How To Improve Bank Regulation in Indonesia: An Empirical Study of Optimal Bank Corrective Action Employing the Dynamic Contingent Claims Model

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Abstract

This study highlights how (sub-optimal) banking regulation in Indonesia can be improved with a view to enhancing the cost-effectiveness of banking regulation and social welfare, and preventing future financial instability. We employ the Fries, Mella-Barral, and Perraudin (FMP) model (1997) and analyse the model under a robust regulatory regime concept to provide a new framework for banking regulation. The FMP model adopts the cash flow approach instead of the frequency of audit approach, using the American call option approach. Maximum likelihood estimates in VAR and GARCH are applied to monthly data on the market returns and deposit values for relatively-large banks. The results show how the authorities in Indonesia can establish optimal closure rules for each bank, levy "fair" deposit insurance premiums, estimate optimal subsidies (for different deposit insurance premiums) and identify the banks' "imminence to bankruptcy".

JEL Classification:

Keywords: Banking Policy, Bank Closures, Bailouts, Deposit Insurance, Econometrics for Finance, Regulation, Risk Management.

1. Introduction

Diamond and Dybvig (1983), most notably, have suggested that there is social welfare to be gained from government intervention, and that deposit insurance can provide a solution to bank runs. Efficient banking regulation can be achieved only if it includes closure policies (Freixas and Rochet, 1999) which prevent moral hazard behaviour; in turn, they should enhance bank regulators' accountability. Yet, Basel II (Basel Committee, 2003) gives more

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discretion to domestic banking authorities and focuses more on the implementation of best practices of risk management. This creates a gap between the needs of efficient banking regulation and the objectives of Basel II, on the one hand, and between the current Indonesian bank regulation and the optimal bank regulation on the other. To fill the gaps, the FMP model (Fries, Mella- Barral, and Peraudin, 1997) - an optimal bank reorganization model - under a robust "regulatory regime" concept developed by Llewellyn, 1999c, is used to provide a framework for optimal banking regulation. Optimal bank reorganization aims at achieving efficient bank regulation, where bank regulators are assumed to act as social planners. It comprises closure rules and bailout policies arising endogenously through the interaction of two factors, namely regulators' attempts to minimize discounted, expected bankruptcy costs, and equity-holders' incentives to recapitalise banks. The shareholders will be allowed to continue to control the bank if the bank is well capitalized. In this paper, the cash flow approach to optimal bank financial reorganization is adopted. The subsidy policies for financially-ailing banks consider the implementation of socially-optimal closure rules at minimum financial cost to regulators and which reduce moral hazard. The FMP model implies that optimal bank reorganization requires a deposit insurance scheme. It involves capital and risk management as crucial factors.

Past academic and empirical studies focus on two main approaches to handling troubled banks, as summarized in Table 1. Firstly, there are the "early closure models" (ECM), as advised by Kane (1986) and adopted by the USA. He suggested a "more vicious approach to resolving the insolvent banks". Kane's approach arose due to the lessons learned from the Savings and Loans financial debacle in the early 80's, which cost the taxpayers 3% of America's output (Weinstein, 1998). Accordingly, under the USA Congress mandate (i.e., the FDIC Improvement Act of 1991), the Fed and the FDIC adopt a "prompt corrective action" approach, which requires bank regulators to impose more stringent rules on banks when the banks' capital ratios decline and to close promptly the banks with capital below critical triggers. A study conducted by Acharya and Dreyfus (1989), based on theoretical analysis under the assumption of a competitive environment, also concluded that financially-ailing banks should be closed promptly, even when their net worth is still positive. Secondly, there are "late closure models" (LCM), or so-called forbearance closure policies, as suggested by Allen and Saunders (1993) and Dreyfus et.al. (1994), who conducted studies of policies implemented by Japan and other countries. If the government allows the shareholders to keep their licenses and the right to control the ailing banks - due to positive net worth - the regulatory bodies gain the benefits in the form of reduced liabilities for the deposit insurance corporation; shareholders increase the banks' distance from closure and the regulatory bodies' preference to keep the ailing banks alive is satisfied. Such policies are based on a fundamental argument that because there are significant bankruptcy costs which are much greater than those involved in other industries, as shown by James (1991), the government's liabilities in the form of deposit guarantee values will be reduced substantially. Japan's policies, however, cost its taxpayers about $500 billion for bailing out the failing banks, which was around 10% of Japan's annual output (Weinstein, 1998). Under this model, the authors were confident theoretically that, by postponing the banks' closure, bank regulators will have less liabilities, which in turn means the tax-payers would also gain benefits through reduced exposure to bank failures.

In contrast, the FMP model adopts optimal bank reorganization rules. The FMP theoretical model and empirical results (Fries and Perraudin, 1994 and Fries, Mason and Perraudin, 1993) show that the authorities' optimal closure and bailout policies are determined by the interaction of regulators' attempts to minimize discounted, expected bankruptcy costs, and equity-holders' incentives to recapitalise banks.

