affect changes in capital ratio (credit risk). To investigate the significance of the changes of the relationship, Chow breakpoint tests were conducted and the results are presented in Tables 6.5 and 6.6. The critical value at the 1 percent level is 1.77 which is far surpassed by all three models of capital changes and credit risk equation. The tests therefore suggest that the change in relationship is significant.

The change in relationship coincides with a drastic change in capital regulation in 2001. Not only is the level of the capital adequacy ratio adjusted (from 4% to 8%), but unlike the previous requirements, the new capital requirements incorporate the credit risk of the assets following the Basel I. The negative impact of credit risk on capital changes may indicate the moral hazard created by the government "blanket guarantee". Banks increased their asset risks and leverage (by lowering capital) in order to maximise the value of the guarantee subsidy (which is consistent with the option-pricing theory of Merton (1977), Black et al. (1978); Kareken and Wallace (1978)). On the other hand, the negative relationship may also suggest that the application of higher capital standards combined with the large losses in bank capital forced banks to increase their capital ratios by reducing

their credit risk. Banks were more risk averse during the recovery period have still not fully recovered from their experiences during the economic crisis. Being reluctant to increase their risks, they were observed lowering credit risk.

During this period the average capital adequacy ratio jumped to 22.7% with the asset credit risk average being 0.327 (see Table 6.1), less than half of the average of asset credit risk in period 1. Most of the banks were considerably overcapitalised with an average capital adequacy ratio of 22.7%, in excess of the minimum capital required, suggesting that the change in relationship may not be only as a result of regulatory influence but also a reflection of the risk aversion of bank managers as a result of the economic crisis. During the crisis the market takes over the supervisory role of regulators by disciplining the illiquid and insolvent banks through bank runs. Maintaining a greater capital ratio than required not only sends a signal of solvency, but may also reflect the banks' belief that holding capital at the regulatory required level will not necessarily protect them from insolvency.

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The results suggest that in an attempt to avoid the risk of losing reputation and market confidence as well as to comply with the regulations, banks became more risk averse after the crisis, investing in a less risky portfolio and holding excessive capital. The findings are consistent with the leverage and risk-related cost avoidance and managerial risk aversion theories of capital structure and risk-taking behaviour in commercial banks. Past research argues that banks hold excess capital above the requirements partly because of the degree of the risk aversion of bank managers and increasing costs of raising deposits and borrowing (O'Hara,

1983), as well as to avoid market discipline if the capital falls below the regulatory minimum capital standards (Furfine, 2001).

The phenomenon raises an important question worth investigating further: whether the decision to change the capital requirements back to 8% during the recovery period (period III) was an economically effective decision or not. By reducing credit risk banks seem to make less risky loans which may create a credit crunch in the economy. The combination of high economic uncertainty and higher regulatory capital requirements with a new risk-based measurement affects the role of banks as financial intermediaries in supplying loans to the economy. This is especially not desired during times when funding supplies are required to help the economy recover from a period of crisis. These results are consistent with the findings in the previous chapter.

### 6.3.4. The Impact of the Type of Bank Ownership on the Interrelationship between Capital and Credit Risk of Asset Portfolio Decisions

#### 6.3.4.1. Introduction

In order to analyse the impact of type of bank ownership on capital and credit risk of asset portfolio decisions, new simultaneous equations with the inclusion of dummy variables representing each type of bank ownership were developed and analysed. The new added dummy variables permit the investigation of the

difference in capital and credit risk of asset portfolio decisions of each type of bank compared to a base category. Due to their special roles, state owned banks are used as the base category.

In addition, to investigate impacts of the explanatory variables on both changes in capital and credit risk for each type of bank ownership, sub sample GMM estimation results are also analysed in each sub period of analysis. The estimation results for the new models with dummy variables added are provided in Tables 6.8 and 6.9. whilst the sub sample estimation results for each type of bank ownership are in Tables 6.10 and 6.11.

#### 6.3.4.2. GMM Estimation Analysis for Full Samples

The Sargan test statistics show that all models of both the *capital equation* and *credit risk equation* cannot reject the hypothesis that the instruments of over identifying are satisfied, when uncorrelated with the error term. The evidence of first order and second serial correlations for all models of both the capital and credit risk equations for a full sample (see Tables 6.8 and 6.9) shows no evidence of second order serial correlation. Therefore, the evidence is generally consistent with Arellano and Bond (1991), suggesting that the residuals follow a random walk.

**Table 6.8 . Full Sample Estimates: Capital Equation**

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + \alpha_9 D_{ij} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + \beta_9 D_{ij} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Type of Ownership dummy (Dij); $D_{1j} = D_{2j} = D_{3j} = D_{4j} = 0$ if the bank is a state owned bank

$D_{1j} = 1$ if the bank is a regional bank, or 0 otherwise; $D_{2j}$ = if the bank is a private domestic bank, or 0 otherwise

$D_{3j} = 1$ if the bank is a joint venture bank, or 0 otherwise; $D_{4j} = 1$ if the bank is foreign bank or 0 otherwise.

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable:** | | | |
|---|---|---|---|
| **Independent Variable** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.781 | 0.645 | -0.073 |
| | 1.037 | 0.313 | -0.435 |
| DRISKj,t | 0.154 * | 0.360 * | 0.280 * |
| | 1.737 | 1.835 | 1.837 |
| CARj,t-1 | 0.092 ** | 0.04 | 0.083 |
| | 2.141 | 1.618 | 1.629 |
| SIZEj,t | -0.260 * | -0.04 | -0.036 * |
| | -1.701 | -1.645 | -1.722 |
| PROFj.t | 0.086 ** | 0.161 | 0.182 |
| | 2.083 | 1.634 | 1.627 |
| MPWR j,t | 0.04 | 0.070 * | 0.044 * |
| | 1.63 | 1.742 | 1.653 |
| ECVARt | 0.009 *** | 0.001 *** | 0.000 * |
| | 4.872 | 3.021 | 1.806 |
| PRESS REGj,t | | 0.102 *** | |
| | | 4.155 | |
| PRESS REGj,t*CARj,t-1 | | 0.617 *** | |
| | | 2.879 | |
| PRESS PEERj,t | | | 0.006 *** |
| | | | 2.64 |
| PRESSPEERj,t* CARj,t-1 | | | 0.008 |
| | | | 1.614 |
| Regional Bank (D1) | -1.243 ** | -1.218 ** | -1.462 ** |
| | -2.035 | -2.299 | -2.393 |
| Private Domestic (D2) | -1.257 ** | -1.232 ** | -1.479 *** |
| | -2.238 | -2.193 | -2.632 |
| Joint Venture Bank (D3) | -1.321 * | -1.295 | -1.554 |
| | -1.691 | -1.539 | -1.047 |
| Foreign Bank (D4) | 1.200 ** | 1.176 *** | 1.411 *** |
| | 2.333 | 2.286 | 2.743 |
| **Sargan test statistic** | 3.0.57 | 9.007 | 3.421 |
| **Wald test (p value)** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1) test** | -0.011* | -0.004* | -0.042 |
| **AR(2) test** | -0.004 | -0.003 | -0.036 |

*,** and *** suggest significant tests at the 10%, 5% and 1% levels respectively

## Table 6.9. Full Sample Estimates: Credit risk Equation

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system. The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + \alpha_9 D_{ij} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + \beta_9 D_{ij} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Type of Ownership dummy (Dij); $D_{1j} = D_{2j} = D_{3j} = D_{4j} = 0$ if the bank is a state owned bank

$D_{1j} = 1$ if the bank is a regional bank, or 0 otherwise; $D_{2j}$ = if the bank is a private domestic bank, or 0 otherwise

$D_{3j} = 1$ if the bank is a joint venture bank, or 0 otherwise; $D_{4j} = 1$ if the bank is foreign bank or 0 otherwise.

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable:** | | | |
|---|---|---|---|
| **Independent Variable** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.854 *** | 0.129 * | 0.432 ** |
| | 5.503 | 1.938 | 2.191 |
| RISKj,t-1 | 0.108 *** | 0.372 *** | 0.101 *** |
| | 3.14 | 5.964 | 3.186 |
| DCAR j,t | 0.217 *** | 0.371 * | 0.257 |
| | 10.37 | 1.946 | 1.624 |
| SIZEj,t | -0.046 *** | 0.013 * | -0.032 |
| | -4.027 | 1.669 | -1.334 |
| PROFj.t | -0.638 ** | -0.903 * | -0.619 * |
| | -2.082 | -1.683 | -1.677 |
| MPWR j,t | -1.691 ** | -1.459 *** | -1.401 * |
| | -2.392 | -2.742 | -1.715 |
| ECVARt | -0.002 *** | -0.023 | -0.027 ** |
| | -3.106 | -1.644 | -2.455 |
| PRESS REGj,t | | -0.282 | |
| | | -0.715 | |
| PRESSREG j,t xRISKj,t-1 | | -0.346 ** | |
| | | -2.148 | |
| PRESS PEERj,t | | | -0.385 ** |
| | | | -1.993 |
| PRESSPEERj,txRISKj,t-1 | | | -0.094 *** |
| | | | 3.91 |
| Regional Bank (D1) | 2.083 *** | 2.041 *** | 2.450 *** |
| | 3.098 | 3.036 | 3.644 |
| Private Domestic (D2) | 2.061 | 2.02 | 2.424 |
| | 1.091 | 1.049 | 1.459 |
| Joint Venture Bank (D3) | 1.013 | 0.993 | 1.191 |
| | 0.999 | 0.959 | 0.35 |
| Foreign Bank (D4) | 1.144 *** | 1.121 *** | 1.346 *** |
| | 2.879 | 2.821 | 3.386 |
| **Sargan test** | 8.22 | 10.13 | 7.245 |
| **Wald test (p-value)** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.413*** | -0.390*** | 0.004 |
| **AR(2)** | -0.184 | -0.189 | 0.004** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

With state owned banks being used as the base category, GMM estimation results for a full sample period show that generally regional banks (D1) and domestic private banks (D2) significantly change their capital at a lower rate than state owned banks, at the 5% significance level as shown in Table 6.8. The sub-period estimation results (Table 6.10) further show that the changes in capital of the domestic private and regional banks are at a significantly lower rate than state owned banks in period I (before the Asian financial crisis and during the required leverage ratio of 8%) and period II (during the Asian financial crisis and when the required leverage ratio is 4%) and not significantly different during the recovery from the Asian financial crisis when the risk adjusted capital requirement of 8% is imposed . Further, the changes in the capital of joint venture and foreign banks are at a significantly higher rate compared to state owned banks in period II during the Asian financial crisis and at the time when the global financial crisis had just hit the world.

**Table 6.10 . Sub-Period Estimates: Capital Equation**

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system. The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + \alpha_9 D_{ij} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + \beta_9 D_{ij} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Type of Ownership dummy (Dij); $D_{1j} = D_{2j} = D_{3j} = D_{4j} = 0$ if the bank is a state owned bank

$D_{1j} = 1$ if the bank is a regional bank, or 0 otherwise; $D_{2j}$ = if the bank is a private domestic bank, or 0 otherwise

$D_{3j} = 1$ if the bank is a joint venture bank, or 0 otherwise; $D_{4j} = 1$ if the bank is foreign bank or 0 otherwise.

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| | **Dependent Variable: $\Delta CAR_{j,t}$** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Independent** | **Model 1** | | | **Model 2** | | | **Model 3** | | |
| **Variable** | **1993-1997** | **1998-2000** | **2001-2009** | **1993-1997** | **1998-2000** | **2001-2009** | **1993-1997** | **1998-2000** | **2001-2009** |
| Constant | -0.761* | -0.611* | -0.591 | -0.572 | -0.195 | -0.67* | -0.717* | -0.181* | -0.178 |
| | -1.707 | -1.87 | -1.571 | -1.395 | -1.08 | -1.736 | -1.869 | -1.716 | -1.611 |
| $DRISK_{j,t}$ | 0.236* | 0.126* | -0.134* | 0.346* | 0.291* | -0.210* | 0.145* | 0.153* | -0.184* |
| | 1.76 | 1.648 | -1.66 | 1.767 | 1.905 | -1.653 | 1.74 | 1.822 | -1.655 |
| $CAR_{j,t-1}$ | 0.096** | 0.082* | 0.057 | 0.048*** | 0.044** | 0.043 | 0.074*** | 0.112** | 0.055 |
| | 2.056 | 1.731 | 0.608 | 2.743 | 2.369 | 0.765 | 2.678 | 2.553 | 0.599 |
| $SIZE_{j,t}$ | 0.011* | -0.054* | -0.0461 | "-0.053** | -0.008* | -0.041* | 0.048* | -0.013* | -0.002 |
| | 1.681 | -1.738 | -1.358 | -2.367 | -1.653 | -1.679 | 1.756 | -1.673 | -0.902 |
| $PROF_{j.t}$ | 0.100** | 0.149*** | -0.14*** | 0.527* | 0.526* | 0.726* | -0.033 | 0.032* | 0.011 |
| | 2.234 | 2.612 | -2.941 | 1.743 | 1.761 | 1.673 | -1.071 | 1.703 | 1.074 |
| $MPWR_{j,t}$ | 0.021* | 0.034 | 0.042* | 0.082* | 0.069 | 0.080* | 0.038 | 0.058* | 0.004 |
| | 1.658 | 1.624 | 1.757 | 1.793 | 1.752 | 1.832 | 1.511 | 1.863 | 1.338 |
| $ECVAR_t$ | 0.0002* | 0.00006* | 0.002** | 0.0002* | 0.00005* | 0.00007 | 0.0003** | 0.0003* | 0.00007* |
| | 1.663 | 1.74 | 2.032 | 1.704 | 1.817 | 1.003 | 1.991 | 1.796 | 1.927 |
| $PRESS\ REG_{j,t}$ | | | | 0.072** | 0.105** | 0.136 | | | |
| | | | | 1.995 | 1.961 | 1.588 | | | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | | | 0.793** | 0.242** | 0.201* | | | |
| | | | | 2.123 | 2.517 | 1.839 | | | |
| $PRESS\ PEER_{j,t}$ | | | | | | | 0.030* | 0.013* | 0.079* |
| | | | | | | | 1.795 | 1.656 | 1.834 |
| $PRESSPEER_{j,t}*\ CAR_{j,t-1}$ | | | | | | | 0.102* | 0.055* | 0.091* |
| | | | | | | | 1.837 | 1.869 | 1.649 |
| Regional Bank (D1) | -1.270 ** | -1.226 ** | 1.119 | -1.551 ** | -1.244 ** | -1.201 | 1.869 | -0.868 * | -0.697 |
| | -2.26 | -2.182 | -1.237 * | -2.215 | -2.215 | -1.138 | -0.767 | -1.924 | -1.24 |
| Private Domestic (D2) | -1.256 ** | -1.212 *** | -1.798 | -1.445 ** | -1.231 ** | -1.188 | -1.115 ** | -0.809 ** | -0.689 |
| | -2.055 | -2.984 | -1.143 | -1.974 | -2.014 | -1.024 | -2.071 * | -2.105 | -1.128 |
| Joint Venture Bank (D3) | 1.335 * | 1.289 *** | -1.911 | 1.303 | 1.308 ** | 1.263 | -1.185 | 0.730 ** | 0.732 |
| | 1.718 | 2.624 | -1.592 * | 1.613 | 2.068 | 1.571 | -1.173 | 2.09 | 1.158 |
| Foreign Bank (D4) | 1.212 | 1.170*** | 1.736 | -1.459 | 1.188* | 1.147 | 1.076 | -0.817 ** | 0.665 |
| | 1.356 | 3.027 | 1.021 | 1.188 | 1.929 | 1.467 | 1.253 | 1.987 | 1.58 |
| **Sargan test** | 6.597 | 5.021 | 3.794 | 5.757 | 5.928 | 6.027 | 5.339 | 4.128 | 6.087 |
| **Wald test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.505*** | -0.481*** | 0.427*** | -0.222*** | -0.378*** | -0.31888 | -0.346*** | -0.580*** | -0.379*** |
| **AR(2)** | -0.03 | -0.031 | -0.045 | -0.0019 | -0.034 | -0.167 | -0.05 | 0.09 | -0.019 |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.11. Sub-period Estimates: Credit risk Equation

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system. The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + \alpha_9 D_{ij} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + \beta_9 D_{ij} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Type of Ownership dummy (Dij); $D_{1j} = D_{2j} = D_{3j} = D_{4j} = 0$ if the bank is a state owned bank

$D_{1j} = 1$ if the bank is a regional bank, or 0 otherwise; $D_{2j}$ = if the bank is a private domestic bank, or 0 otherwise

$D_{3j} = 1$ if the bank is a joint venture bank, or 0 otherwise; $D_{4j} = 1$ if the bank is foreign bank or 0 otherwise.