Table 1: Past Studies of Closure Policies

Authors	Model specifications	Conclusions
Kane (1986), (Acharya and Dreyfus (1989)	Empirical model based on the Savings and Loans fiasco in the '80s. Theoretical model assuming the optimal closure rule minimizes the government's liability, consisting of: (i) discounted value of the bank's losses in the event of failure; and (ii) discounted cost of auditing the bank minus deposit insurance premia	Early Closure policies Prompt reorganization policies when a bank still has positive net assets
Allen and Saunders (1993), Dreyfus et.al. (1994)	Significant bankruptcy costs lead to forbearance closure policies to reduce government liabilities	Late closure policies
Fries and Perraudin (1994) and Fries, Mason and Perraudin (1993) and Fries, Mella-Barral and Perraudin (1997)	Theoretical and empirical models show that optimal authorities' closure and bailout policies are determined by the interaction of regulators' attempts to minimize discounted, expected bankruptcy costs, and equity holders' incentives to recapitalise banks. The policies are implemented by taking into account socially optimal closure rules at minimum financial cost to regulators and which reduce moral hazard problems.	Optimal bank closure policies

When a bank experiences financial difficulties, regulators take corrective measures in the form of bank reorganization or bank closure. The systemic risk argument, or domino effect theory, where bank problems may spread to the other banks, including healthy banks, may result in a bail-out by government (i.e. taxpayers) when shareholders are unable to inject adequate capital; whilst protection of small depositors, as an objective of financial regulation, must be met. This bail-out increases the government's budget deficit and is therefore reported to parliament, as the representative of the tax-payers. For example, for the four countries worst affected by the 1997/1998 East Asian Crisis (Indonesia, Korea, Malaysia and Thailand), the costs of bank recapitalization have been estimated at between 19% and 30% of GDP (World Bank, 1999). Bank regulators in Indonesia have implicitly adopted a blanket guarantee scheme - an implicit ad hoc deposit insurance scheme - to protect small depositors since the end of 1997, after a multi-dimensional crisis hit Indonesia at the start of July 1997, triggered by the decrease in the external value of the currency in Thailand resulting from currency speculation in the foreign currency markets. The crisis forced the Indonesian government to bail out the ailing banks (involving nearly all the banks) to the tune of Rp164, 536 trillion (Dendawijaya, 2001).

This research is an empirical study of the implementation of the FMP model in Indonesia using the American call option approach. Maximum likelihood estimates in VAR and GARCH are applied to monthly data on the market returns and equity and deposit values for relatively-large Indonesian banks, including regional banks and foreign banks. The results indicate that the authorities can establish an optimal closure rule for each bank, levy fair deposit insurance premiums that can be adjusted to take account of quantitative and qualitative factors, estimate optimal subsidies at different deposit insurance premiums, and identify the banks' imminence to bankruptcy.

The FMP model implies that the optimal bank reorganization involves a deposit insurance scheme. The results suggest a number of specific policy reforms. First, the authorities should limit deposit insurance premiums to be levied on the Indonesia banks to between zero and 30 basis points, ceteris paribus, depending on the banks' performance and financial condition, as measured by capital, earnings and the level of risk exposures analysed within an optimal closure policy if the bank regulators act as social planners. Second, although any subsidy (bail-out) given to a financially-ailing bank should be limited, bail-out can reduce social costs significantly, since an optimal subsidy policy takes into account the deposit insurance premiums, interest rates, banks' performance (i.e. returns and capital values), bankruptcy costs, and monitoring costs. Third, because the main determinants of the value of deposit guarantees to a bank are the volatility of the flow of the bank's returns per deposits (state variable) and the ratio of the state variable at the end of sample to the closure point, the banks and bank regulators should pay more attention to improve these performance measures by implementing an "enterprise risk management" framework (Venkat, 2000) which can enhance the shareholders' value. Fourth, since the "imminence to bankruptcy" can be identified for each bank, the authorities should allocate resources to monitor more closely and draft action plans to reorganize those most likely to face imminent bankruptcy, thereby raising the cost-effectiveness of banking regulation. Fifth, the bank regulators should also consider the establishment of an explicit deposit insurance scheme to protect small depositors and to reduce systemic risk in the form of bank panics (which can infect healthy banks) and disruptions to the payments system. Finally, bank regulators in Indonesia should refocus their strategies to develop banking regulation and supervision based on the optimal bank regulations derived in this study, and to develop the banking industry based on the enterprise risk management framework.

The paper is structured as follows. In Section 2, we describe optimal bank regulation in theory and practice. In section 3, we discuss optimal bank corrective action and the dynamic contingent claims model. Section 4 represents an application of the dynamic contingent claims model to the Indonesian banking industry. Section 5 explains the implications of the results of the empirical study for bank regulatory policy in Indonesia. Lastly, Section 6 contains our summary and conclusions.

2. Optimal Bank Regulation in Theory and Practice

2.1 Background

While financial institutions play a vital and ever-increasing role in every economy (Greenspan, 1996; Kelley, 1996; and Dewatripont and Tirole, 1999), the costly and large-scale banking sector problems evident in many countries during the last fifteen years have shown that they remain fragile (see for example Lindgren et.al., 1996). The scale of such problems has been the greatest since the Great Depression of the 1930s, as noted by Goodhart et.al. (1999), Llewellyn (1999a) and Kaufman (1996). Demirguc, Kunt and Detragiache (1998) found that banking crises emerge when the macroeconomic environment is weak, and that indicators of financial liberalization are positively and significantly related to the probability of banking crises occurring. Financial crises throughout the world indicate very powerfully two common characteristics; weak internal risk analysis, management and control systems, and weak (or even perverse) incentives within the financial system generally and financial institutions in particular. Almost always and everywhere banking crises are a complex interactive mix of economic, financial and structural weaknesses (Llewellyn, 1999a).

Llewellyn (1997) states that sound economic development requires two things: an efficient financial system and a stable, robust financial system. Williamson and Maher (1998) and Kaminsky and Reinhart (1998) found an empirical link between financial liberalisation and financial crises. They showed that almost all of their sample of 34 economies that undertook financial liberalisation between the beginning of the 1980's and mid 1997 subsequently experienced some form of systemic financial crisis. These findings would appear to be valid for Indonesia, as financial liberalisation was launched with a packet of deregulation measures in October 1988 (Bank Indonesia, 1988) and the economy started suffering a financial crisis in mid-1997.

2.2 The Rationale of Financial Regulation

There has been a widespread rethinking of financial regulation and supervision. Many "free banking" economists, such as Dowd (1996a,b) and Benston and Kaufman (1996), argue that these crises and problems are due to the effect of misguided regulatory efforts. Consistent with the views of Freixas and Rochet (1999), Dewatripont and Tirole (1999), Goodhart et.al. (1999), Dale and Wolfe (1998), Kelley (1996) and Kane (1996), financial regulation is generally used to protect the consumers against monopolistic exploitation, to provide smaller, retail (or less informed) clients with protection, to ensure systemic stability, to reduce the social costs of a financial firm failure and to promote an efficient and effective banking system that supports economic growth (see also the theoretical welfare economics of A.C. Pigou (1932) and Paul Samuelson (1947)). Following Llewellyn (1997), regulators should recognize four general propositions before setting out their regulatory frameworks. Firstly, there are important distinctions to be drawn between regulation, monitoring (observing whether the rules are obeyed) and supervision. Secondly, regulators supply regulatory, monitoring and supervisory services to various stakeholders that might have different demands. Thirdly, regulation imposes a range of costs, and regulators are risk averse. Regulators should avoid the misperception that regulation is costless. Fourthly, regulators may change the behaviour of regulated firms by imposing external rules or through creating incentives for firms to behave in a particular way.

The regulated institutions behave in a way which is consistent with the "representation theorem", whereby to deliver systemic stability and social objectives, a "contract" between the regulators and regulated firms is created[1]. There are seven components of the economic rationale for regulation and supervision in banking and financial services: (1) the systemic risk of bank runs might trigger a contagion effect that creates bank panics; (2) regulations are needed to counteract market imperfection and failures; (3) depositors are unable to monitor the financial firms and /or the cost and volume of monitoring activity is prohibitive; (4) consumers need confidence in the financial institutions with which they deposit; (5) there is the potential for "gridlock" for two reasons; adverse selection problems and moral hazard problems; (6) safety net arrangements, in the form of a lender of last resort or a deposit insurance /compensation scheme, can create moral hazard problems for both consumers and banks; (7) consumer demand for lower transaction costs requires regulation.

Analytical approaches to bank regulation comprise the "regulation design" approach and the "regulation analysis" approach (Freixas and Rochet, 1999); both aim to prevent excessive risk-taking by banks yet avoid moral hazard through the use of regulatory instruments, such as cash reserve requirements and bank disclosure policy (Bhattacharya, Boot, Thakor, 1998; Dewatripont and Tirole, 1999; and Stiglitz, 1994). The regulation analysis approach is aimed at analysing the consequences of a given regulation that either exists or is under study by the regulatory authorities. Goodhart et.al. (1999) and Llewellyn (1999b) suggest two types of financial regulation: (i) prudential and systemic regulation; and (ii) conduct of business regulation.

It is clear that systemic issues are central to the regulation of banks as banks are always threatened by a bank run, a danger that can spread to other banks causing large-scale bank panic[2]. Moral hazard problems arise because of the safety net arrangements and need to be suppressed by regulators and Central Bankers[3]. In this regard, advances in risk management

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[1] The representation theorem is adopted widely by, for example, Dewatripont and Tirole (1999); and Fries et.al. (1997). It requires regulators to represent the depositors by intervening in banks when they hit certain capital thresholds.

[2] In theory, bank runs are distinguished from bank panics. Bank runs happen when depositors observe large withdrawals from their banks; they fear bankruptcy and respond by withdrawing their own deposits. The excessive withdrawals can generate an externality for the bank suffering the liquidity shortage, since they imply an increase in the bank's probability of failure. But they can also generate an externality for the whole banking system if the agents view the failure as a symptom of difficulties occurring throughout the industry. Bank runs affect an individual bank, and bank panics affect the whole banking industry.

[3] Goodhart et.al (1999) quote Governor Kelley of the Federal Reserve Board: It is probably fair to say that there is considerable agreement among Central Bankers and other economic policy-makers that (bank's) unique balance sheet structure creates inherent potential instability in the banking system. Rumours concerning an

theory and practices are a challenge for regulators to improve their regulation, monitoring and supervision (Kelley, 1996).

Banks, however, function in a modern economy because of four reasons (Gurley and Shaw, 1960; Benston and Smith, 1976; and Fama, 1980). Firstly, banks are involved in the transformation process of financial contracts and services in two ways, that is term transformation and the payments system, which leads to a lowering of costs. Secondly, a bank is regarded as a pool of liquidity that provides depositors with a liquidity insurance against idiosyncratic shock and the customers' needs can be satisfied by the banks. This is the basis of a fractional reserve system in which some portion of deposits can be used to finance profitable but illiquid investments that contain a source of fragility when depositors withdraw their deposits for reasons other than liquidity needs (Bryant, 1980; Diamond and Dybvig 1983). Thirdly, a bank functions as a delegated monitor for depositors. The basis of delegated monitoring is asymmetric information and the moral hazard problem, as discussed firstly by Diamond (1984). Fourthly, a bank functions as an information-sharing coalition. Leland and Pyle (1977) argue that borrowers can obtain benefits (i.e. better financing conditions) when they form a coalition, provided they are able to communicate truthfully the quality of their projects within the coalition.

On the other hand, regulators and supervisors face problems in achieving the objectives of regulation for three reasons. Firstly, the players of the banking system (i.e. regulators, financial intermediaries, borrowers, and depositors) are always faced with asymmetric information problems. Free-riding depositors need to be represented by external bodies i.e. regulators[4]; and the true condition of the banks is difficult to ascertain because of accounting lags. Secondly, there are difficulties in ensuring that banks meet the set regulations. Not only regulators but also the market can monitor the compliance level of banks. Thirdly, the nature of finance is necessarily risky.

Risk management and measurement have evolved significantly since the Basel Accord (Basel I) was adopted in 1988[5], as noted in Basel II (Basel Committee, 1999). Basel II proposes (it was agreed in June 2004) a three-pillared approach to bank regulation, namely improved minimal capital requirements, market discipline, and supervisory review. Three

individual bank's financial condition (can spread); if the distressed institution is large or prominent, the panic can spread to other banks, with potentially debilitating consequences for the economy as a whole".