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Independent** | **Dependent Variable: ΔRISKj,t** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | | | **Model 2** | | | **Model 3** | | |
| **Variable** | **1993-1997** | **1998-2000** | **2001-2009** | **1993-1997** | **1998-2000** | **2001-2009** | **1993-1997** | **1998-2000** | **2001-2009** |
| Constant | 0.052 | 1.894*** | -8.265*** | -0.625*** | -0.076 | -3.876*** | 1.144*** | 1.630*** | 2.196*** |
| | 0.774 | 2.737 | -14.613 | -9.915 | -0.608 | -20.205 | 27.864 | 8.579 | 5.982 |
| $RISK_{j,t-1}$ | 0.234*** | 0.278*** | 0.934*** | 0.233*** | 0.294** | 0.459*** | 0.139*** | 0.226** | 0.337*** |
| | 2.833 | 3.897 | 4.127 | 4.298 | 2.535 | 3.919 | 2.717 | 2.09 | 3.03 |
| $DCAR_{j,t}$ | 0.678*** | 0.411** | -0.29* | 0.1481** | 0.083* | -0.473*** | 0.302*** | 0.435*** | -0.346*** |
| | 2.718 | 1.993 | -1.804 | 1.982 | 1.705 | -3.404 | 3.892 | 3.986 | 3.452 |
| $SIZE_{j,t}$ | 0.013 | -0.17 | -0.679* | 0.063* | -0.029* | -0.312*** | 0.093 | -0.089* | -0.171** |
| | 1.491 | -1.56 | -1.825 | 1.751 | -1.69 | -2.701 | 1.279 | -1.845 | -1.969 |
| $PROF_{j,t}$ | -0.551** | -0.462** | -0.986*** | -0.127* | -0.1607 | -1.041*** | -0.691** | -0.507 | -0.910** |
| | -2.063 | -2.016 | -2.621 | -1.829 | -1.059 | -2.789 | -1.972 | -1.511 | -2.014 |
| $MPWR_{j,t}$ | 0.651 | 0.175 | -1.659* | -1.125* | -1.568* | -1.602** | 1.51** | -1.556*** | -1.305** |
| | 1.057 | 1.014 | -1.778 | -1.808 | -1.899 | -2.036 | 2.285 | -2.69 | -2.455 |
| $ECVAR_t$ | -0.0012 | -0.0002 | -0.008 | -0.0001* | -0.0005* | -0.0002 | -0.0003* | -0.0005* | -0.0001* |
| | -1.511 | -1.457 | -1.522 | -1.66 | -1.702 | -1.538 | -1.861 | -1.703 | -1.649 |
| $PRESS\ REG_{j,t}$ | | | | -0.152** | -0.169*** | 0.064* | | | |
| | | | | -2.141 | -2.729 | 1.937 | | | |
| $PRESSREG_{j,t} x\ RISK_{j,t-1}$ | | | | -0.502** | -0.674** | -0.743** | | | |
| | | | | -2.305 | -2.543 | -2.243 | | | |
| $PRESS\ PEER_{j,t}$ | | | | | | | 0.023** | 0.052*** | 0.002 |
| | | | | | | | 2.551 | 3.127 | 0.352 |
| $PRESSPEER_{j,t} x RISK_{j,t-1}$ | | | | | | | 0.020*** | 0.007** | 0.124 |
| | | | | | | | 4.481 | 2.213 | 1.474 |
| Regional Bank (D1) | 0.864 | 0.916 | 0.822 | 0.993 | 0.928 | 0.827 | 0.759 | 0.905 | 0.728 |
| | 1.321 | 1.276 | 1.089 | 1.29 | 1.295 | 1.25 | 1.173 | 1.072 | 0.725 |
| Private Domestic (D2) | 2.776 | 2.954 ** | 2.832 | 2.954 | 2.994 ** | 2.014 | 2.050 * | 2.084 ** | 1.812 |
| | 1.257 | 2.034 | 1.107 | 1.535 | 2.232 | 1.489 | 1.851 | 2.086 | 0.99 |
| Joint Venture Bank (D3) | -1.106 * | -2.597 * | -1.873 | -1.597 | -1.476 | -2.155 | -1.161 | -1.069 | -2.137 |
| | -1.700 | -1.816 | -1.217 | -1.444 | -1.176 | -1.135 | -1.066 | -1.081 | -1.566 |
| Foreign Bank (D4) | 1.661 | 2.997 ** | 2.001 | 1.176 * | 1.910 ** | 1.937 | 1.841 | 1.967 ** | 1.96 |
| | 1.342 | 2.238 | 1.276 | 1.729 | 2.287 | 1.597 | 1.629 | 2.097 | 1.403 |
| **Sargan test** | 7.464 | 8.344 | 7.873 | 5.721 | 12.301 | 12.506 | 11.078 | 6.491 | 12.631 |
| **Wald test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.303*** | -0.562*** | -0.591*** | -0.401** | -0.217** | 0.0149 | -0.685*** | -0.473*** | -0.0887 |
| **AR(2)** | -0.178 | -0.229 | -0.002 | -0.296 | -0.148 | -0.003 | -0.006 | -0.028 | -0.485 |
| **Chow F-statistic** | | | 5.727** | | | 3.282** | | | 3.013** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

On the other hand, the estimation results on the risk equation in Table 6.11 show that domestic private (D2) and foreign state owned banks (D4) experience a change in their credit risk that is significantly higher compared to state owned banks in period II , at least at the 5% significance level. Table 6.11 also shows that joint venture banks' change in credit risk is significantly lower than that of state banks in period III. The results show that regional banks behave insignificantly different in terms of credit risk taking activities compared to state owned banks in all periods, and adjust their capital more conservatively compared to the state owned banks.

The statistics in Table 6.12 show that, especially during the Asian financial crisis, state owned banks were always undercapitalised compared to other types of bank, even though domestic private banks suffered the most in terms of profitability, as shown by the highest drop in ROA, all of which may have reduced their ability to accumulate equity. The GMM estimation results support this finding, showing that private domestic banks changed their capital level at lower rates than the state owned banks and restructured the credit risk of asset portfolios more aggressively during the Asian financial crisis compared to the state owned banks, in order to cope with loss. This might reflect the fact that they are not as protected by government as the state owned banks, especially as the government's unlimited blanket guarantee was withdrawn during the Asian financial crisis.

**Table 6.12. Solvency, Profitability and Credit Risk of Each Type of Bank Ownership**

| | **Period I :** | **Period II :** | **Period III :** |
|---|---|---|---|
| | **1993-1997** | **1998 - 2000** | **2001-2009** |
| | **Leverage Ratio** | **Leverage Ratio** | **CAR** |
| Industry | 7.50 | -3.83 | 19.40 |
| State | 7.53 | -6.26 | 18.51 |
| Private | 8.21 | -2.05 | 19.08 |
| Regional | 6.19 | -1.05 | 18.00 |
| Joint | 9.21 | -4.26 | 18.00 |
| Foreign | 6.66 | -4.22 | 28.43 |
| | **RWATA** | **RWATA** | **RWATA** |
| State | 30.61 | 72.606 | 46.53 |
| Private | 29.71 | 44.424 | 49.73 |
| Regional | 29.22 | 27.981 | 42.77 |
| Joint | 43.32 | 73.757 | 33.89 |
| Foreign | 29.32 | 32.683 | 51.26 |
| | **ROA** | **ROA** | **ROA** |
| State | 0.6380 | -9.18 | 2.42 |
| Private | 1.8960 | -8.63 | 3.97 |
| Regional | 1.9800 | -9.81 | 3.56 |
| Joint | 2.2640 | -11.87 | 3.27 |
| Foreign | 0.0360 | -0.09 | 0.04 |

Source ; Bank of Indonesia, Annual Reports 1993-2009

The estimation results also confirm the fact that joint venture and foreign banks have better supports from their foreign owners during a financial crisis and liquidity crisis, enabling them to access the capital market more easily than state owned banks, so that they are able to adjust their capital level at a higher rate than the state owned banks. Moreover, the results also show that the ability of foreign owners to diversify the total risks the activities of their foreign branches provided incentives for foreign banks to adjust their credit risk of asset portfolios more aggressively than the state owned banks during the Asian financial crisis.

The results also show that during the recovery from the Asian financial crisis and at the beginning of the GFC (period III) generally banks behave insignificantly different compared to the state owned banks in deciding their capital and credit risk asset portfolio strategies.

#### 6.3.4.3. GMM Estimation Analysis for the Each Type of Bank Ownership

Tables 6.13 to 6.22 provide the GMM estimation results of the simultaneous equations for each type of bank ownership (sub sample equations). Robustness tests show that all models of both the *capital equation* and *credit risk equation* cannot reject the hypothesis that the instruments of over identifying are satisfied, uncorrelated with the error term.

The sub sample estimation analysis allows us to investigate the relationships between changes in capital level and credit risk asset portfolio decisions for each type of bank ownership. It is found that that some types of bank ownership exhibit similar relationships between changes in capital and portfolio credit risk. Therefore, the discussion is based on the types of bank ownership with similar signs and significance of the relationships.

### 6.3.4.3.1. State Owned and Regional Government Banks

#### I. The Relationship between Changes in Capital Adequacy Ratio and Credit risk

Tables 6.13 and 6.14 provides sub period estimation results for capital and credit risk equations.

**Table 6.13 Sub-Period Estimates: Capital Equation (State Owned Banks)**

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable =** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Independent Variable** | **Model** | **Model** | **Model 3** | **Model** | **Model** | **Model** | **Model** | **Model** | **Model 3** |
| Constant | 0.197 | 0.617 | 0.078 | 0.187 | 0.588 | 0.06 | 0.167 | 0.628 | 0.065 |
| | 1.399 | 1.289 | 0.869 | 1.323 | 1.229 | 0.665 | 1.186 | 1.313 | 0.727 |
| $DRISK_{j,t}$ | -0.026** | - | -0.488** | 0.025*** | 0.187*** | 0.374*** | 0.022*** | 0.200*** | 0.408*** |
| | -1.983 | -2.991 | -2.206 | 2.875 | 2.851 | 2.689 | 2.681 | 2.747 | 2.846 |
| $CAR_{j,t-1}$ | 0.035*** | 0.039*** | 0.047 | 0.033*** | 0.037*** | 0.036* | 0.030*** | 0.040*** | 0.035* |
| | 4.577 | 5.514 | 0.876 | 4.328 | 5.256 | 1.671 | 3.88 | 5.617 | 1.733 |
| $SIZE_{j,t}$ | 0.216** | 0.749** | 0.493** | 0.204 | 0.714 | 0.377 | -0.183 | -0.763 | -0.412 |
| | 1.972 | 1.999 | 1.993 | 0.919 | 0.957 | 0.789 | -0.824 | -0.709 | -0.863 |
| $PROF_{j,t}$ | 0.219** | 0.346*** | 0.032** | 0.207** | 0.330*** | 0.025** | 0.186** | 0.353*** | 0.027** |
| | 2.237 | 2.959 | 2.176 | 2.115 | 2.821 | 2.135 | 1.996 | 3.014 | 2.148 |
| $MPWR_{j,t}$ | 0.165* | 0.171* | 0.162 | 0.156 | 0.163 | 0.124 | 0.140* | 0.174* | 0.135* |
| | 1.783 | 1.662 | 1.229 | 1.402 | 1.584 | 0.941 | 1.726 | 1.693 | 1.828 |
| $ECVAR_t$ | 0.001 | 0.004 | 0.003 | 0.001* | 0.004* | 0.002* | 0.001*** | 0.004** | 0.002*** |
| | 1.505 | 1.501 | 0.944 | 1.76 | 1.838 | 1.713 | 3.819 | 2.547 | 2.966 |
| $PRESS\ REG_{j,t}$ | | 0.063 | | | 0.059 | | | 0.074 | |
| | | 1.241 | | | 1.173 | | | 1.472 | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | 0.411** | | | 0.389*** | | | 0.487** | |
| | | 2.564 | | | 4.479 | | | 2.553 | |
| $PRESS\ PEER_{j,t}$ | | | 0.042** | | | 0.032*** | | | 0.035*** |
| | | | 2.032 | | | 2.755 | | | 2.725 |
| $PRESSPEER_{j,t}* CAR_{j,t-1}$ | | | 0.010*** | | | 0.008*** | | | 0.008*** |
| | | | 2.705 | | | 3.305 | | | 5.427 |
| **Sargan test** | 9.77 | 7.671 | 6.577 | 12.857 | 9.793 | 7.893 | 7.763 | 6.891 | 6.991 |
| **Wald Joint test (p** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | - | - | | - | - | | - | - | |
| **AR(1)** | 0.705*** | 0.781*** | 0.7427*** | 0.822*** | 0.978*** | -0.21888 | 0.846*** | 0.880*** | -0.879*** |
| **AR(2)** | -0.022 | -0.013 | -0.035 | -0.0014 | -0.013 | -0.124 | -0.021 | 0.072 | -0.009 |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.14 Sub-Period Estimates: Capital Equation (Regional Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DCAP** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.324 | 0.048 | 0.843 | 0.306 | 0.046 | 0.645 | 0.275 | 0.049 | 0.705 |
| | 0.39 | 0.119 | 0.439 | 0.369 | 0.114 | 0.336 | 0.331 | 0.121 | 0.368 |
| $DRISK_{j,t}$ | -0.098** | -0.048** | -0.131** | 0.093* | 0.046** | 0.100** | 0.083** | 0.049** | 0.109** |
| | -2.496 | -2.422 | -2.519 | 1.947 | 1.994 | 2.398 | 2.421 | 2.429 | 2.435 |
| $CAR_{j,t-1}$ | 0.082 | 0.036 | 0.066 | 0.078 | 0.034 | 0.05 | 0.07 | 0.037 | 0.055 |
| | 0.685 | 0.392 | 0.467 | 0.648 | 0.483 | 0.557 | 0.581 | 0.395 | 0.49 |
| $SIZE_{j,t}$ | 0.119* | 0.124* | 0.090* | -0.112* | -0.118* | -0.069* | 0.101** | 0.126** | 0.075** |
| | 1.828 | 1.875 | 1.733 | -1.729 | -1.787 | -1.706 | 2.155 | 2.291 | 2.014 |
| $PROF_{j.t}$ | 0.076** | 0.106*** | 0.092*** | 0.072** | 0.101*** | 0.070** | -0.065** | -0.108** | -0.077** |
| | 2.16 | 2.995 | 2.765 | 2.152 | 2.902 | 2.035 | -2.036 | -2.203 | -2.148 |
| $MPWR_{j,t}$ | 0.049* | 0.072* | 0.056* | 0.046* | 0.068* | 0.043* | 0.042* | 0.073* | 0.046* |
| | 1.671 | 1.812 | 1.882 | 1.68 | 1.727 | 1.675 | 1.717 | 1.845 | 1.801 |
| $ECVAR_t$ | 0.009 | 0.009 | 0.004 | 0.008 | 0.008 | 0.003 | 0.007* | 0.009* | 0.003* |
| | 0.13 | 0.138 | 0.12 | 0.122 | 0.217 | 0.092 | 1.711 | 1.806 | 1.691 |
| $PRESS\ REG_{j,t}$ | | 0.055 | | | 0.052 | | | 0.056 | |
| | | 1.215 | | | 1.158 | | | 1.238 | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | 0.487 | | | 0.464 | | | 0.496* | |
| | | 1.582 | | | 1.508 | | | 1.761 | |
| $PRESS\ PEER_{j,t}$ | | | 0.031 | | | 0.024 | | | 0.026* |
| | | | 1.178 | | | 0.902 | | | 1.799 |
| $PRESSPEER_{j,t}* CAR_{j,t-1}$ | | | 0.021* | | | 0.016* | | | 0.018 |
| | | | 1.833 | | | 1.79 | | | 0.864 |
| **Sargan test** | 13.636 | 10.378 | 7.842 | 11.9 | 12.253 | 12.458 | 11.036 | 8.533 | 12.582 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.675*** | -0.814*** | -0.742*** | -0.672*** | -0.874*** | -0.018 | -0.646*** | -0.728*** | -0.679*** |
| **AR(2)** | -0.0264 | -0.027 | -0.04 | -0.002 | -0.03 | -0.147 | -0.044 | 0.079 | -0.017 |
| **Chow F-statistic** | | | 8.921*** | | | 6.743*** | | | 10.406*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

The GMM subsample estimation results in Tables 6.13 and 6.14 show that there are negative and significant impacts of credit risk on the capital ratio in period I at the 5% significance level for both state owned and regional banks Similarly, there are negative and significant impacts of change in the capital ratio on portfolio credit risk at the 5% significance level for both banks in period I, the period before the Asian financial crisis when the minimum 8% flat leverage ratio was imposed by the government (Tables 6.15 and 6.16). The results imply that during period I the state owned and regional banks reduced their capital holdings when they increased the credit risk and vice versa.