[4] The free-riding problem and asymmetric information associated with regulation lead to the representation hypothesis. The representation hypothesis is an idea of banking regulation, which is explored in depth by Dewatripont and Tirole (1999).

distinct methods for the calculation of minimal capital were proposed. A standardised approach geared towards smaller banks was proposed. Exposures to different counterparties would be quantified in terms of risk weights based on assessments by external rating agencies, which are more sensitive to risks than in previous risk-bucketing plans. For more sophisticated banks, two internal rating-based approaches to credit risk have been devised - the foundation and advanced - that allow greater use of a bank's own internal credit risk models. The Basel Committee intended to tailor regulations so that banks are encouraged to migrate towards the more sophisticated approaches, and these new approaches allow bank regulatory capital to follow more closely economic capital calculated using the banks' internal models. Others, however, argue that bank regulators and banks should focus on the implementation of an integrated (or enterprise) risk management approach instead of the traditional risk management approach (Risk, 2003). There, however, is no guarantee that all risks can be removed by the regulators. Therefore, banks have the responsibility to identify, measure and control the risks using the enterprise risk management framework. The role of the regulators, on behalf of depositors, meanwhile is to limit the idiosyncratic shocks to reduce the probability of macroeconomic shocks that can threaten the payment systems and result in taxpayers facing substantial payouts because of the safety net arrangements (Kelley, 1996; Diamond and Dybvig, 1983; Bhattachrya and Gale, 1987).

2.2. Optimal Bank Regulation

As noted above, the policy justification for banking regulation principally encompasses three main principles: (i) to ensure the safety and soundness of banks in order to prevent systemic risk, and to maintain payment systems (Merton (1979) and Edwards and Scott (1977) also note that the soundness of individual banks provides assurance to depositors and borrowers that promotes public welfare); (ii) to promote an efficient and effective banking system that supports economic growth; and (iii) to protect small depositors who do not have incentives to, or lack experience in, monitoring banks. As a result, depositors need a regulator to represent their interests as financial institutions play a major role in capital formation and distributions. Vojta (1973), however, noted that their performance, operations and decision-making have been seriously distorted by arbitrary regulations.

Regulators, however, should bear in mind two factors: (i) that banking regulations appear to involve diverse issues and cover heterogeneous firms so that no one model can suit all

[5] For further analysis, see a comprehensive discussion provided by Hall (1989).

circumstances; and (ii) banking regulation is widely viewed as being fully evolved, although many issues remain unsolved (Bhattachrya, Boot, Thakor, 1998). One of the evolutionary factors affecting banking regulation has been the evolution of risk measurement and the management approach, in particular since the Basle Accord was adopted in 1988 (McDonough, 1998).

Following Llewellyn (1999c), external regulation is only one of seven components of a "regulatory regime" (RR) necessary to create a safe and sound banking system. The RR should comprise seven components: (1) the **rules** established by regulatory agencies (the regulation component)**;** (2) **monitoring and supervision** by regulatory agencies**;** (3) the incentive structures faced by regulatory agencies, consumers and, most especially, regulated firms; (4) **market discipline and monitoring;** (5) intervention arrangements in the event of compliance failures of one sort or another; (6) **corporate governance** in financial firms; and (7) disciplining and accountability arrangements applied to regulatory agencies (Appendix 1 provides a summary of the seven components in the form of the 25 principles of the RR). The seven components of the RR should be combined in an overall regulatory strategy and all components are necessary; none is sufficient. Should regulatory agencies emphasize only one component, it may weaken one or more of the other components that may reduce their overall impact. The key factor to optimising the effectiveness of a regulatory regime is the portfolio mix of the seven core components, and the optimum combination of the components would change over time. We analysed optimal bank regulation under the RR, particularly in relation to optimal bank corrective action (FMP model). As noted in Table 2 the RR has similar features to the FMP model, so that the FMP model and the RR support each other in developing optimal bank regulations.

2.3 Regulation Instruments

The safety and soundness instruments of bank regulation comprise five broad types: (i) deposit interest rate ceilings; (ii) restrictions, such as entry/exit policy, branching, network restrictions, narrow banking, merger restrictions and portfolio restrictions; (iii) risk-based capital requirements; (iv) a deposit insurance system; and (v) regulatory monitoring, including closure policies and accounting policies (Freixas and Rochet, 1999; Battacharya, Boot, Thakor, 1998; Dewatripont and Tirole, 1999). Consequently, the banking system needs safety net arrangements to address the implications of bank failures. These arrangements typically comprise, firstly, a lender of last resort (ideally following Bagehot's (1873) principles, which include lending to only illiquid but solvent financial institutions, subject to a penalty rate, backed by good collateral, and announced to financial institutions in advance) to lessen the systemic risk by way of monitoring the banks' solvency and protecting the payments system (Aharony and Swary, 1983; Humprey, 1986; Guttentag and Herring, 1987; Herring and Vanhundre, 1987, and Saunders, 1987)[6]. This requires a distinction to be drawn between liquidity and solvency problems, where liquidity support is to be seen as a privilege and not a right, and to be used alongside open market operations. Secondly, bank regulators and central banks need mechanisms to reduce moral hazard problems as they arise. Thirdly, there is a need for a deposit insurance system, conducted by the public or private, or a combination of both. Fourthly, banking regulation and supervision should always be present.

Table 2: A Comparison of the Analytical Features of the Optimal Corrective Action Models and the Regulatory Regime Concept

The Elements of the RR Concept	The Elements of the FMP Model
1. Rules	- Closure rules - Subsidy or bailout rules - Capital regulations - Principles of risk management
2. Monitoring and supervision	Costs of monitoring
3. Incentive structures	- Equity holders' willingness /unwillingness to keep banks operating by injecting capital. - Moral hazard problems
4. Market discipline	-Bankruptcy cost generated from the externalities in the financial system - Stock prices -Disciplining of depositors, shareholders and regulators, including deposit insurance institutions - Interest rates
5. Intervention arrangements	-Intervention rules -Subsidy rules
6. Corporate Governance	-Equity-holders' willingness to keep their banks going - The basic model focuses on total net cash-flow available to bank shareholders - Principles of risk management
7. Disciplining and accountability applied to regulatory agencies.	- Subsidy rules - Socially efficient closure rules - Capital regulations

Source: Llewellyn (1999c) and Fries, Mella-Barral and Perraudin (1997).

[6] For instance, Miron (1986) found that, in the period after the founding of the Federal Reserve in the US with its role as a lender of last resort, the frequency of bank panics tended to be less than prior to its founding (i.e. 1914). He makes a simple test by using a Bernouli distribution. He estimates that prior to the founding of the Fed, the probability of having a panic during a given year was 0.316. This implies that the probability of having no bank panic during the fourteen years 1914-1918 was only 0.005. He rejects the hypothesis of no change in the frequency of panics at a 99 per cent level of confidence. However, the period 1929-1933 in the US economy shows the adverse results of the inappropriate use of the LLR. Friedman and Schwartz (1963) and Meltzer (1986) stated that the Central Bank neither conducted the open market operations necessary to provide liquidity insurance for illiquid banks nor followed the Bagehotian Principles. In the UK, before 1866, the Bank of England was reactive to protect its own gold reserves, which could worsen panics. After that year, by adopting Bagehot's principles, the UK was able to prevent crises in 1878, 1890, and 1914 from bank panics, by timely announcement and corrective measures (Bordo, 1990)

3. Optimal Bank Corrective Action within the Dynamic Contingent Claims (FMP) Model

When a bank experience financial difficulties, regulators must take corrective measures or reorganize the bank under an appropriate regulatory framework. There are two polar approaches to handling a troubled bank: (i) early closure (Kane, 1986); and (ii) late closure (Allen and Saunders, 1993). Under the early closure approach, the regulator takes actions to generate the "fair" deposit insurance premium and the optimal closure rules for the troubled banks (Acharya and Dreyfus, 1989). Proponents suggest the regulators should typically close the troubled banks while they still have positive net assets. In the USA, under a US Congress mandate (i.e., the FDIC Improvement Act of 1991), the Fed and the FDIC adopt a "prompt corrective action" approach, which requires bank regulators to impose more stringent rules on banks when their capital ratios decline and to close promptly the banks with capital below critical triggers. In contrast, under the late closure approach, involving the well-known "regulatory forbearance", the corrective measures are taken by regulators because there exist significant bankruptcy costs that may actually reduce the regulators' liability in the form of the value of the authorities' deposit guarantee liability.

Fries, Mella-Barral and Perraudin (1997) developed the Dynamic Contingent Claims Model to studied the optimality of different closure policies and their impact on deposit insurance based on a basic equation of total net cash flow available to bank equity-holders (the FMP model). They studied a series of different possible closure rules and subsidy policies through the interaction of: (i) regulators' attempts to minimize discounted, expected bankruptcy costs; and (ii) equity-holders' incentives to recapitalise banks. They define subsidy policies for distressed banks that implement socially-optimal closures rules at minimum financial cost to regulators and which reduce moral hazard. They developed two models: (i) the endogenous closure rule models; and (ii) the endogenous bail out models. The model has been used to study optimal bank reorganizations in the USA (Fries and Perraudin, 1994) and in Japan (Fries, Mason and Perraudin, 1993).

3.1 Fundamental Equations

The FMP model, initiated by Allen and Saunders (1993), studies the optimality of different closure policies and their impact on deposit insurance. Under the FMP model, bank corrective action is undertaken at a closure rule when a bank's equity is at a maximum. According to the model, *the value of the bank's equity*, U_t, equals $U(k_{t,}D_t) = V(k_t)D_t$ which is a function of the state variable $k_t \left[\equiv g_t / D_t \right]$, where:

$$V(k_t) = \frac{k_t}{s-\mu_g} - \frac{s+y}{s-\mu_D} - \left[\frac{\underline{k}}{s-\mu_g} - \frac{s+y}{s-\mu_D} \right] \left(\frac{k_t}{\underline{k}} \right)^{\lambda} \tag{1}$$