## Table 6.15 Sub-Period Estimates: Credit Risk Equation (State Owned Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DRISK** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Independent Variable** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.237 | 0.457 | 0.563 | 0.273 | 0.485 | 0.598 | 0.283 | 0.496 | 0.591 |
| | 1.079 | 0.392 | 0.115 | 1.245 | 0.416 | 0.122 | 1.286 | 0.426 | 0.121 |
| $RISKj_{,t-1}$ | 0.140** | 0.202** | 0.204** | 0.162** | 0.214** | 0.217** | -1.209* | -1.546* | -1.358* |
| | 2.130 | 2.175 | 2.165 | 1.996 | 2.307 | 2.300 | -1.791 | -1.897 | -1.829 |
| $DCAR_{j,t}$ | -0.158** | -0.168** | -0.237*** | 0.182** | 0.178** | 0.252*** | 0.394** | 0.440*** | 0.394** |
| | -1.978 | -2.565 | -2.713 | 2.259 | 1.972 | 2.883 | 2.375 | 2.594 | 2.344 |
| $SIZE_{j,t}$ | 0.051 | 0.043 | 0.054 | -0.059 | -0.046 | -0.058 | 0.061 | 0.047 | 0.057 |
| | 1.095 | 0.987 | 1.127 | -1.263 | -1.047 | -1.197 | 1.571 | 1.514 | 1.531 |
| $PROF_{j.t}$ | -0.330** | -0.406** | -0.375** | -0.381** | -0.430** | -0.398** | 0.394** | 0.440*** | 0.394** |
| | -1.992 | -2.390 | -2.232 | -2.299 | -2.536 | -2.372 | 2.375 | 2.594 | 2.344 |
| $MPWR_{j,t}$ | 1.014 | 1.424 | 1.293 | -1.170 | -1.511 | -1.374 | -1.209* | -1.546* | -1.358* |
| | 0.831 | 0.768 | 1.039 | -0.959 | -1.239 | -0.998 | -1.791 | -1.897 | -1.829 |
| $ECVAR_t$ | -0.002** | -0.002*** | -0.002*** | -0.002*** | -0.002*** | -0.002*** | -0.003** | -0.002*** | -0.002*** |
| | -2.072 | -2.601 | -2.589 | -3.137 | -2.759 | -3.070 | -2.242 | -2.823 | -2.703 |
| $PRESS\ REG_{j,t}$ | | -0.122 | | | -0.130** | | | 0.133** | |
| | | -0.960 | | | -2.018 | | | 2.042 | |
| $PRESSREG_{j,t}\ xRISKj_{,t-1}$ | | -0.240** | | | -0.254** | | | -0.260** | |
| | | -2.157 | | | -2.289 | | | -2.341 | |
| $PRESS\ PEER_{j,t}$ | | | -0.199* | | | -0.211* | | | 0.209 |
| | | | -1.743 | | | -1.752 | | | 1.498 |
| $PRESSPEER_{j,t}xRISKj_{,t-1}$ | | | -0.068* | | | -0.072** | | | 0.072 |
| | | | -1.842 | | | -2.170 | | | 1.144 |
| **Sargan test** | 15.114 | 16.896 | 15.942 | 11.585 | 24.909 | 25.325 | 22.434 | 13.143 | 25.577 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | 0.453*** | 0.656*** | -0.179*** | -0.601** | -0.417** | 0.005 | 0.788*** | 0.973*** | -0.089 |
| **AR(2)** | -0.119 | -0.153 | -0.001 | -0.198 | -0.099 | -0.002 | -0.004 | -0.019 | -0.325 |
| **Chow F-statistic** | | | 15.267*** | | | 6.782*** | | | 6.132*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.16 Sub-Period Estimates: Credit Risk Equation (Regional Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DRISK** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Independent Variable** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.237 | 0.457 | 0.563 | 0.273 | 0.485 | 0.598 | 0.283 | 0.496 | 0.591 |
| | 1.079 | 0.392 | 0.115 | 1.245 | 0.416 | 0.122 | 1.286 | 0.426 | 0.121 |
| $RISKj_{,t-1}$ | 0.140** | 0.202** | 0.204** | 0.162** | 0.214** | 0.217** | -1.209* | -1.546* | -1.358* |
| | 2.130 | 2.175 | 2.165 | 1.996 | 2.307 | 2.300 | -1.791 | -1.897 | -1.829 |
| $DCAR_{j,t}$ | -0.158** | -0.168** | -0.237*** | 0.182** | 0.178** | 0.252*** | 0.394** | 0.440*** | 0.394** |
| | -1.978 | -2.565 | -2.713 | 2.259 | 1.972 | 2.883 | 2.375 | 2.594 | 2.344 |
| $SIZE_{j,t}$ | 0.051 | 0.043 | 0.054 | -0.059 | -0.046 | -0.058 | 0.061 | 0.047 | 0.057 |
| | 1.095 | 0.987 | 1.127 | -1.263 | -1.047 | -1.197 | 1.571 | 1.514 | 1.531 |
| $PROF_{j.t}$ | -0.330** | -0.406** | -0.375** | -0.381** | -0.430** | -0.398** | 0.394** | 0.440*** | 0.394** |
| | -1.992 | -2.390 | -2.232 | -2.299 | -2.536 | -2.372 | 2.375 | 2.594 | 2.344 |
| $MPWR_{j,t}$ | 1.014 | 1.424 | 1.293 | -1.170 | -1.511 | -1.374 | -1.209* | -1.546* | -1.358* |
| | 0.831 | 0.768 | 1.039 | -0.959 | -1.239 | -0.998 | -1.791 | -1.897 | -1.829 |
| $ECVAR_t$ | -0.002** | -0.002*** | -0.002*** | -0.002*** | -0.002*** | -0.002*** | -0.003** | -0.002*** | -0.002*** |
| | -2.072 | -2.601 | -2.589 | -3.137 | -2.759 | -3.070 | -2.242 | -2.823 | -2.703 |
| $PRESS\ REG_{j,t}$ | | -0.122 | | | -0.130** | | | 0.133** | |
| | | -0.960 | | | -2.018 | | | 2.042 | |
| $PRESSREG_{j,t}\ xRISKj_{,t-1}$ | | -0.240** | | | -0.254** | | | -0.260** | |
| | | -2.157 | | | -2.289 | | | -2.341 | |
| $PRESS\ PEER_{j,t}$ | | | -0.199* | | | -0.211* | | | 0.209 |
| | | | -1.743 | | | -1.752 | | | 1.498 |
| $PRESSPEER_{j,t}xRISKj_{,t-1}$ | | | -0.068* | | | -0.072** | | | 0.072 |
| | | | -1.842 | | | -2.170 | | | 1.144 |
| **Sargan test** | 15.114 | 16.896 | 15.942 | 11.585 | 24.909 | 25.325 | 22.434 | 13.143 | 25.577 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.453*** | -0.656*** | -0.179*** | -0.601** | -0.417** | 0.005 | -0.788*** | -0.973*** | -0.089 |
| **AR(2)** | -0.119 | -0.153 | -0.001 | -0.198 | -0.099 | -0.002 | -0.004 | -0.019 | -0.325 |
| **Chow F-statistic** | | | 15.267*** | | | 6.782*** | | | 6.132*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

The negative relationships between portfolio credit risk and change in capital confirm the major flaw of the leverage ratio, that is that the leverage ratio fails to take into account the risk of the assets. As a result, imposing leverage ratio requirements gives an incentive for banks to engage in high credit risk taking activities with a low level of capital. Political and developmental roles of government owned banks have forced the state owned and regional government banks to engage in risky loss making investments, by providing financing on non commercial terms to the regions or extending credit based on political connections, as instructed by the government (Shrinivas, 2004: Andrews, 2005). Sharma (2004) states that risky lending practices are often the result of both explicit and implicit pressure exerted by members of powerful and well-connected families, their cronies and other high ranking military and government officials, to make loans to favoured borrowers. Weak credit assessment enhances the risk of the practice of making loans based on political pressure which, in turn, leads to a high level of non-performing loans at the state owned and regional banks.

On the other hand, the negative relationships also confirm the moral hazard effect of the government ownership of the state owned and regional government banks. The government's role as a capital provider and its assistance in case of trouble seems to be anticipated. Therefore, the state owned and regional banks reduce their capital holding as the credit risk of their asset portfolio increases, with the belief that government will never let these banks fail. The combination of the weaknesses of the leverage ratio and moral hazard of "the too big or too important to fail" of the government ownership was deepened, as enforcement of the capital

regulations was very weak and the inability of regulators to impose the regulations effectively highlights the weakness and high insolvency risk of the banking system in period I (Pangestu, 2000 ). As a result, as shown in Table 6.12, state owned and regional banks were undercapitalised during period I with the average of leverage ratios of the state owned and regional banks being 7.5% and 6.2% respectively.

The capital and risk relationships of the state owned and regional banks changed during the Asian Financial Crisis in period II. There are significant and positive relationships between changes in capital and credit risk in both capital and credit risk equations at 5% significance level. With the government imposing the new leverage ratio requirement of 4%, state owned and regional banks still held low capital but at the same time also lowered the credit risk of their asset portfolio at a greater rate, resulting in positive relationships between both changes in capital ratio and credit risk. Just as with any other types of bank, as a result of the loss suffered during the Asian financial crisis, the average leverage ratios of these banks were negative and much lower than the regulatory minimum requirements in period II.

The relationships between changes in capital ratio and credit risk remain significant and positive at the 5% significance level in both capital and credit risk equations during the period of recovery from the Asian financial crisis in period III, when the government tightened the capital requirements by imposing the risk adjusted Basel I Accord with 8% minimum capital adequacy ratio. The estimation results show that state owned and regional banks exhibit positive relationships

between changes in capital as well as portfolio credit risk in period III. State owned and regional banks increase their capital holdings significantly, while at the same time increasing their credit risk portfolio but at a lower rate, and vice versa. This resulted in the average capital adequacy ratios of these banks being higher, above the minimum capital requirement, as shown in the descriptive statistics in Table 6.12

## II. Explanatory Variables Affecting Changes in Capital and Credit Risk

- **Lagged Capital Level and Lagged Credit Risk Level**

Sub–sample estimation results for state owned banks show that the lagged CAR significantly and positively affects changes in capital ratio in all periods for models 1 and 2 at the 5% significance level (see table 6.13). The variables are not significant for model 3 in all periods. The subsample results show that state owned banks significantly and positively adjust their current capital level based on the previous level during both stable and volatile economic conditions (before, during and after the financial crisis), except for those that are under peer pressure due to having a lower capital level compared to other banks in the industry. These banks are more likely to adjust their capital level based on the shortage of capital compared to other banks in the industry. This is also supported by the findings that peer pressure significantly and positively affects undercapitalised state owned banks in adjusting their capital adequacy ratio, at the 5% significance level as shown in Table 6.13.

The sub -sample estimation results of the credit risk equation for state owned banks show that the lagged credit risk significantly and positively affects changes in credit risk of asset portfolios in periods I and II, at the 5% significance level, for state owned banks (Table 6.15). Nevertheless, it does not affect the changes in the credit risk in period III. This implies that during the more stable economic conditions in period III, in order to recover the huge losses experienced by the state owned banks due to the Asian financial crisis, the banks restructured their credit risk of asset portfolios to avoid making the same mistakes as they did during the Asian financial crisis. This also implies that the new risk adjusted capital regulations imposed in period III have succeeded in forcing the banks to adjust their credit risk independently, regardless of the previous period's credit risk level.

In contrast to the state owned banks, all regional banks do not significantly adjust their capital level based on the previous capital adequacy ratio, as all coefficients of lagged CAR are insignificant in all models in all periods (Table 6.14). On the other hand, all regional banks, regardless of whether or not they are under regulatory and peer pressures, significantly and positively adjust their credit risk based on the previous credit risk level at the 5% significance level (Table 6.16). This implies that, unlike state owned banks, regional banks carefully restructured their asset portfolios' credit risk continuously taking into account the previous credit risk of asset portfolios, regardless of the economic conditions and capital regimes.

- **Size**

Estimation results for state owned banks and regional banks show that size significantly and positively affects changes in capital before the Asian financial crisis (period I) at the 5% significance level (Table 6.13). Larger state owned banks held greater capital during this period. On the other hand, size does not significantly affect changes in portfolio credit risk in all periods. Considering all state owned banks are medium to large in size (see Table 6.15), the results from the ANOVA statistics then suggest that the state owned banks held greater capital adequacy ratios with riskier asset portfolios compared to other types of banks - mostly smaller banks- in period I. They were also less profitable and less liquid compared to other banks. On the other hand, state owned banks were less risky in terms of capital holding and the credit risk of asset portfolios after the Asian financial crisis (period III) since they significantly improved their capital adequacy ratios and liquidity as well as reduced their portfolio credit risk better than other types of bank. Unfortunately there has not yet been an improvement in their profitability following the Asian financial crisis.

On the other hand, the size of regional banks significantly and negatively affects changes in capital only during the recovery period after the Asian financial crisis in period III, but it does not affect changes in the credit risk of asset portfolios in any of the periods (see Tables 6.14 and 6.16). After the Asian financial crisis when the government adjusted the capital requirements to 8%, smaller regional banks increased their capital level without any significant changes in credit risk. On the

other hand, larger regional banks reduced their capital level significantly without any significant changes in credit risk.

- **Profitability**

Sub-period estimation results show that current earnings significantly and positively affect changes in capital for state owned banks in all periods at the 5% significance level (Table 6.13). On the other hand, current earnings significantly and negatively affect changes in the credit risk portfolio in periods I and II, and significantly and positively affect changes in the credit risk of asset portfolios in period III, all at the 5% significance level (Table 6.15). State owned banks restrained their credit risk taking activities, generated returns from the less risky activities and managed to increase their capital level in periods I and II. On the other hand, profitability seemed to promote risk taking activities in period III as the state owned banks took on more credit risk in order to generate higher return and used the retained earnings to increase their capital adequacy ratio in period III when the economy was recovering from the Asian financial crisis and when the capital regulations were tightened in period III.

Regional banks' current earnings significantly and positively have an impact on changes in capital in periods I and II and significantly and negatively affect changes in capital in period III at least at the 5% significance level (Table 6.14). On the other hand, their current earnings significantly and negatively affect changes in credit risk in periods II and period III. The result implies that regional banks increased

capital through retained earnings before and during the Asian financial crisis (periods I and II) (Table 6.16). However, due to huge losses by the regional banks during the Asian financial crisis, the retained earnings were unable to increase the capital level in period III. The regional banks generated their returns by investing in less risky assets during and after the Asian financial crisis.

- **Market Power**

Even though state owned banks dominate deposit and loan markets, the market power of the state owned does not significantly impact on changes in capital ratios as well as changes in credit risk. The same results are also found for regional banks. The market share of total deposits in the deposit market does not affect the changes in capital and the credit risk of asset portfolio decisions for both state owned and regional banks.

- **Economic Uncertainty**

For state owned banks, economic uncertainty significantly and positively affects changes in capital only in period III at the 5% significance level, but significantly and negatively affects changes in credit risk in all periods at the same significance level (Tables 6.13 and 6.15). The findings support the buffer capital theory. Namely that state owned banks hold greater capital when economic uncertainty increases and reduce their capital holdings when economic uncertainty is lower as in period

III. On the other hand the banks consistently reduce their credit risk during high economic uncertainty and increase their credit risk when economic conditions are stabilised.