where,

U_t = market value of the bank's equity

g_t = the cash flow of risky interest income

s_t = the safe rate of interest

D_t = the bank's total deposits

γ = the deposit insurance premium the banks pay the government

V_t = the bank's equity to deposits ratio

μ_g = drift parameter of *g*

μ_D = drift parameter of *D*

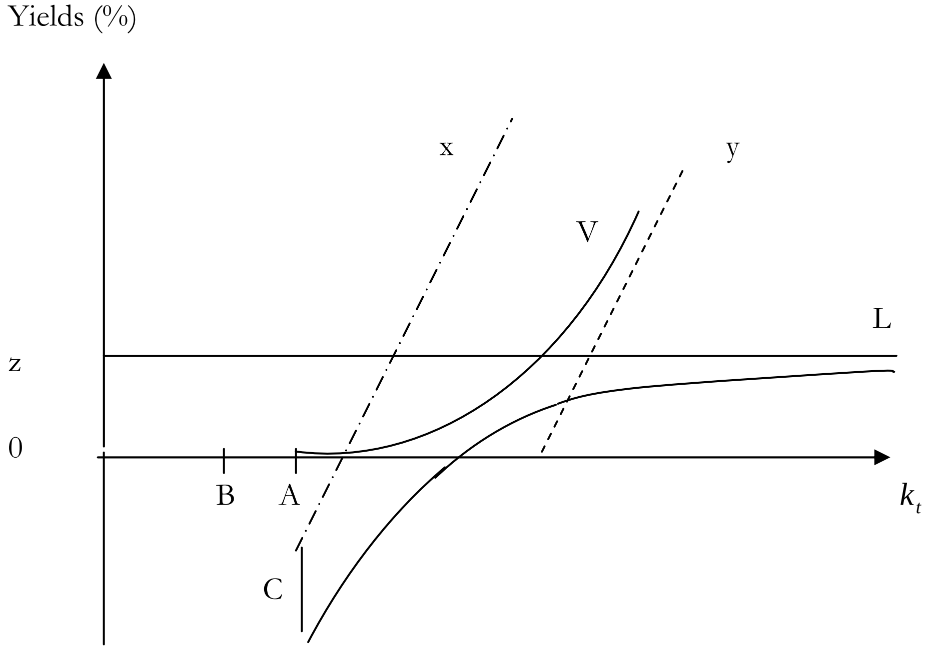
$\underline{k}$ = the trigger level of k_t for closure

λ (i.e. the probability of an increment in time) is the negative root of $\lambda^2\sigma_k^2/2 + \lambda(\mu_g - \mu_D - \sigma_k^2/2) - (s-\mu_{D)} = 0, \mathit{and}\ \sigma_k \equiv \sqrt{\sigma_g^2 + \sigma_D^2 - 2p\sigma_g\sigma_D}$ is the instantaneous standard deviation of k_t.

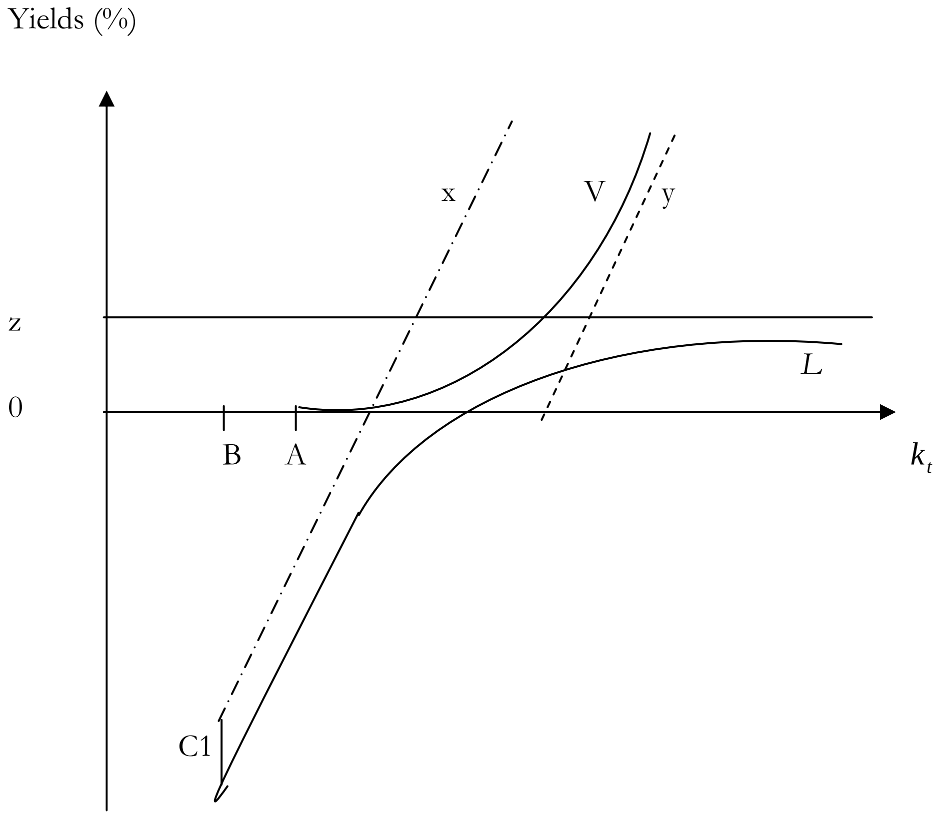
Bank value may approach an unlimited value because the possibility of bankruptcy will be smaller and smaller as k_t gets bigger and bigger. Graphically, the bank's per deposit equity value V_t becomes asymptotic in k_t as $k \rightarrow \infty$, as can be seen in Figures 1.a and 1.b. The figures are the results of a simulation using dummy data to show a bank's per deposit equity value, V_t, the government's liability, *L*, and the subsidy, $b_m(k_t)$. Figure 1.a indicates the graph of the bank's equity to deposits ratio, V_t, which is a function of the state variable, k_t (see Equation 1), when no subsidies are given. If the k_t hits the trigger closure point, $\underline{k}$, then the bank's value, V_t (and U_t) equals zero. In contrast, if the $k_t \rightarrow \infty$, then the V_t asymptotically approaches the unlimited liability value, as represented by the straight line part of $\frac{k_t}{s-\mu_g} - \frac{s+y}{s-\mu_D}$ (or line y).

Figure 1 Endogenous Closure Rule and Bailout Models

a. No Subsidies given



b. Subsidy policy adopted



Source: Fries, Mella-Barral and Perraudin (1997).

Notes on Figure 6.1:

$$x = \frac{k_t}{s-\mu_g} - \frac{s}{s-\mu_D} \quad \text{from equation (1)}$$

$$y = \frac{k_t}{s-\mu_g} - \frac{s+y}{s-\mu_D} \quad \text{from equation (1)}$$

$$z = \frac{y-\xi_m}{s-\mu_D} \quad \text{from equation (2)}$$

A = $\underline{k}^*$; B = $\underline{k}^{**}$; C = C($\underline{k}^*$); and C1= C($\underline{k}^{**}$)

Note that if the k_t is still just above the $\underline{k}$, i.e. $k_t > \underline{k}$, then earnings are negative. This means that the shareholders must be moving the point $\underline{k}$ to a point such as $\underline{k}$* (or point A) and even $\underline{k}$** (or point B) by injecting fresh funds into the bank to keep the bank liquid.

At this stage, however, the shareholders face another investment choice, which is investment in safe assets (or risk free investment), such as US Government Treasury Bills, so why do they recapitalise the bank? The answer is that the bank's shareholders invest the funds in the ailing bank in the hope of making capital gains, and the curvature of *V*(k_t) increases the likelihood of making capital gains.

Figure 1.b depicts the closure rule with a subsidy provided by the authorities rather than a capital injection from the shareholders. The effect is that the government's liabilities increase, so that the bankruptcy cost per unit of deposit becomes C($\underline{k}$**), rather than the C($\underline{k}$*) depicted in Figure 1.a, at closure point $\underline{k}$**.

Turning our attention to the *deposit insurance corporation's claim*, *L*, [equals the government's deposit insurance liability, $M(k_{t,} D_t) = L(k_{t,})D_t$], this is given by:

$$L(k_t) = \frac{y-\xi_m}{s-\mu_D} + \left[\frac{\underline{k}^*}{s-\mu_g} - \frac{s+y-\xi_m}{s-\mu_D} - c(\underline{k}^*)\right]\left(\frac{k_t}{\underline{k}^*}\right)^{\lambda} \qquad (2)$$

where,

ξ_m = monitoring cost per dollar of deposit if a bank keeps operating and

$c(\underline{k}^*)$ = bankruptcy cost at the closure point

And the *actuarially fair, constant deposit insurance premium rate*, y_f, is given by:

$$y_f = -(s-\mu_D)\left[\frac{\underline{k}}{(s-\mu_g)} - \frac{s}{s-\mu_D} - c(\underline{k})\right]\frac{(k_0/\underline{k})^{\lambda}}{1-(k_0/\underline{k})^{\lambda}} + \xi_m \tag{3}$$

where k_o is the level of the state variable at t=0

A fair flat deposit insurance premium rate for a bank subject to the authorities' choice of optimal closure, $\underline{k}$, is therefore a function of k_0, the value of the bank, $V(k_0)$, bankruptcy costs, $c(\underline{k})$, and monitoring costs, ξ_m. Bankruptcy costs, or so-called deadweight costs, are the expected value of administrative and legal costs borne by the authorities in reorganizing the bank when the bank fails to generate earnings.

3.2 Closure Rules

In setting the closure rules, it is assumed the regulator cannot inject subsidies to maintain a troubled bank as a going concern, at closure point, $\underline{k}$, and that the deposit insurance premium, *y*, is held constant; and if the shareholders inject new capital, it becomes "a binding constraint" (i.e. the authorities postpone closing a bank) on banking policy. Furthermore, if regulators act as social planners, they will select $\underline{k}$, to minimize the discounted, expected lump-sum bankruptcy and monitoring costs, ignoring the additional cost to the insurance corporation (i.e. Government) of taking on the bank's portfolio of deposits and loans. This means that the *unconstrained* socially optimal closure rule $\underline{k}^{**}$ can be written mathematically as:

$$\underline{k}^{**} \equiv \arg\min\left\{ c(k)\left(\frac{k_t}{\underline{k}}\right)^{\lambda} + \frac{\xi_m}{s-\mu_D}\left(1-\left(\frac{k_t}{\underline{k}}\right)^{\lambda}\right)\right\} \tag{4}$$

where,

$\left(\frac{k_t}{\underline{k}}\right)^{\lambda}$ = the value of an asset that pays out one dollar the first time the process k_t hits $\underline{k}$,

and $D_t\xi_m/(s-\mu)$ = the capitalised value of an income flow that pays a perpetual income stream $D_t\xi_m$.

Meanwhile, the *constrained* (i.e. depending on equity-holders' willingness to recapitalise a troubled financial institution) socially optimal closure rule is $\hat{\underline{k}} \equiv \max\{\underline{k}^{**}, \underline{k}^{*}\}$, where $\underline{k}^{*}$ is the closure rule that maximizes the bank's equity value. This, mathematically, follows the partial derivative rules for optimisation (Jacques, 1999) of the function of a bank's equity value, V_t, i.e. setting $V^{'}(\underline{k})$ equal to 0 and proving the second derivative is negative for all k_t.

Thus, given equation 1 and taking a partial derivative of equity value V with respect to $\underline{k}$ yields:

$$\frac{\partial V}{\partial \underline{k}} = \frac{-1}{s-\mu_g}\left(\frac{k_t}{\underline{k}}\right)^{\lambda} + \left(\frac{\underline{k}}{s-\mu_g} - \frac{s+\gamma}{s-\mu_d}\right)\left(\frac{k_t}{\underline{k}}\right)^{\lambda}\frac{\lambda}{\underline{k}}.$$

Setting this equals to 0 yields:

$$\left(\frac{\underline{k}}{s-\mu_g} - \frac{s+\lambda}{s-\mu_D}\right)\frac{\lambda}{\underline{k}} = \frac{1}{s-\mu_g} \tag{5}$$

Therefore, we find the closure rule that maximizes the bank's equity value is

$$\underline{k}^{*} = \left(\frac{-\lambda}{1-\lambda}\right)\left(\frac{s-\mu_g}{s-\mu_D}\right)(s+y) \tag{6}$$

assuming the second derivative is negative for all k_t.

For different parameters' values, the constraint $\hat{\underline{k}} = \underline{k}^{*}$ may or may not bind. For an example of when it does, suppose C is independent of $\underline{k}$ and $c\rangle \xi/(s-\mu_D);$ then regulators would like to postpone closure indefinitely as $\underline{k}^{**}$, the unconstrained socially optimal closure rule, equals 0. The constrained optimum $\hat{\underline{k}}$, however, would be $\underline{k}^{*}$.