On the other hand, for regional banks, economic uncertainty does not significantly affect changes in capital, but significantly and negatively affects changes in credit risk at the 5% significance level as can be seen in period III (Tables 6.14 and 6.16) . While regional banks do not adjust their capital ratios based on economic conditions, the banks consistently reduce their credit risk during the high economic uncertainty and increase their credit risk when economic conditions are stabilised in period III.

- **Regulatory & Peer Group Pressure on Undercapitalised Banks**

Both regulatory and peer group pressures do not significantly affect undercapitalised state owned and regional banks in causing them to increase their capital in all sub- periods (Tables 6.13 and 6.14). On the other hand, regulatory pressure significantly and negatively affect changes in the credit risk of asset portfolios in period II for undercapitalised regional banks at the 5% significance level and significantly and positively affects t changes in credit risk during period III for both state owned and regional banks at the 5 % significance level (Tables 6.15 and 6.16). This indicates that undercapitalised state owned and regional banks adjusted their credit risk without any significant increase in capital ratios in period III. Only undercapitalised regional banks reduced the credit risk of their asset

portfolio during the Asian Financial crisis (period II) without significant change in their capital level. This supports the "too big or too important too fail" theory for undercapitalised government owned banks, as discussed above.

#### 6.3.4.3.2. Private Domestic and Joint Venture Banks

##### I. The Relationship between Changes in Capital Adequacy Ratio and Credit risk

Private domestic and joint venture banks exhibit positive relationships between changes in capital and credit risk of asset portfolio in both capital (tables 6.17 and 6.18) and portfolio credit risk equations (Tables 6.19 and 6.20) in periods I and II. Imposing capital regulations seems to be effective in disciplining the private domestic and joint venture banks by forcing them to increase their capital when they increase the credit risk of their asset portfolios and allowing them to hold less capital when investing in a lower credit risk for asset portfolios in these periods.

These banks protected themselves from insolvency by increasing their capital holdings while engaging in risky activities in period I, despite the regulatory leverage ratio requirement not differentiating the requirement for banks with different credit risks. The rate of change in capital relative to total assets of both private domestic and joint venture banks is more than the regulatory requirement to cover the change in the credit risk, resulting in a higher average leverage ratio than the regulatory minimum requirement. The average leverage ratio of the

private domestic banks was 8.2%, slightly above the 8 % minimum required in this period. On the other hand, the average leverage ratio of the joint venture banks was 9.2%, greater than the minimum requirement (see table 6.12)

## Table 6.17 Sub-Period Estimates: Capital Equation (Private Domestic Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DCAR** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.685 | 0.474 | 0.474 | 0.067 | 0.790 | 0.503 | 0.072 | 0.816 | 0.515 |
| | 0.834 | 0.538 | 0.538 | 0.417 | 0.962 | 0.571 | 0.443 | 0.994 | 0.584 |
| $DRISK_{j,t}$ | 0.288** | | 0.065** | 0.233** | 0.332** | 0.069** | 0.248** | -0.343** | -0.071*** |
| | 2.185 | 2.272 | 2.272 | 2.275 | 2.186 | 2.267 | 2.374 | -2.386 | -2.768 |
| CARj,t-1 | 0.033** | | 0.033*** | 0.046*** | 0.038 | 0.035* | 0.049 | 0.039 | 0.036 |
| | 2.059 | 2.583 | 2.583 | 3.469 | 1.375 | 1.680 | 1.561 | 1.454 | 1.118 |
| SIZEj,t | -0.060*** | | -0.045*** | -0.053*** | -0.069* | -0.047* | -0.056* | -0.071*** | -0.048** |
| | -3.435 | -2.583 | -2.583 | -3.469 | -1.655 | -1.680 | -1.661 | -2.710 | -2.072 |
| PROFj.t | 0.110** | | 0.112** | 0.136** | 0.127** | 0.119** | 0.144** | 0.131** | 0.122** |
| | 2.015 | 2.072 | 2.072 | 2.544 | 2.245 | 2.199 | 1.990 | 2.319 | 2.249 |
| MPWR j,t | -0.026*** | | -0.041*** | -0.045*** | -0.029*** | -0.043** | -0.048** | -0.030** | -0.044*** |
| | -3.532 | -3.382 | -3.382 | -3.365 | -2.767 | -2.466 | -2.450 | -2.526 | -2.750 |
| ECVARt | 0.001* | | 0.002* | 0.002* | 0.001* | 0.002* | 0.002* | 0.001*** | 0.002*** |
| | 1.715 | 1.668 | 1.668 | 1.846 | 1.731 | 1.770 | 1.654 | 3.752 | 2.811 |
| PRESS REGj,t | | 0.070*** | 0.070*** | | | 0.074** | | | 0.076*** |
| | | 3.460 | 3.460 | | | 2.549 | | | 2.585 |
| PRESS REGj,t*CARj,t-1 | | 0.053*** | 0.053*** | | | 0.056** | | | 0.058** |
| | | 3.397 | 3.397 | | | 2.482 | | | 2.516 |
| PRESS PEERj,t | | | | 0.076* | | | 0.080 | | |
| | | | | 1.658 | | | 0.977 | | |
| PRESSPEERj,t* CARj,t-1 | | | | 0.062** | | | 0.066* | | |
| | | | | 2.477 | | | 1.757 | | |
| **Sargan test** | 13.722 | 10.444 | | 7.892 | 11.975 | 12.330 | 12.536 | 11.105 | 8.586 |
| **Wald test (p value)** | 0.000*** | 0.000*** | | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.625*** | -0.681*** | | -0.542*** | -0.342*** | -0.458*** | -0.232 | -0.546*** | -0.880*** |
| **AR(2)** | -0.016 | -0.017 | | -0.024 | -0.001 | -0.018 | -0.090 | -0.027 | 0.049 |
| **Chow F-statistic** | | | | 7.942*** | | | 5.103** | | |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.18 Sub-Period Estimates: Capital Equation (Joint Venture Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DCAP** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| Constant | 0.078 | 0.081 | 0.072 | 0.074 | 0.078 | 0.055 | 0.066 | 0.083 | 0.060 |
| | 0.489 | 0.512 | 0.462 | 0.463 | 0.488 | 0.353 | 0.415 | 0.522 | 0.386 |
| DRISKj,t | 0.042** | 0.045** | 0.041** | 0.039** | 0.043** | 0.031** | -0.036** | -0.046** | -0.034** |
| | 2.278 | 2.386 | 2.085 | 2.168 | 2.277 | 2.266 | -2.251 | -2.560 | -2.374 |
| CARj,t-1 | 0.062*** | 0.067*** | 0.057** | 0.058*** | 0.064*** | 0.044*** | 0.052 | 0.068 | 0.048 |
| | 2.602 | 2.816 | 2.563 | 3.515 | 3.731 | 3.245 | 1.359 | 1.550 | 1.261 |
| SIZEj,t | -0.301 | -0.315 | -0.278 | -0.285*** | -0.301*** | -0.213*** | -0.256 | -0.321 | -0.233 |
| | -0.998 | -1.044 | -0.921 | -2.943 | -2.995 | -2.705 | -0.846 | -1.064 | -0.771 |
| PROFj.t | 0.117*** | 0.123*** | 0.110*** | 0.111*** | 0.117*** | 0.084** | -0.099** | -0.125*** | -0.092** |
| | 3.806 | 3.890 | 3.668 | 2.708 | 2.802 | 2.276 | -2.531 | -2.926 | -2.396 |
| MPWR j,t | -0.042 | -0.044 | -0.039 | -0.040 | -0.042 | -0.030 | -0.036 | -0.045 | -0.032 |
| | -0.958 | -1.003 | -0.885 | -0.906 | -0.956 | -0.677 | -0.812 | -1.022 | -0.740 |
| ECVARt | 0.004* | 0.004* | 0.003* | 0.004* | 0.004* | 0.003* | 0.003 | 0.004 | 0.003 |
| | 1.787 | 1.893 | 1.714 | 1.790 | 1.823 | 1.687 | 1.149 | 1.317 | 0.954 |
| PRESS REGj,t | | 0.081* | | | 0.077*** | | | 0.082** | |
| | | 1.942 | | | 2.947 | | | 2.081 | |
| PRESS REGj,t*CARj,t-1 | | 0.093*** | | | | | | | |
| | | 2.838 | | | | | | | |
| PRESS PEERj,t | | | 0.064 | | | 0.049 | | | 0.053** |
| | | | 1.603 | | | 1.227 | | | 2.134 |
| PRESSPEERj,t* CARj,t-1 | | | 0.086* | | | 0.066** | | | 0.072* |
| | | | 1.705 | | | 2.152 | | | 1.760 |
| **Sargan test** | 11.677 | 8.887 | 6.715 | 10.190 | 10.493 | 10.668 | 9.450 | 7.307 | 10.774 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.725*** | -0.681*** | -0.412*** | -0.522*** | -0.778*** | -0.124 | -0.546*** | -0.678*** | -0.279** |
| **AR(2)** | -0.028 | -0.029 | -0.041 | -0.002 | -0.031 | -0.154 | -0.046 | 0.083 | -0.017 |
| **Chow F-statistic** | | | 10.772*** | | | 7.903*** | | | 10.306*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.19. Sub-Period Estimates: Credit Risk Equation (Private Domestic Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DRISK** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 1.526 | 3.092 | 3.092 | 1.718 | 1.443 | 2.948 | 1.315 | 1.294 | 3.150 |
| | 0.870 | 1.144 | 1.144 | 0.916 | 0.823 | 1.091 | 0.701 | 0.738 | 1.165 |
| RISKj,t-1 | 0.164*** | 0.299** | 0.299** | 0.291*** | 0.155** | 0.285** | 0.223** | 0.139** | 0.305** |
| | 2.986 | 2.441 | 2.441 | 2.712 | 2.178 | 2.327 | 2.076 | 1.984 | 2.486 |
| $DCAR_{j,t}$ | 0.245*** | 0.222*** | 0.245*** | 0.207** | 0.232** | 0.211*** | -0.159** | -0.208** | -0.226*** |
| | 2.918 | 2.838 | 2.856 | 2.274 | 2.181 | 2.705 | -1.974 | -2.063 | -2.891 |
| SIZEj,t | -0.054*** | -0.093*** | -0.093*** | -0.076*** | -0.052** | -0.089** | -0.058** | -0.046* | -0.095* |
| | -2.617 | -2.842 | -2.842 | -2.705 | -2.053 | -2.518 | -2.031 | -1.771 | -1.891 |
| PROFj.t | -0.468** | 0.718*** | 0.718*** | 0.642*** | -0.442 | -0.684 | -0.491 | -0.397** | 0.731*** |
| | -2.293 | -3.046 | -3.046 | -2.593 | -1.168 | -1.290 | -1.184 | -2.094 | -3.102 |
| MPWR j,t | 0.729** | 0.879** | 0.879** | 0.850** | 0.690 | 0.838 | 0.650 | 0.618** | 0.731*** |
| | 2.027 | 2.150 | 2.150 | 2.450 | 0.973 | 1.054 | 0.875 | 2.094 | 3.102 |
| ECVARt | -0.006*** | -0.010*** | -0.010*** | -0.005*** | -0.005 | -0.009 | -0.004 | -0.005 | -0.010 |
| | -2.952 | -3.480 | -3.480 | -2.940 | -0.744 | -1.018 | -0.650 | -1.160 | -1.295 |
| PRESS REGj,t | | 0.299** | 0.299 | | | 0.266** | | | 0.284** |
| | | 0.160*** | 2.162 | | | 2.292 | | | 2.165 |
| PRESSREG j,t xRISKj,t-1 | | 2.581 | 0.160 | | | 0.152** | | | 0.157*** |
| | | | 2.581 | | | 2.460 | | | 2.670 |
| PRESS PEERj,t | | | | 0.188** | | | 0.144** | | |
| | | | | 2.170 | | | 2.130 | | |
| PRESSPEERj,txRISKj,t-1 | | | | 0.064*** | | | 0.049** | | |
| | | 8.344 | | 2.664 | | | 2.039 | | |
| **Sargan test** | 7.464 | | | 7.873 | 5.721 | 12.301 | 12.506 | 11.078 | 6.491 |
| **Wald Joint test** | | 0.000*** | | | | | | | |
| **(p-value)** | 0.000*** | 0.876*** | | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.603*** | -0.229 | | -0.901*** | -0.810** | -0.517*** | 0.013 | -0.768*** | -0.878*** |
| **AR(2)** | -0.178 | | | -0.002 | -0.296 | -0.148 | -0.003 | -0.006 | -0.028 |
| **Chow F-statistic** | | | | 7.127*** | | | 4.582*** | | |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.20. Sub-Period Estimates: Credit Risk Equation (Joint Venture Banks)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.

The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$

The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$

Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)

Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable = DRISK** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.563 | 0.532 | 0.525 | 0.649 | 0.565 | 0.558 | 0.671 | 0.578 | 0.551 |
| | 1.003 | 0.949 | 0.936 | 1.157 | 1.007 | 0.995 | 1.196 | 1.03 | 0.983 |
| RISKj,t-1 | 0.105** | 0.100** | 0.098** | 0.122** | 0.106** | 0.104** | 0.126** | 0.108** | 0.103** |
| | 2.107 | 2.096 | 1.986 | 2.393 | 2.082 | 2.057 | 2.473 | 2.13 | 2.032 |
| $DCAR_{j,t}$ | 0.258** | 0.244** | 0.241** | 0.298** | 0.259** | 0.256** | -0.308** | -0.265** | -0.253** |
| | 2.233 | 2.091 | 2.089 | 2.335 | 2.031 | 2.006 | -2.412 | -2.278 | -2.183 |
| SIZEj,t | 0.039 | 0.036 | 0.036 | 0.044** | 0.039** | 0.038** | -0.046* | -0.040* | -0.038* |
| | 1.212 | 1.147 | 1.131 | 2.398 | 2.216 | 2.202 | -1.845 | -1.744 | -1.688 |
| PROFj.t | -0.683** | -0.646** | -0.638** | -0.788 | -0.686 | -0.677 | -0.814** | -0.702** | -0.669** |
| | -2.177 | -2.13 | -2.117 | -1.297 | -1.125 | -1.08 | -2.267 | -2.187 | -2.081 |
| MPWR j,t | 1.214 | 1.149 | 1.133 | 1.401 | 1.219 | 1.204 | -1.448* | -1.247* | -1.190* |
| | 1.517 | 1.435 | 1.415 | 1.55 | 1.522 | 1.504 | -1.808 | -1.757 | -1.749 |
| ECVARt | -0.003 | -0.003 | -0.003 | -0.003 | -0.003 | -0.003 | -0.004 | -0.003 | -0.003 |
| | -1.353 | -1.226 | -1.196 | -0.715 | -0.362 | -0.333 | -0.805 | -0.716 | -0.593 |
| PRESS REGj,t | | -0.192** | | | -0.204** | | | -0.721*** | |
| | | -2.119 | | | -2.187 | | | -3.215 | |
| PRESSREG j,t xRISKj,t-1 | | -0.110*** | | | -0.117 | | | 0.120*** | |
| | | -2.78 | | | -1.588 | | | 2.932 | |
| PRESS PEERj,t | | | -0.139** | | | -0.148* | | | -0.146** |
| | | | -2.264 | | | -1.734 | | | -2.327 |
| PRESSPEERj,txRISKj,t-1 | | | 0.048** | | | -0.051* | | | 0.05 |
| | | | 1.979 | | | -1.71 | | | 1.078 |
| **Sargan test** | 13.211 | 14.768 | 13.934 | 10.126 | 21.772 | 22.136 | 19.609 | 11.488 | 22.356 |
| **Wald Joint test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.579*** | -0.876*** | -0.679*** | -0.412** | -0.317** | 0.0121 | -0.765*** | -0.787*** | -0.187 |
| **AR(2)** | -0.164 | -0.211 | -0.002 | -0.272 | -0.136 | -0.003 | -0.006 | -0.026 | -0.045 |
| **Chow F-statistic** | | | 11.727*** | | | 5.282*** | | | 7.419*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

The Asian financial crisis influenced these banks in maintaining the positive relationships between changes in capital and portfolio credit risk in the second period. As a result of the Asian financial crisis, these banks lowered their capital holdings as well as the credit risk of their portfolios. During this period, they experienced a huge drop in, and negative value of, capital due to the huge losses in their operations as indicated by the sharp drop in ROA and negative leverage ratio (see Table 6.12). As a result some of the banks were liquidated and merged, the number of the private domestic and joint venture banks dropped by.47% and 56% respectively during the period as shown in Table 3.1

These banks improved their capital holdings and adjusted their credit risk negatively in period III, when the regulators tightened capital regulations, imposing an 8% minimum requirement as a risk adjusted capital adequacy ratio. Recovering from the Asian financial crisis, they protected themselves against the default risk by reducing their credit risk and increasing their capital by more than required. As a result, most of private domestic and joint venture banks were overcapitalised in period III, with the average capital adequacy ratio 19.1% and 18% respectively (see Table 6.12).

Due to overcapitalisation and an improved liquidity position, private domestic and joint venture banks were able to absorb losses and to better deal with the liquidity crisis resulting from the global financial crisis in 2008. This is shown by the insignificant impact of the crisis on the non performing loans and Return on Assets in 2008 - 2009. Also, due to the lower reliance of the banks in general on the

overseas sources of funds and the smaller exposure to the structured derivatives market as discussed in Chapter 3, these banks survived the crisis better than other types of banks.

## II. Explanatory Variables Affecting Changes in Capital and Credit risk

- **Lagged Capital Level and Lagged Credit risk Level**

Sub sample estimation results for private domestic banks show that the lagged CAR significantly and positively affects the changes in the capital ratio of private domestic banks at least at the 5% significance level only in period 1 and it is not significant in other periods (Table 6.17). On the other hand, the lagged credit risk of asset portfolios positively affects the changes in credit risk in all periods and all models at the 5% significance level (Table 6.19). The results show that all private domestic banks positively adjust their credit risk based on the previous credit risk level regardless of the state of the economic condition. On the other hand, only during a period of more stable economic conditions (such as period I) do the banks adjust their capital adequacy ratio based on the previous capital adequacy ratio. During a crisis (namely periods II and III), the banks do not take into account the previous capital level as the significant determinant factor, as they face turbulent economic conditions that may result in unstable equity values.

Joint venture banks, regardless of whether or not they are under regulatory and peer pressures, significantly and positively adjust their capital level based on the

previous capital adequacy ratio as seen during periods I and II, when all coefficients of lagged CAR are significant and positive in all models at the 5% level (Table 6.18). On the other hand, all joint venture banks significantly and positively adjust their credit risk based on the previous credit risk in all periods at the 5% level (Table 6.20). In order to recover the loss experienced by the joint venture banks during the Asian financial crisis, the banks do not consider the previous capital level as the significant determining factor while still adjusting their credit risk significantly based on the previous year's credit risk.

- **Size**

Estimation results for private domestic banks show that size significantly and negatively affects changes in capital in periods I and III at least at the 5% significance level and significantly and negatively affects changes in asset portfolio credit risk in periods I and II at the 5% significance level (Tables 6.17 and 6.19). Smaller private domestic banks significantly increased their holdings in capital as well as the credit risk of their portfolios while larger private banks reduced their capital level and the credit risk of their portfolios in period I. When the leverage ratio required was reduced from 8% to 4% in period II, smaller private domestic banks significantly increased the credit risk of portfolio assets without any significant increase in their capital level. On the other hand, larger private banks significantly reduced their asset portfolio credit risk in period II without significant changes in capital level. When the risk adjusted capital ratios were imposed and the level was increased back to 8% in period III, smaller private domestic banks

increased their capital level without any significant changes in their asset portfolio credit risk while larger banks reduced their capital without changing their credit risk significantly.

As all private domestic banks are small banks, ANOVA statistics provided in Table 6.7 suggest that during period I, all private domestic banks were undercapitalised based on the regulatory capital requirement as well as based on the industry average. The average leverage ratio of domestic private banks was the lowest in this period with the asset portfolio credit risk being higher than medium state owned banks The ANOVA statistics also show that during the Asian financial crisis in periods II and III, private domestic banks changed their attitude towards insolvency and credit risk by increasing their holdings in capital and at the same time reducing their credit risk. Their capital level was better than state owned banks in period II even though their credit risk was greater than state owned banks in the same period. Nevertheless, their profitability was lower than before the crisis, lower than the state owned banks while their liquidity was in a worse state,, worse than the state owned banks.

In period III, private domestic banks improved their capital to a level higher than the state owned banks, while their credit risk was insignificantly higher than in the previous period and also higher than that of state owned banks. Unfortunately the profitability of the private owned banks dropped and was still lower than state owned banks, with the liquidity even significantly worse than in the period before and worse than that of the state owned banks.

In period II, size significantly affects changes in capital and credit risk for joint venture banks (Tables 6.18 and 6.20). It negatively affects changes in capital and positively affects changes in credit risk. After the crisis, with the 8% risk adjusted capital requirements and most of the banks being overcapitalised, larger joint venture banks reduced their holdings in capital and increased their credit risk, while smaller joint venture banks increased their capital level while reducing their credit risk.

- **Profitability**

Private domestic banks' current earnings significantly and positively impact on changes in capital at the 5% significance level in all periods and significantly and negatively affect changes in asset portfolio credit risk in periods I and III at least at the 5% significance level , but they do not significantly affect credit risk in period II (Tables 6.17 and 6.19). In periods I and III, as with state owned banks, private domestic banks increased their capital adequacy ratio through retained earnings whilst generating profits by investing in less risky assets. On the other hand, during the Asian financial crisis (period II) their decisions in generating returns did not affect their credit risk.

Current earnings of joint venture banks significantly and positively affect changes in capital in periods I and II and significantly and negatively affects changes in capital in period III at least at the 5% significance level, whilst they significantly and negatively affect changes in credit risk in periods I and III (Tables 6.18 and 6.20).

Joint venture banks increased their capital ratio through retained earnings before and during the Asian financial crisis. Due to huge losses by the regional banks during the Asian financial crisis, the retained earnings were unable to increase the capital ratio in period II.

- **Market Power**

Market power significantly and negatively affects changes in capital ratios in all periods at the 5% significance level for private domestic banks, whilst it significantly and positively affects changes in credit risk in periods I and III at the same significance level (Tables 6.17 and 6.19). This shows that private domestic banks with greater market power reduced their holdings in equity while investing in riskier assets before and after the Asian financial crisis.

On the other hand, market power does not significantly impact on changes in capital ratios or on changes in credit risk for joint venture banks (Tables 6.18 and 6.20).

- **Economic Uncertainty**

For private domestic banks, economic uncertainty significantly and positively affects changes in capital only in period III at the 5 % significance level, but significantly and negatively affects changes in asset portfolio credit risk in period I

at the same significance level (Tables 6.17 and 6.19). The findings support the buffer capital theory: private domestic banks hold greater capital when economic uncertainty increases and reduce their capital holdings when the economic uncertainty is lower. On the other hand the banks consistently reduce the credit risk of asset portfolios during the high economic uncertainty and increase the credit risk when economic conditions are stabilised.

In contrast, economic uncertainty does not significantly affect either changes in capital or the credit risk of joint venture banks at the 5% significance level (Tables 6.18 and 6.20)

- **Regulatory & Peer Group Pressure on Undercapitalised Banks**

Regulatory pressure significantly and positively affects undercapitalised private domestic banks in adjusting their capital level and negatively affects the credit risk of asset portfolios in all periods at the 5% significance level. On the other hand peer group pressure only significantly and negatively affects changes in capital in period III and changes in asset portfolio credit risk in periods I and II (Tables 6.17 and 6.19).

This implies that regulatory pressure is more effective in influencing undercapitalised banks to adjust their capital level and credit risk to meet the regulatory capital requirements. Private domestic banks with lower capital levels compared to the industry adjust their capital significantly so that it meets the

industry average during the more economically stable period (period III) where access to the equity market is much easier and cheaper than the crisis period. On the other hand, during the Asian financial crisis, the peer pressure is significant in influencing undercapitalised banks to improve their credit risk structure in order to meet the industry average capital ratio.

On the other hand, the estimation results show that for undercapitalised joint venture banks, regulatory pressure significantly affects changes in capital in periods II and III but does not significantly affect the credit risk of asset portfolios in all sub -periods, whilst peer pressure does not affect changes in capital in all periods but affects changes in asset portfolio credit risk in period II (Tables 6.18 and 6.20). Undercapitalised joint venture banks improve their capital ratio by adjusting their capital level but not all the credit risk of asset portfolios during and after the Asian financial crisis.

#### 6.3.4.3.3. Foreign Banks

**I. The Relationship between Changes in Capital Adequacy Ratio and Credit Risk**

Foreign banks exhibit different capital and portfolio credit risk relationships in different sub- periods (Tables 6.21 and 6.22). In period I, the estimation results show negative impacts of portfolio credit risk and changes in capital on the capital equations as well as the portfolio credit risk equations. Foreign banks reduce their

capital holding (credit risk of asset portfolios) when they increase their credit risk of asset portfolios (capital holding) and vice versa at least at the 5% significance level. The relationships support the moral hazard of foreign ownership theory in affecting risk taking activities of foreign banks. Capital and liquidity supports provided by foreign owners and the ability to diversify risks by the foreign owner gives incentives for the foreign banks to lower their capital when they increase their credit risk in period I.

The capital and portfolio credit risk relationships change during the Asian financial crisis in period II, the estimation results showing a positive impact of asset portfolio credit risk and capital in both the capital and portfolio credit risk equations. Due to the loss suffered during this period, as shown by the reduction in the banks' average ROAs below that of other types of banks , the banks reduced their capital holdings and at the same time reduced their credit risk. As a result, the average leverage ratio was lower than the 4% regulatory requirement shown in Table 6.12.

## Table 6.21 Sub-Period Estimates: Capital Equation (Foreign Bank)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| **DCAR** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.124 | 0.276 | 0.306 | 0.117 | 0.263 | 0.234 | 0.105 | 0.281 | 0.256 |
| | 0.075 | 0.124 | 0.125 | 0.071 | 0.118 | 0.096 | 0.064 | 0.126 | 0.105 |
| $DRISK_{j,t}$ | -0.184 *** | -0.163 ** | -0.120 ** | 0.174 ** | 0.155 ** | 0.092 ** | -0.156 *** | -0.166 *** | -0.100 ** |
| | -2.979 | -2.542 | -2.276 | 2.187 | 2.385 | 2.466 | -2.678 | -2.979 | -2.486 |
| $CAR_{j,t-1}$ | 0.081 * | 0.079 | 0.085 * | 0.076 ** | 0.075 ** | 0.065 ** | 0.068 | 0.080 | 0.072 |
| | 1.867 | 1.573 | 1.921 | 2.575 | 2.279 | 2.070 | 1.412 | 1.508 | 1.607 |
| $SIZE_{j,t}$ | 0.075 | 0.070 | 0.072 | -0.071 | -0.067 | -0.055 | -0.064 ** | -0.072 *** | -0.060 ** |
| | 0.165 | 0.282 | 0.187 | -1.386 | -1.274 | -1.166 | -2.520 | -2.856 | -2.402 |
| $PROF_{j.t}$ | 0.142 ** | 0.139 ** | 0.169 *** | 0.135 ** | 0.132 ** | 0.130 ** | -0.121 ** | -0.141 ** | -0.142 ** |
| | 2.057 | 2.177 | 2.723 | 2.195 | 2.075 | 2.054 | -2.174 | -2.218 | -2.279 |
| $MPWR_{j,t}$ | -0.036 | -0.039 | -0.047 | 0.034 ** | 0.038 *** | 0.036 ** | 0.030 ** | 0.040 ** | 0.039 ** |
| | -1.470 | -1.470 | -1.384 | 2.323 | 2.622 | 2.218 | 2.186 | 2.533 | 2.287 |
| $ECVAR_t$ | 0.006 * | 0.008 * | 0.005 * | 0.006 * | 0.007 * | 0.004 | 0.005 ** | 0.008 ** | 0.004 ** |
| | 1.754 | 1.893 | 1.683 | 1.718 | 1.836 | 1.427 | 2.284 | 2.515 | 2.156 |
| $PRESS\ REG_{j,t}$ | | 0.072 *** | | | 0.069 *** | | | 0.074 *** | |
| | | 3.004 | | | 2.864 | | | 3.060 | |
| $PRESS\ REG_{j,t}*CAR_{j,t-1}$ | | 0.091 ** | | | 0.068 *** | | | 0.072 * | |
| | | 1.984 | | | 2.873 | | | 1.745 | |
| $PRESS\ PEER_{j,t}$ | | | 0.050 * | | | 0.038 * | | | 0.042 * |
| | | | 1.890 | | | 1.745 | | | 1.681 |
| $PRESSPEER_{j,t}* CAR_{j,t-1}$ | | | 0.073 ** | | | 0.056 * | | | 0.061 * |
| | | | 2.475 | | | 1.814 | | | 1.755 |
| **Sargan test** | 10.225 | 7.783 | 5.881 | 8.923 | 9.188 | 9.342 | 8.275 | 6.398 | 9.435 |
| **Wald test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | -0.905*** | -0.581*** | -0.677*** | -0.522*** | -0.678*** | -0.223 | -0.654*** | -0.578*** | -0.549*** |
| **AR(2)** | -0.027 | -0.028 | -0.041 | -0.002 | -0.031 | -0.153 | -0.046 | 0.082 | -0.017 |
| **Chow F-statistic** | | | 16.871*** | | | 7.478** | | | 11.662*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

## Table 6.22 Sub-Period Estimates: Credit Risk Equation (Foreign Bank)

The simultaneous equations are estimated with Generalised Method of Moments (GMM) dynamic system.
The basic capital equation is: $\Delta CAR_{j,t} = \alpha_0 + \alpha_1 PRESS_{j,t} + \alpha_2 SIZE_{j,t} + \alpha_3 PROF_{j,t} + \alpha_4 MPWR_{j,t} + \alpha_5 \Delta RISK_{j,t} + \alpha_6 ECVAR_t - \alpha_7 CAR_{j,t-1} - \alpha_8 PRESS_t \times CAR_{j,t-1} + E_{j,t}$
The basic credit risk equation is: $\Delta RISK_{j,t} = \beta_0 + \beta_1 PRESS_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 PROF_{j,t} + \beta_4 MPWR_{j,t} + \beta_5 \Delta CAR_{j,t} + \beta_6 ECVAR_t - \beta_7 RISK_{j,t-1} - \beta_8 PRESS_t \times RISK_{j,t-1} + U_{j,t}$
Where : CAR = Total Capital (Tier I + Tier II)/ Risk Weighted Assets, RISK = Risk Weighted Total Assets/Total Assets, SIZE = Total Assets, PROF = Return on Assets, MPWR = Market Power: Herfindahl index for demand deposits, ECVAR = Market interest rate variance; Pressure dummy ($PRESS_{j,t}$) ; PRESS = 1 if a bank has a capital adequacy ratio less than the regulatory capital requirement (PRESS REG) or peer group (PRESS PEER) average capital level.; PRESS = 0 if a bank has a capital adequacy ratio equal or more than the regulatory capital requirement (PRESS REG) or peer group average (PRESS PEER)
Model 1 is the basic equation excluding regulatory (PRESS REG) and peer pressures (PRESS PEER) variables, Model 2 is Model 1 with additional regulatory pressure (PRESS REG) variables and Model 3 is Model 1 with additional peer group pressure variables (PRESS PEER).

| **Dependent Variable =** | **Period I : 1993-1997** | | | **Period II : 1998 - 2000** | | | **Period III : 2001 - 2009** | | |
|---|---|---|---|---|---|---|---|---|---|
| **DRISK** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** | **Model 1** | **Model 2** | **Model 3** |
| Constant | 0.247 | 0.397 | 0.467 | 0.285 | 0.421 | 0.496 | 0.295 | 0.431 | 0.490 ** |
| | 0.192 | 0.678 | 2.323 | 0.221 | 0.719 | 2.468 | 0.229 | 0.736 | 2.439 |
| $RISK_{j,t-1}$ | 0.626 | 0.422 * | 0.509 | 0.722 *** | 0.448 ** | 0.541 *** | 0.746 * | 0.458 * | 0.534 |
| | 1.444 | 1.75 | 1.542 | 2.866 | 2.457 | 2.638 | 1.721 | 1.899 | 1.619 |
| $DCAR_{j,t}$ | -0.294 ** | -0.299 ** | -0.334 *** | 0.339 *** | 0.317 ** | 0.355 *** | -0.350 *** | -0.325 ** | -0.350 *** |
| | -2.167 | -2.202 | -2.867 | 2.985 | 2.337 | 3.35 | -2.679 | -2.39 | -2.825 |
| $SIZE_{j,t}$ | 0.022 *** | 0.019 ** | 0.237 *** | -0.026 *** | -0.020 ** | -0.251 *** | -0.027 *** | -0.021 ** | -0.248 *** |
| | 2.589 | 2.118 | 2.807 | -2.833 | -2.247 | -2.72 | -2.894 | -2.299 | -3.259 |
| $PROF_{j.t}$ | -0.530 ** | -0.476 ** | -0.448 ** | -0.612 * | -0.505 * | -0.476 | -0.632 *** | -0.516 *** | -0.470 ** |
| | -2.521 | -2.458 | -2.364 | -1.755 | -1.674 | -1.512 | -3.814 | -2.813 | -2.482 |
| $MPWR_{j,t}$ | -1.223 *** | -1.228 *** | -1.046 ** | -1.411 *** | -1.303 *** | -1.112 *** | -1.458 ** | -1.333 ** | -1.099 ** |
| | -2.721 | -2.821 | -2.462 | -3.985 | -3.151 | 2.972 | -2.551 | -2.242 | -1.999 |
| $ECVAR_t$ | -0.002 ** | -0.002 ** | -0.031 ** | -0.003 | -0.002 | -0.032 * | -0.003 ** | -0.002 ** | -0.032 ** |
| | -2.282 | -2.277 | -2.203 | -1.486 | -1.019 | -1.745 | -2.569 | -1.997 | -2.347 |
| $PRESS\ REG_{j,t}$ | | -0.923 ** | | | -0.979 *** | | | -1.002 *** | |
| | | -2.237 | | | -2.782 | | | -2.8 | |
| $PRESSREG_{j,t}\ xRISK_{j,t-1}$ | | 0.328 ** | | | 0.348 ** | | | -0.356 ** | |
| | | 1.998 | | | 2.067 | | | -2.114 | |
| $PRESS\ PEER_{j,t}$ | | | 0.317 * | | | 0.336 *** | | | 0.333 * |
| | | | 1.759 | | | 2.694 | | | 1.674 |
| $PRESSPEER_{j,t}xRISK_{j,t-1}$ | | | -0.060 * | | | 0.063 *** | | | 0.062 * |
| | | | -1.836 | | | 2.951 | | | 1.728 |
| **Sargan test** | 8.434 | 9.428 | 8.896 | 6.464 | 13.900 | 14.132 | 12.519 | 7.334 | 14.272 |
| **Wald test (p value)** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| **AR(1)** | 0.673*** | 0.416*** | 0.891*** | -0.421** | -0.327** | 0.0123 | 0.768*** | 0.573*** | -0.087 |
| **AR(2)** | -0.166 | -0.213 | -0.002 | -0.275 | -0.138 | -0.003 | -0.006 | -0.026 | -0.451 |
| **Chow F-statistic** | | | 8.127*** | | | 5.882*** | | | 5.013*** |

*, ** and *** suggest significant tests at the10%, 5% and 1% levels respectively.

In period III, as banks are recovering from the Asian financial crisis and the new 8% risk-adjusted capital requirement takes effect, the capital and asset portfolio credit risk relationships change, as indicated by the negative impact of the credit risk of asset portfolio and capital in both the capital and portfolio credit risk equations. It seems that the experience of the Asian financial crisis has changed their risk taking attitude, so that they become risk averse by increasing their capital level and reducing their credit risk of their asset portfolio, resulting in an average capital adequacy ratio of 28.4%, higher than the 8% regulatory requirement. The foreign banks' average of capital adequacy ratio in this period is the highest.

Due to their greater solvency and less risky asset portfolio investment, during the Asian financial crisis foreign banks were not as affected by the global financial crisis as other types of banks.

## II. Explanatory Variables Affecting Changes in Capital and Credit Risk

- **Lagged Capital Level and Lagged Credit Risk Level**

The sub -period estimation results show that all foreign banks significantly and positively adjust their capital adequacy ratio based on the previous level only in period II at the 5% significance level in all models (Table 6.21). Similarly, only in period II do all of the foreign banks significantly and negatively adjust the credit risk of their asset portfolios based on the previous credit risk level, as the coefficients of the lagged credit risk are significant and negative at the 5%

significance level in that period (Table 6.22). The results suggest that only during the Asian financial crisis do they significantly increase their capital ratio and reduce their credit risk based on the previous level.

- **Size**

Size significantly affects changes in asset portfolio credit risk in all periods in different directions. In period I, size positively affects changes in asset portfolio credit risk with no significant impact on changes in capital. Similarly, there is no significant impact of size on changes in capital in period II, but it significantly and negatively affects the credit risk of asset portfolios at the 5% significance level. In period III size significantly and negatively affects both changes in capital and the credit risk of asset portfolios (Tables 6.21 and 6.22).

The results imply that before the Asian financial crisis, larger foreign banks increased their credit risk without significant adjustment on the capital level. During the Asian financial crisis, when the capital requirements were reduced to the minimum of 4% leverage ratio, larger banks reduced their credit risk but still without any significant changes in capital level. When the risk adjusted capital ratios were imposed at 8% level, large banks both reduced their capital holdings and credit risk in order to meet the minimum requirement. The behaviour of large foreign banks supports the moral hazard of large banks that are supported by their foreign owners. The capital and liquidity supports enable them to be less responsive in adjusting their capital and more willing to change their credit risk.

- **Profitability**

As with regional and joint venture banks, the current earnings of foreign banks significantly and positively affect changes in capital in periods I and II and significantly and negatively affect changes in capital in period III at least at the 5% significance level, whilst they significantly and negatively affect changes in credit risk in periods I and III (Tables 6.21 and 6.22). Foreign banks increased their capital ratio through retained earnings before and during the Asian financial crisis. Due to huge losses of the regional banks during the Asian financial crisis, the retained earnings were unable to increase the capital ratio in period III. On the other hand, current earnings affected the credit risk structure of asset portfolios before and after the Asian financial crisis and not during the Asian financial crisis. It seems that in an attempt to recover the drop in earnings during the Asian financial crisis, foreign banks increased the credit risk of their assets during the period when the current earnings were low and vice versa, reducing the credit risk of their asset portfolios when current earnings were high.

- **Market Power**

Market power significantly and positively affects changes in capital ratios in periods II and III at the 5% significance level and significantly and negatively affects changes in credit risk in all periods at the 5% significance level (Tables 6.21 and 6.22). This shows that foreign banks with larger market share reduced the credit

risk of their asset portfolios in period I without a significant change in capital. On the other hand foreign banks with greater market power increased their holdings in equity while investing in less risky assets during and after the Asian financial crisis.

- **Economic Uncertainty**

Economic uncertainty significantly and positively affects changes in capital only in period III at the 5% significance level, but significantly and negatively affects changes in credit risk of asset portfolio in the same period at the same significance level (Tables 6.21 and 6.22). The findings support the buffer capital theory that, after they recover from the severe Asian financial crisis in period III, banks hold greater capital when the economic uncertainty increases and reduce their capital holdings when the economic uncertainty decreases. On the other hand the banks consistently reduce their credit risk during high economic uncertainty and increase the credit risk when economic conditions are stabilised.

- **Regulatory & Peer Group Pressure on undercapitalised banks**

Regulatory pressure significantly affects changes in capital and portfolio in all periods at the 5% significant level . It positively affects changes in capital and negatively affects changes in credit risk ,whilst peer group pressure only significantly and positively affects changes in credit risk in period II (Tables 6.21

and 6.22).

#### 6.3.4.3.4. Summary

In summary, the important findings regarding the impacts of the explanatory factors on changes in capital and credit risk for each type of bank ownership are:

- State owned banks significantly and positively adjust their current capital level based on the previous level during both stable and volatile economic conditions. On the other hand, during more stable economic conditions the state owned banks restructure their credit risk of asset portfolio regardless of the previous period's credit risk. This also implies that the 8% credit risk adjusted capital regulations that are imposed have succeeded in forcing the state owned banks to adjust their credit risk based on the current capital level. On the other hand, regional banks, private domestic banks and joint venture banks positively restructure the credit risk of their asset portfolios, continuously taking into account the previous credit risk of their asset portfolios regardless of economic conditions and capital regimes. Only during a period of more stable economic conditions (as in period I) do private domestic banks adjust their capital adequacy ratio based on the previous capital adequacy ratio. In contrast, during a period of less stable economic conditions foreign banks significantly increase their capital ratio and reduce their credit risk based on the previous level.

- Size significantly impacts changes in capital and asset portfolio credit risk and does so differently for different types of bank ownership in all of the sub -

sample periods. Larger state owned banks hold greater capital compared to smaller banks at all times. On the other hand, size does not significantly affect changes in the portfolio credit risk of state owned banks in all periods. In contrast, larger private domestic, regional, joint venture and foreign banks reduce capital levels and the credit risk of their portfolios before the Asian financial crisis. The size impacts on these banks do not change after the Asian financial crisis when the government adjusts the capital requirements to 8%. Larger regional banks become less risk averse by reducing their capital level without any significant changes in credit risk. On the other hand, larger private domestic banks become risk averse by significantly reducing their credit risk of portfolio assets when they reduce their capital level. Possible interpretations are that large banks have easier access to capital markets and can therefore operate with lower amounts of capital or that they feel less pressure to increase their capital to assets ratio because of a "too-big-to fail" effect. A larger size also allows a greater diversification to mitigate credit risk exposure.

- Profitability affects capital and credit risk decisions for all types of bank ownership. State owned banks generating returns from less risky activities managed to increase their capital level before and during the Asian financial crisis. On the other hand the state owned banks took on more credit risk in order to generate higher returns and used retained earnings to increase the capital adequacy ratio when the economy was recovering from the Asian financial crisis and when the capital regulations were tightened. Regional banks increased capital through retained earnings before and during the Asian

financial crisis. However, due to the huge losses of the regional banks during the Asian financial crisis, the retained earnings were unable to increase capital levels in period III. The regional banks generated their returns by investing in less risky assets during and after the Asian financial crisis.

Before the Asian financial crisis and during the recovery from the crisis periods, private domestic, joint venture and foreign banks increased their capital adequacy ratio through retained earnings whilst generating profits by investing in less risky assets. On the other hand, during the Asian financial crisis their decisions in relation to generating returns did not affect the credit risk for both types of bank. It seems that in an attempt to recover from the fall in earnings during the Asian financial crisis, these banks increase the credit risk of their assets when the earnings are low and vice versa, reducing the credit risk of the asset portfolio when the current earnings are high.

- The market share of total deposits in the deposit market does not affect the changes in the capital and the credit risk of asset portfolio decisions for state owned, regional banks and joint venture banks. On the other hand, private domestic banks and foreign banks with greater market power reduced their holdings in equity while investing in riskier assets before and after the Asian financial crisis. Foreign banks with greater market power increased their holdings in equity while investing in less risky assets during and after the Asian financial crisis.

- The findings on the impact of economic uncertainty on changes in capital and credit risk of different types of bank ownership generally support the buffer capital theory. State owned, private domestic and foreign banks hold greater capital when the economic uncertainty increases and reduce their capital holdings when the economic uncertainty is lower. All banks except joint venture banks consistently reduce their credit risk during high economic uncertainty and increase their credit risk when economic conditions are stabilised. In contrast, economic uncertainty does not significantly affect both changes in the capital and credit risk of joint venture banks at the 5% significance level

- The estimation results show that regulatory and peer group pressures have different impacts on bank capital and credit risk for different types of undercapitalised banks. Generally, regulatory pressure is more binding than peer group pressure in influencing undercapitalised state owned and regional banks to adjust their credit risk without any significant impact on capital ratios. In other words, undercapitalized state owned and regional banks do not behave significantly differently from adequately capitalized banks in adjusting their capital level . The results are not surprising given that, being government owned banks, it is difficult for them to increase shareholders' equity.

  Similarly, regulatory pressure significantly affects changes in capital and credit risk for private domestic, joint venture and foreign banks whilst peer group

pressure only significantly affected changes in credit risk during the Asian financial crisis. The insignificance of the peer group pressure variable in the risk equations further indicates that regulatory pressure is more binding than the industry pressure to induce undercapitalized banks to adjust the riskiness of their portfolio.

In conclusion, the results show that regulatory pressure is effective in shifting the credit risk of asset portfolios towards less risky assets, especially during more stable economic conditions. The impact on credit risk reflects the true effect of the capital requirements since the marginal contribution of peer group pressure in the capital equations is either insignificant or negative.

## 6.4. Conclusion

This chapter explains the relationship between changes in the capital adequacy ratio and credit risk and the impact of the explanatory variables on changes in the capital adequacy ratio and credit risk. It also explores the impact of the changes in capital regulations and economic crisis on the relationship.

The empirical results suggest that all explanatory variables significantly affect the capital adequacy ratio and credit risk. The results show that there is a change in the risk taking attitudes of large and small size banks. Moreover, undercapitalised banks or banks under peer group pressure also displayed changing attitudes as a result of the economic crisis. The results also find that, after the Asian financial

crisis, banks changed their attitudes toward insolvency and credit risk. In general, the economic crisis reduced the risk taking appetite of banks. Furthermore the results support the conclusion that capital levels were higher for banks during the period of recovery and rehabilitation from the economic crisis. This indicates that capital regulations were at least partially effective during the period covered. A majority of the Indonesian banking sector became more risk averse, holding more capital with less risky investments. This is attributable to the economic crisis as well as to the implementation of capital regulations.

The empirical results also support the hypothesis that changes in the capital adequacy ratio and credit risk are positively interrelated. Banks adjust their capital ratio and credit risk positively by increasing their capital as credit risk increases, and also increase their credit risk when they increase their capital level. This occurs especially when they are under regulatory pressure.

Specifically, the positive correlations were found before the Asian financial crisis period when the flat (risk-independent) capital standards were imposed, and during the crisis when the risk-independent capital standard was reduced to 4% as a result of the financial crisis. These results support the mean-utility theory of Koehn and Santomero (1980), that banks compensate for the loss of utility created by higher capital ratios by switching to higher risk investments and vice versa. The results suggest that banks will tend to offset regulatory-induced capital increases with increases in asset risk unless constrained from doing so by regulators.

The estimation results also provide evidence that after the crisis there is a negative relationship between changes in capital and credit risk. This supports the bankruptcy avoidance theory, showing a greater degree of bank risk aversion. An increase in the regulatory capital standard during the period of high economic uncertainty forced banks to reduce their credit risk and increase their capital level. However, this may in effect disturb the major role of banks as financial intermediaries. The results also show that stringent capital regulations effectively forced banks under regulatory pressure to increase their capital when they increased their credit risk.

The empirical results of each type of bank ownerships show that the type of bank ownership significantly affects capital and credit risk relationships as well as the explanatory variables affecting the relationships. The results also show the intended impact of capital regulations in adjusting capital and credit risk taking behaviour of all types of bank ownership, especially after the Asian financial crisis.

Government owned banks (state owned and regional banks) behave similarly in terms of credit risk taking activities and capital decisions, with regional banks adjusting their capital more conservatively compared to state owned banks. The results show a change of risk taking behaviour of government owned banks as a result of the Asian financial crisis and the change in capital regulations. The results show that before the Asian financial crisis, state owned and regional banks exhibit negative relationships between portfolio credit risk and change in capital, where they reduce their capital holdings when they increase the credit risk. The negative

relationships confirm the major flaw of leverage ratio and the moral hazard effect of "too big or too important to fail" of government ownership of the banks that is occasioned by explicit or implicit government guarantees. The government guarantees induce banks to engage in high credit risk taking activities and reckless lending, without maintaining an adequate amount of capital. The political and developmental roles of government owned banks and weak credit assessment have led the state owned and regional government banks to engage in risky loss-making investments, by providing financing on non commercial terms to regions or extending credit based on political connections, as instructed by the government. Moreover, the government is expected to provide capital assistance, and in extreme cases, to bail out the banks even in the absence of explicit government guarantees. There was a strong belief that neither investors nor lenders would bear the full cost of banking failure (Djiwandono, 1999)

The relationships changed during, after the Asian financial crisis and during the GFC when government imposed different capital requirements in order to restore the solvency of the banking system. The relationships between changes in capital ratio and credit risk became significant and positive, and state owned and regional banks increased their capital holdings significantly while at the same time increasing their credit risk portfolio but at a lower rate, resulting in the average capital adequacy ratio being higher than the minimum capital requirement.

On the other hand, privately owned banks (private domestic, joint venture and foreign banks) exhibited different attitudes in adjusting their capital and credit risk

compared to government owned banks. Realising that they are not as implicitly protected as the government owned banks, privately owned banks change their capital at a lower rate than state owned banks and restructure the credit risk of asset portfolio more aggressively. In the case of the private domestic banks, risky lending practices usually involve banks making loans to affiliated companies. The financial and economic liberalisation in 1988 increased the attraction of many of Indonesia's large business conglomerates for opening one or more private banks. Most of these banks were not managed on an independent basis; instead they were used as funding sources for the affiliated business where they extended loans to suit the funding needs of the businesses. Even though regulators imposed rules regarding the aggregate amount that a bank could lend to its affiliated companies, there were no clear provisions to enforce the rules. These loans to affiliated companies were among the riskiest loans held by private banks. (Sharma, 2004). Joint venture and foreign banks adjusted their capital level at a greater rate than the state owned banks as they had better supports from their foreign owners during the financial and liquidity crises, enabling them to access the capital market more easily than state owned banks. Moreover, the joint venture and foreign banks adjusted their credit risk of asset portfolio more aggressively than the state owned banks due to the ability of foreign owners to diversify the total risks of their foreign branches' activities.

After investigating the relationships between capital and credit risk on the privately owned banks, it seems that imposing any type of capital requirements in any kind of economic conditions, regardless whether the capital requirements are adjusted

to asset risks, seems to be effective in disciplining the private domestic and joint venture banks. Capital requirements are effective in forcing the banks to increase their capital when they increase their credit risk of their asset portfolio and allowing them to hold less capital when investing in lower credit risk of asset portfolio in periods I and II. These banks have lowered their capital holdings as well as the credit risk of their portfolios as a result of the Asian financial crisis. The banks also improved their capital holdings and adjusted their credit risk positively during the crisis. Recovering from the Asian financial crisis and facing the GFC, they protected themselves against the default risk by increasing their capital and reducing their credit risk. Private domestic and joint venture banks were able to absorb losses and better deal with the liquidity crisis from the GFC in 2008 due to being overcapitalisation, having favourable liquidity position, and being less reliant on international source of funds.

The capital and credit risk relationships for foreign banks change over the sample periods. The nature of the relationships shows how capital requirements were not effective in minimizing the moral hazard effect of foreign ownership before the Asian financial crisis but they did become effective during and after the crisis. Before the Asian financial crisis, capital and liquidity supports provided by foreign owners, and the ability to diversify risks by the foreign owner encouraged foreign banks to lower their capital when they increased their credit risk. The relationships changed during the Asian financial crisis and the recovery periods. During the Asian financial crisis with 4% leverage ratio requirements, foreign banks reduced their capital holdings due to the huge losses suffered during the crisis, and also reduced

their credit risk. As banks were recovering from the Asian financial crisis and the new 8% risk-adjusted capital requirement took effect, they became more risk averse. They increased their capital level at the higher rate when they reduced the credit risk of asset portfolio, resulting in the average capital adequacy ratio higher than the 8% regulatory requirement. The foreign banks' average of capital adequacy ratio in this period was the second highest after joint venture banks.

To sum up, the new 8% risk adjusted capital requirements seem to be effective in inducing some types of bank to increase their capital when they increase portfolio credit risk. All types of banks appear to have raised their capital, especially after the Asian financial crisis when the 8% risk adjusted BASEL II capital requirements were imposed. This is a result consistent with Koehn and Santomero (1980) who argue that more stringent capital regulation will cause a utility maximizing bank to increase asset risk and, on the other hand, force banks to increase their capital when they increase asset risk, as explained by "bankruptcy cost avoidance" theory and "managerial risk aversion" theory (Shrieves and Dahl, 1992).

The experience from the Asian financial crisis and the application of BASEL II credit risk adjusted capital requirements have had the intended impacts on risk taking activities of the banks. In order to avoid market discipline and for reputational purposes, most types of bank are overcapitalised and have increased liquidity while increasing their asset risk. Due to the overcapitalisation, a better liquidity position, all banks in general are able to absorb losses and to better deal with the liquidity crisis that resulted from the GFC in 2008. Also, due to less reliance of the banks in

general on the overseas sources of funds and less exposure to the structured derivatives market as discussed in Chapter 3, these banks have survived the crisis.

# Chapter 7

# Conclusion and Implications

## 7.1. Overview

This thesis studies bank risk taking behaviour with regard to adjusting capital and asset portfolios and the way in which economic uncertainty and capital regulations affect the risk taking behaviour. This thesis addresses two objectives. The first objective is to investigate the impact of adverse shocks in the economy on a bank's decisions in adjusting its capital and asset portfolio. The second objective is to examine interrelationships between the capital and asset portfolio decisions and the impact of economic uncertainty and changes in capital regulations on these relationships.

This thesis is motivated by the lack of general consensus on the effectiveness of capital regulations in controlling banks' risk taking, as well as lack of consensus on how banks should be regulated This is despite the awareness of regulators, supervisory authorities and the banks themselves of the importance of capital and of the minimum level of equity capital to assets ratio in banks required to maintain long-term solvency as well as to maintain public confidence. Moreover, the existing research has been mostly undertaken in comparatively stable economic environments, with no changes in capital regulations and with accompanying

unconditional guarantees provided by the government in the form of explicit deposit insurance.

Indonesian banks provide a good sample for this thesis for three reasons. First, Indonesia experienced a severe economic crisis as a result of Asia's financial crisis in 1997 and survived the GFC in 2008. Second, Indonesian banks have been exposed to different capital regulations as part of the recapitalisation and restructuring of the banking sector due to the Asian financial crisis. Lastly, before and during the Asian financial crisis, Indonesia had not adopted an explicit deposit insurance system, even though a full blanket guarantee was in place until 2001. Using Indonesian banks as a focus of this study not only controls for the impact of deposit insurance, but also incorporates the impact of an implicit government guarantee, which has not been widely explored in the existing literature.

## 7.2. Main Findings

The main findings of this thesis are as follows.

First, the economic crisis has had a permanent impact on these bank's asset portfolios and sources of funds component. The breaks and shifts in portfolio components, as a result of the application of new banking regulations, support the proposition that changes in financial regulations give incentives to banks to immediately adjust their portfolios, especially if they were capital constrained. Nevertheless, the significant changes of capital regulations in 2001 only create breaks on government bonds but do not create any breaks in other series of asset

component and the sources of funds, especially total equity. This suggests that in order to meet the new capital requirements, banks gradually, but steadily, adjust either the level of capital or the credit risk of their asset portfolios.

Second, all explanatory variables such as type of bank ownership, size, profitability, market power, economic uncertainty and regulatory and peer pressures, significantly affect the banks' capital and the credit risk of asset portfolio decisions. However, there is a difference in the risk taking attitude among different sized banks, as well as among different types of bank ownership.

Government owned banks (state owned and regional banks) behave similarly in terms of credit risk taking activities and capital decisions, with regional banks adjusting their capital more conservatively compared to state owned banks. On the other hand, privately owned banks (private domestic, joint venture and foreign banks) exhibit different attitudes in adjusting their capital and credit risk compared to government owned banks. Realising that they are not as implicitly protected as the government owned banks, privately owned banks change their capital at a lower rate than state owned banks and restructure the credit risk of their asset portfolios more aggressively.

The results also show different risk taking attitudes of large banks in comparison to small sized banks. Smaller banks tend to hold higher capital and increase their holdings in riskier assets after such a crisis, whilst larger banks are more risk averse, holding less risky assets and therefore also holding less capital. The risk

taking attitude is negatively correlated with profitability, with larger banks with the lowest portfolio risk being the most profitable during and after the crisis periods, whilst smaller banks' profitability continuously declines during these periods. They are the least profitable in the industry. The results also show that profitable banks increase their capital through retained earnings and generate returns by investing in lower credit risk assets. The findings on market power support the risk averse attitude of larger banks and show that banks with greater market power protect their valuable banking charter by financing with more equity and also choose to invest in safer portfolios even though this means they might sacrifice some of their potential profits.

The results on the economic stability variable suggest that generally banks are more risk averse during high levels of uncertainty in the economy. The increase in the level of uncertainty in the economy forces banks to forgo additional returns by investing in low risk investments and reducing leverage as uncertainty regarding the cost of funds increases. The results also show that stringent regulatory capital requirements are effective in forcing undercapitalised banks to increase their capital level when they increase the credit risk of their asset portfolios. It suggests that experience gained from the crisis, combined with regulatory and peer pressure, effectively forces all banks to hold greater capital ratio than required, and as a result all banks are overcapitalized after such a crisis.

Third, the empirical results support the hypothesis that changes in leverage and capital adequacy ratios and portfolio risk are interrelated and the relationships

change after a financial crisis. The interrelationships are significantly positive before the Asian financial crisis, as banks adjust their capital as the credit risk of asset portfolio increases, and also increase the credit risk of their asset portfolios when they increase their capital level. The results suggest that banks tend to offset regulatory-induced capital increases with an increase in asset risk unless constrained from doing so by the regulators. Nevertheless, state owned and regional banks exhibit negative relationships between portfolio credit risk and change in capital, as they reduce their capital holdings when they increase the credit risk and vice versa. The negative relationships confirm the major flaw of the leverage ratio and the moral hazard effect of "too big or too important to fail" of government ownership of banks occasioned by explicit or implicit government guarantees that induce banks to engage in high credit risk taking activities and reckless lending, without maintaining an adequate amount of capital.

A negative relationship is observed post crisis: this supports the bankruptcy avoidance theory, and shows a greater degree of risk aversion by the banks. An increase in the regulatory capital standard during higher levels of economic uncertainty forces banks to reduce the credit risk of their asset portfolios and increase their capital level resulting in higher average CAR than the requirements post crisis. The banks are generally well capitalized as measured by the Basel I Total Capital Adequacy Ratio. Due to being relatively overcapitalised, having comfortable level of liquidity and relatively low non performing loans, the banks are able to absorb losses and better deal with the liquidity crisis from the GFC in 2008.

This thesis establishes that, even though capital regulations were at least partially effective in coercing banks to hold adequate capital, the changes in attitude towards insolvency and portfolio risks after the crisis may not have occurred because of the new capital regulations. Banks self regulate themselves by holding more capital than required and adjust their risk taking activities to signal solvency and avoid the severe banking failure experienced during the economic crisis.

### 7.3. Policy Implications

Kane (2000) describes three characteristics that are required so that market and regulators can effectively perform their respective roles in evaluating, monitoring and disciplining banks' risk taking activities: transparency, deterrence and accountability. These characteristics are related to the availability of information for creditors and regulators about banks' financial performance and risk taking (transparency), to the ability of creditors and regulators in assessing the information in order to protect themselves from externalities caused by banks becoming insolvent (deterrence), and finally, to the ability of taxpayers in assessing government officials' activities so that the regulators can be held responsible for their actions (accountability). These characteristics are missing in the Indonesian banking system.

As Soesastro and Basri (1999) and Pangestu (2003) point out, even though the measures to ensure the soundness and safety of the banking systems had been established prior to the Asian financial crisis, the Indonesian banking system was

not supported by the required prudential supervisory, regulatory, and legal framework to allow the three required characteristics to exist . For countries in which transparency, deterrence and accountability are very weak, implementing effective capital regulations may be impossible. Banks seem to be aware of this, as is shown by their holding more excess capital than required since 2001. Maintaining a greater capital ratio than required not only sends a signal of solvency, but may also reflect the banks' belief that holding capital at the regulatory required level will not necessarily protect them from insolvency. However, holding too much capital has an adverse impact on banks' profitability which in turn affects the safety of the whole banking sector, as well as slowing down economic growth, especially if banks increase their capital ratio by reducing the supply of loans to the economy. Therefore, in order to ensure the efficacy of regulatory capital requirements, the Indonesian government must address the weaknesses that exist in the institutional environment. Moreover, the GFC provides a major lesson that bank capital is a necessary but not *sufficient* requirement for a bank's stability and solvency. Vigilant prudential regulators are required to ensure the intended impact of the capital requirement on banks' risk-taking behaviour can be achieved.

While BIS is improving Basel II by broadening the regulatory, supervisory and information perimeter to ensure that all financial activities that cause systemic risk are adequately captured (Claessens et al, 2010), several actions need to be taken by Indonesian banking regulators to improve the institutional environment are :

- **Transparency**

In order to provide adequate information for creditors and regulators about banks' financial performance and risk taking, collection and disclosure of information on important activities needs to be enhanced. The information collected, disclosed and analysed need to be of much higher quality than is currently the case and to include a much larger set of activities, covering on and off-balance sheet activities, liquidity profiles as well as risk exposures and concentrations. Therefore, the information is not only available but it is also readily interpretable and comparable. One way to achieve this is to require banks to supply all financial transactions to clearing houses with effective protections (Claessens et al, 2010).

- **Deterrency**

Obtaining more and better organized information is required to enhance ability of creditors and regulators in assessing systemic risk. Improvement in the assessment of risks requires advanced statistical approaches to obtain and utilize timely and higher frequency real and financial indicators. Moreover, the risk assessment improvement also requires effective early warning systems which

utilize analysis on the linkages between macroeconomic indicators and financial sector performance.

- **Accountability**

To enhance accountability, agencies involved in regulation and supervision need to have clear mandates to pursue financial stability. A *clear mandate* makes it easier to measure an *agency's* performance against that *mandate.* Consideration should be given to include mitigation of systemic risks as an explicit goals for central banks and regulators involved. The agencies also need to have appropriate instruments corresponding with these mandates.

Effective oversight not only requires sufficient resources but also close communication and a flow of information among all parties involved and responsible for supervision. To ensure the cooperation between agencies, a legal framework that includes mechanisms through which a regulatory agency can share its information and concerns with another is critically required (Davis, 2010 and Claessens et al, 2010).

### 7.4. Limitations

The limitations of this thesis mostly are related to the data and model specification. This thesis uses data provided by the banks and the most reliable sources available in Indonesia: The Central Bank of Indonesia and The Ministry of Finance. However the data from the Central Bank and Ministry of Finance is aggregated data with

limited information with regards to the details of the figures. For example, since only the final figures of the risk weighted assets to total assets ratio are provided, it is difficult to assess the validity of the ratio. There is no breakdown of the components of the risky assets including the off-balance sheet assets. Therefore it limits the type of risk measurements that can be evaluated in this thesis. Also, as the risk weighted assets are calculated by applying risk weights established by the Basel I Accord, not only are they not accurately related to bank's risk taking activities, but also the risk weights do not fully reflect the true risk of a bank (Avery and Berger 1991). Ideally, the risk weighted assets should be recalculated, so as to incorporate other risks, not just credit risk as directed by the Basel I Accord.

Another limitation is the fact that book value financial data is used instead of market value. This means that the validity of the data depends on the reporting quality of the accounting systems adopted in Indonesia. Finally, the unavailability of collapsed and small regional banks' data exposes this thesis to survivorship bias.

### 7.5. Further Research

Capital regulations and bank's risk taking behaviour is still a topic of controversy, especially in the light of the latest banking and economic crisis. The findings of this thesis provide a further direction for research, viz., to identify the optimal capital that the market requires that may differ from the regulatory capital requirement. This capital requirement may be more credible than the regulatory capital requirement, especially for countries with weak institutional environments.

This thesis implicitly suggests that there may be an impact of market discipline on banking risk taking. Therefore, it would be of interest to study further the impact of market discipline, as opposed to regulatory discipline, on banks' risk taking in environments, such as those in developing countries, with severe asymmetric information.

# APPENDICES

# APPENDIX A

### Table A.1. Stationary Tests with Single Break Innovational Outlier 2 (IO2) Model

IO2 model assumes no break under the null hypothesis of unit root, changes are assumed to take place gradually, allowing for a break in both the intercept and slope.

$Y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta D(TB)_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_i$

Where TB is the unknown time break (1 < TB < T),

DU = 1 if t > TB and zero otherwise,

$DT_t = T_t$ if t > TB and zero otherwise,

D(TB) = 1 if t = TB+1 and zero otherwise,

$Y_t$ is any ARMA process and $e_t$ is the residual term assumed white noise.

| Variable | Lag k | *M* | *B* | *Θ* | *γ* | *δ* | *A* | Inference | TB1 |
|---|---|---|---|---|---|---|---|---|---|
| **Certificate of Bank Indonesia** | 0 | 1.482* | 0.749 | 0.0270 | -0.027 | -0.194 | -0.804*** | Stationary | Q4 1998 |
| | | 1.646 | 1.308 | 1.558 | -1.325 | -0.570 | -7.960 | | |
| **Government Bonds** | 0 | 4.311*** | 3.184*** | 0.0378*** | -0.047*** | -2.074*** | -0.444*** | Stationary | Q4 1998 |
| | | 12.044 | 13.112 | 6.502 | -6.546 | -9.680 | -9.762 | | |
| **C&I Loans** | 0 | 5.912*** | -0.0314 | 0.032 | -0.010 | 0.146 | -0.496** | Stationary | Q4 1998 |
| | | 5.469 | -1.539 | 1.048 | -1.226 | 1.362 | -5.333 | | |
| **Demand Deposits** | 7 | 6.625 | 0.044** | 0.228** | -0.012*** | -0.075 | -0.298 | Non stationary | Q2 1998 |
| | | 1.620 | 2.018 | 2.105 | -2.583 | -0.860 | -0.687 | | |
| **Time, Savings & Foreign Deposits** | 0 | 5.738*** | 0.682*** | 0.031*** | -0.022*** | -0.246*** | -0.495*** | Stationary | Q3 1997 |
| | | 9.211 | 10.063 | 8.915 | -9.305 | -6.350 | -8.956 | | |
| **Equity** | 8 | 5.430 | 2.111 | 0.043 | -0.051 | -2.302** | -0.411 | Non stationary | Q2 1998 |
| | | 0.295 | 1.105 | 0.276 | -1.377 | -2.160 | -0.187 | | |

All tests were performed on logarithmic values. The critical values for α at the 1% and 5% are -5.68 and -5.05, respectively (Perron, 1997).

**Table A.2 Stationary Tests with a Two Break Model (Model AA)**

Model AA assumes breaks under both the null and the alternative allowing two breaks in the intercept only

$\Delta Y_t = \mu + \beta_t + \theta DUI_t + \omega DU2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t$

Where TB is the unknown time break ($1 < TB < T$),

$DU1_t = 1$ if $(t > TB_1)$, and zero otherwise

$DU2_t = 1$ if $(t > TB_2)$, and zero otherwise

$Y_t$ is any ARMA process and $e_t$ is the residual term assumed white noise.

| Variable | Lag k | *M* | *B* | *θ* | *Ω* | *A* | Inference | TB1 | TB2 |
|---|---|---|---|---|---|---|---|---|---|
| **Certificate of Bank Indonesia** | 4 | -1.56 | 0.040*** | 0.276 | -0.681*** | -0.0000174 | Non stationary | Q4 2002 | Q2 2004 |
| | | -1.337 | 4.247 | 1.454 | -2.709 | -3.953 | | | |
| **Government Bonds** | 1 | 3.187*** | 0.022*** | 1.961*** | -0.408*** | -0.00000198 | Non stationary | Q1 1999 | Q3 2003 |
| | | 4.845 | 3.517 | 11.251 | -3.658 | -3.299 | | | |
| **C&I Loans** | 5 | 0.642 | 0.015*** | -0.354*** | -0.041*** | -0.000000396 | Non stationary | Q4 1998 | Q1 2006 |
| | | 0.199 | 3.422 | -4.265 | -3.867 | -0.535 | | | |
| **Demand Deposits** | 1 | 5.416*** | 0.0361*** | -0.050*** | 0.090 | -0.00000428 | Non stationary | Q2 1998 | Q2 2000 |
| | | 4.011 | 3.825 | -4.863 | -0.152 | -0.729 | | | |
| **Time, Savings & Foreign Deposits** | 3 | -0.560 | 0.015*** | 0.247*** | 0.0617*** | -0.00000167*** | Stationary | Q4 1997 | Q3 2000 |
| | | -1.297 | 7.958 | 9.885 | 3.387 | -10.9711 | | | |
| **Equity** | 8 | 36.476*** | 0.307*** | -1.289*** | -0.033*** | -0.00000506 | Non stationary | Q2 1998 | Q3 2003 |
| | | 8.947 | 9.614 | -7.252 | -3.921 | -3.580 | | | |

All tests were performed on logarithmic values .The critical values for α at the 1% and 5% are -7.34 and -6.82, respectively (Lumsdaine and Pappell (1997))

## Table A.3. : Stationary Tests with a Two Break (Model CC)

Model CC assumes breaks under both the null and the alternative hypothesis allowing two breaks in the slope and the intecept

$\Delta Y_t = \mu + \beta t + \theta DUI_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t$

Where $T_B$ is the unknown time break ($1 < TB < T$),

$DU1_t = 1$ if $(t > TB_1)$, and zero otherwise

$DU2_t = 1$ if $(t > TB_2)$, and zero otherwise

$DT1_t = (t\text{-}TB_1)$ if $(t > TB_1)$, and zero otherwise

$DT2_t = (t\text{-}TB_2)$ if $(t > TB_2)$, and zero otherwise

$Y_t$ is any ARMA process and $e_t$ is the residual term assumed white noise.

| Variable | Lag k | *M* | *B* | *Θ* | *γ* | *Ω* | *Ψ* | *α* | Inference | TB1 | TB2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Certificate of Bank Indonesia** | 4 | -1.848 | 0.051** | -1.226** | -0.208** | 1.053* | -0.117* | -1.55E-05 | Non stationary | Q1 1997 | Q1 2003 |
| | | -1.026 | 2.001 | -2.115 | -2.573 | 1.834 | -1.772 | -2.817 | | | |
| **Government Bonds** | 8 | 3.994 | 0.102 | -1.326*** | 0.416*** | -1.057* | -0.582*** | -3.48E-06 | Non stationary | Q1 1998 | Q1 2001 |
| | | 0.676 | 1.553 | -3.743 | 4.888 | -1.681 | -6.289 | -0.584 | | | |
| **C&I Loans** | 4 | 27.946*** | 0.067*** | -0.509*** | -0.0759** | 0.086 | 0.032 | -5.25E-06 | Non stationary | Q2 1998 | Q3 2000 |
| | | 7.119 | 6.331 | -4.124 | -2.504 | 1.618 | 1.163 | -6.081 | | | |
| **Demand Deposits** | 8 | 9.073*** | 0.0664*** | 0.027 | 0.066 | -0.234*** | -0.037 | -1.39E-05 | Non stationary | Q3 1997 | Q2 1998 |
| | | 2.933 | 3.908 | 0.274 | 1.420 | -3.381 | -0.803 | -4.122 | | | |
| **Time, Savings & Foreign Deposits** | 1 | -15.912*** | -0.040*** | -0.018 | 0.066*** | 0.089*** | 0.001 | -5.07E-06 | Non stationary | Q1 1997 | Q4 2000 |
| | | -4.460 | -3.570 | -0.541 | 4.560 | 2.754 | 0.240 | -5.226 | | | |
| **Equity** | 1 | 2.451 | 0.038** | 0.467* | -0.092 | -1.422*** | 0.217 | -2.49E-05 | Non stationary | Q4 1997 | Q2 1998 |
| | | 1.097 | 2.369 | 1.688 | -0.526 | -8.528 | 1.218 | -5.918 | | | |

All tests were performed on logarithmic values. The critical values for α at the 1% and 5% are -7.34 and -6.82, respectively (Lumsdaine and Pappell (1997))

## Table A. 4 . : Stationary tests with Single and Multiple Breaks – Final Results

IO2 model assumes no break under the null hypothesis of unit root, changes are assumed to take place gradually, allowing for a break in both the intercept and slope, where : $Y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta D(TB)_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_i$

Model AA assumes breaks under both the null and the alternative allowing two breaks in the intercept only, where :

$\Delta Y_t = \mu + \beta t + \theta DUI_t + \omega DU2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t$

Model CC assumes breaks under both the null and the alternative hypothesis allowing two breaks in the slope and the intercept, where :

$\Delta Y_t = \mu + \beta t + \theta DUI_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha Y_{t-1} + \Sigma c_i \Delta Y_{t-1} + e_t$

Where TB is the unknown time break ($1 < T_b < T$),

$DU = 1$ if $t > TB$ and zero otherwise, $DT_t = T_t$ if $t > TB$ and zero otherwise, $D(TB) = 1$ if $t = TB+1$ and zero otherwise,

$DU1_t = 1$ if $(t > TB_1)$, and zero otherwise, $DU2_t = 1$ if $(t > TB_2)$, and zero otherwise, $DT1_t = (t-TB_1)$ if $(t>TB_1)$, and zero otherwise

$DT2_t = (t-TB_2)$ if $(t>TB_2)$, and zero otherwise

| Variable | Lag k | *M* | *B* | *Θ* | *Γ* | *Ω* | *Ψ* | *α* | Inference | Model | TB1 | TB2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Certificate of Bank Indonesia** | 4 | -1.848 | 0.0505** | -1.226** | -0.208** | 1.053* | -0.117* | -1.55E-05 | Non stationary | CC | Q4 1998 | Q1 2006 |
| | | -1.026 | 2.001 | -2.115 | -2.573 | 1.834 | -1.772 | -2.817 | | | | |
| **Government Bonds** | 8 | 3.993 | 0.103* | -1.326*** | 0.416*** | -1.057** | -0.582*** | 0.00E+00 | Non stationary | CC | Q4 1998 | Q1 2001 |
| | | 0.676 | 1.753 | -3.743 | 4.888 | -1.981 | -6.289 | -0.584 | | | | |
| **C&I Loans** | 5 | 0.642 | 0.015*** | -0.354*** | | -0.040*** | | -3.96E-07 | Non stationary | AA | Q4 1998 | Q1 2006 |
| | | 0.199 | 3.422 | -4.265 | | -3.867 | | -0.535 | | | | |
| **Demand Deposits** | 7 | 6.625 | 0.044** | 0.228** | -0.012*** | | | -2.98E-01 | Non stationary | IO2 | Q2 1998 | |
| | | 1.620 | 2.018 | 2.105 | -2.583 | | | -0.687 | | | | |
| **Time, Savings & Foreign Deposits** | 3 | -0.560 | 0.015*** | 0.247*** | | 0.061*** | | -1.67E-06 | Non stationary | AA | Q4 1997 | Q3 2000 |
| | | -1.297 | 7.958 | 9.885 | | 3.387 | | -3.971 | | | | |
| **Equity** | 8 | 36.47*** | 0.307*** | -1.289*** | | -0.032*** | | -5.06E-06 | Non stationary | AA | Q2 1998 | Q3 1999 |
| | | 8.946 | 9.614 | -7.252 | | -3.921 | | -3.580 | | | | |

All tests were performed on logarithmic values. The critical values for α at the 1% and 5% for Model IO2 are -5.68 and -5.05, respectively (Perron, 1997), and for models AA and CC are -7.34 and -6.82, respectively (Lumsdaine and Pappell (1997))

# Appendix B

# List of Banks

## State Owned Banks

1. PT Bank Ekspor Indonesia (Persero) Tbk
2. PT Bank Negara Indonesia (Persero) Tbk.
3. PT Bank Rakyat Indonesia (Persero) Tbk.
4. PT Bank Tabungan Negara (Persero) Tbk.
5. PT Bank Mandiri (Persero) Tbk.

## Regional Banks

1. BPD Kalimantan Selatan
2. BPD Kalimantan Timur
3. BPD Sulawesi Tenggara
4. BPD Yogyakarta
5. PT Bank DKI
6. PT Bank Lampung
7. PT Bank Kalteng
8. PT BPD Aceh
9. PT BPD Jambi
10. PT BPD Sulawesi Selatan
11. PT BPD Sumatera Barat
12. PT BPD Jawa Barat dan Banten
13. PT BPD Kalimantan Barat
14. PT BPD Maluku
15. PT BPD Bengkulu
16. PT BPD Jawa Tengah
17. PT BPD Jawa Timur
18. PT BPD Nusa Tenggara Barat
19. PT BPD Nusa Tenggara Timur
20. PT BPD Sulawesi Tengah
21. PT BPD Sulawesi Utara Sulut)
22. PT BPD Bali (BPD Bali)
23. PT BPD Papua
24. PT BPD Riau
25. PT BPD Sumatera Selatan
26. PT BPD Sumatera Utara

## Private National Banks

1. PT Bank Agroniaga Tbk.
2. PT Bank Antardaerah
3. PT Bank Artha Graha Internasional Tbk.
4. PT Bank Bukopin Tbk.
5. PT Bank Bumi Arta Tbk.
6. PT Bank Central Asia Tbk.
7. PT Bank Niaga Tbk.
8. PT Bank Danamon Indonesia Tbk.
9. PT Bank Ekonomi Raharja Tbk.
10. PT Bank Ganesha
11. PT Bank Hana
12. PT Bank Himpunan Saudara 1906 Tbk.
13. PT Bank ICB Bumiputera
14. PT Bank ICBC Indonesia
15. PT Bank Index Selindo
16. PT Bank Internasional Indonesia Tbk.
17. PT Bank Kesawan Tbk.
18. PT. Bank Lippo
19. PT Bank Maspion Indonesia
20. PT Bank Mayapada Internasional Tbk.
21. PT Bank Mega Tbk.
22. PT Bank Mestika Dharma
23. PT Bank Metro Express
24. PT Bank Muamalat Indonesia Tbk.
25. PT Bank Mutiara Tbk., formerly known as PT Bank Century Tbk.
26. PT Bank Nusantara Parahyangan Tbk.
27. PT Bank OCBC NISP Tbk.
28. PT Bank Bali
29. PT Bank Universal
30. PT Bank Prima Express
31. PT Bank Artamedia
32. PT Bank Patriot
33. PT Bank Sinarmas
34. PT Bank Swadesi Tbk.
35. PT Bank Syariah Mandiri
36. PT Bank Syariah Mega Indonesia
37. PT Bank UOB Buana Tbk.
38. PT PAN Indonesia Bank Tbk.
39. PT Anglomas Internasional Bank
40. PT Bank Andara, formerly known as Bank Sri Partha
41. PT Bank Artos Indonesia
42. PT Bank Barclays Indonesia, formerly known as Bank Akita
43. PT Bank Bisnis Internasional
44. PT Bank BRI Syariah

45. PT Bank Dipo International
46. PT Bank Eksekutif Internasional
47. PT Bank Fama Internasional
48. PT Bank Harda Internasional
49. PT Bank Harfa
50. PT Bank Ina Perdana
51. PT Bank Jasa Jakarta
52. PT Bank Kesejahteraan Ekonomi
53. PT Bank Mayora
54. PT Bank Mitraniaga
55. PT Bank Multi Arta Sentosa
56. PT Bank Royal Indonesia
57. PT Bank Sahabat Purba Danarta
58. PT Bank SBI Indonesia, formerly known as Bank Indomonex
59. PT Bank Sinar Harapan Bali
60. PT Bank Swaguna
61. PT Bank Tabungan Pensiunan Nasional Tbk.
62. PT Bank UIB
63. PT Bank Victoria International Tbk.
64. PT Bank Yudha Bhakti
65. PT Centratama Nasional Bank
66. PT Liman International Bank
67. PT Nationalnobu
68. PT Prima Master Bank

## Joint Venture Banks

1. PT ANZ Panin Bank
2. PT Bank Commonwealth
3. PT Bank Agris, formerly known as PT Bank Finconesia
4. PT Bank BNP Paribas Indonesia
5. PT Bank Capital Indonesia
6. PT Bank DBS Indonesia
7. PT Bank KEB Indonesia
8. PT Bank Maybank Indocorp
9. PT Bank Mizuho Indonesia
10. PT Bank OCBC Indonesia
11. PT Bank Rabobank International Indonesia
12. PT Bank Resona Perdania
13. PT Bank UOB Indonesia
14. PT Bank Windu Kentjana International Tbk., formerly known as PT Bank Multicor Tbk
15. PT Bank Sumitomo Mitsui Indonesia

## Foreign Banks

1. The Royal Bank of Scotland, formerly known as ABN AMRO Bank (RBS Indonesia)
2. Bank of America, N.A.
3. Bank of China Limited
4. Citibank N.A.
5. Deutsche Bank AG.
6. JP. Morgan Chase Bank, N.A.
7. Standard Chartered Bank
8. The Bangkok Bank Comp. Ltd
9. The Bank of Tokyo Mitsubishi UFJ LTD.
10. The Hongkong & Shanghai B.C.

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