In certain circumstances, for example, when bankruptcy costs are independent of profitability and monitoring costs are low, the authorities will postpone the closure of the bank until after the point at which equity-holders are willing to keep the bank liquid by injecting capital. In another form of corrective action, the bank is closed and the government liquidates its deposits so that the bank can be sold to investors to keep it operating as a going concern. The trade off between closing early to avoid monitoring costs and closing late so as to put off meeting the costs of bankruptcy is given by:

$$\frac{d\underline{k}^{**}}{d\xi_m}\rangle 0$$

and $\frac{d\underline{k}^{**}}{d\xi_0}\langle 0$ (7)

where,

ξ_m represents monitoring costs and

ξ_0 represents fixed backruptcy costs.

In other words, if shareholders inject new capital, the optimal unconstrained closure point, $\underline{k}^{**}$, is increasing in monitoring costs and decreasing in fixed bankruptcy costs per dollar of deposits. If the deposit insurance premium, y, is held constant, the constrained closure point, $\underline{k}^{*}$, is unaffected by changes in either monitoring cost, ξ_m, or fixed bankruptcy costs, ξ_0. If y is adjusted in an actuarially fair manner and is increasing in ξ_m and ξ_0, then $\underline{k}^{*}$ is increasing in both ξ_m and ξ_0.

3.3 State-dependent Subsidy Rules

The first thing to determine is the amount of subsidy (or bailout policy), $b_*(k_t)$, that implements the closure rule, $\underline{k}^{*}$, whilst minimizing the deposit insurance corporation's financial liability.

Let $b_*(k_t)$ be a subsidy policy given by:

$$b_*(k_t) \equiv \begin{cases} -k_t + (s+y) + \nu & \forall k_t \in (\underline{k}^{**}, \underline{k}^{*}) \\ 0 & \forall k_t \geq \underline{k}^{*} \end{cases} \tag{8}$$

where $\nu > 0$ is an arbitrarily chosen small number.

The value of the equity and the deposit insurance corporation's liability when the authorities adopt the subsidy policy $b_*(k_t)D_t$, are $U_i(k_{t,}D_t) = V_i(k_t)D_t$ *and* $M_i(k_t, D_t) = L_i(k_t)D_t, i = 1,2,$ respectively for two intervals $I_1 \equiv [\underline{k}^{**}, \underline{k}^{*}]$ and $I_2 \equiv [\underline{k}^{*}, +\infty]$ where one value of the bank's equity to deposit ratio equals zero, $V_1(k_t)$ =0, and the other value, $V_2(k_t)$, is as given in equation (1). The value of the deposit guarantee corporation's claim per dollar of deposit insured, *Li*, differs significantly from the value obtained without subsidies. The value of the deposit insurance liability is then given by:

$$L_i(k_t) = \frac{k_t}{s-\mu_g} - \frac{s+\xi_m}{s-\mu_D} - \left(c(k^{**}) - \frac{\xi_m}{s-\mu_D}\right)\left(\frac{k_t}{k^{**}}\right)^{\lambda} \quad \text{, and} \tag{9a}$$

$$L_2(k_t) = \frac{y-\xi_m}{s-\mu_D} + \left[\frac{k^*}{s-\mu_g} - \frac{s+y-\xi_m}{s-\mu_D} - c(k^{**})\right]\left(\frac{k_t}{k^*}\right)^{\lambda} \tag{9b}$$

It should be noted that: (i) $\underline{k}^{*}$ is a reversible switch point in that the possibility remains that the bank will recover at any time up to the first occasion on which k_t reaches $\underline{k}^*$; and (ii) the net discounted costs of bankruptcy and monitoring are strictly smaller than for the case without subsidy, since $\underline{k}$** is chosen to minimize these costs. This means that subsidizing the bank is actually cheaper for the authorities than letting it close. Consequently, given the deposit insurance premium rate, *y*, the authorities' deposit insurance liability under the subsidy rules, $b_*(k_t)$, is strictly less than their liability would be if the closure point that has been moved to the point of $\underline{k}^{**}$ is still less than the previous closure point, $\underline{k}^*$; regulators are thus unable to subsidize ailing banks if $\underline{k}^{**} \langle \underline{k}^*$ and $L_i(k_t) \rangle L(k_t)$, for the two intervals $i = 1,2$.

The subsidy rule, $b_m(k_t)$, that (i) supports a given closure rule, $\underline{k}$, (ii) eliminates moral hazard problems, and (iii) is fairly priced at the time zero level of the state variable, $k_{0,}$ is also set out in the FMP model. Specifically, it is given by:

$$b_m(k_t) = y + \left(\frac{s-\mu_g}{k_0 - \underline{k}}\right)\left[\frac{\underline{k}}{s-\mu_g} - \frac{s}{s-\mu_D} - c(\underline{k})\left(\frac{k_0}{\underline{k}}\right)^{\lambda} - \frac{\xi_m}{s-\mu_D}\left(1-\left(\frac{k_0}{\underline{k}}\right)^{\lambda}\right)\right]\left\{k_t - \underline{k}\left(\frac{s-\mu_D}{s-\mu_g}\right)\right\} -$$

$$\underline{k}\left(\frac{s-\mu_D}{s-\mu_g}\right) + s \tag{10}$$

where $\underline{k}$ is chosen by the regulators to be high or low, which in turn is connected to the existence or not of moral hazard problems, as defined. This means that: (i) if the regulators adopt a given closure rule, $\underline{k}$, while charging an actuarially fair constant deposit insurance premium, y_f, the moral hazard problem is higher than without providing subsidies; and (ii) the state-contingent subsidy, $b_m(k_t)$, that eliminates the moral hazard problems and supports the closure rule, $\underline{k}$, decreases when the state variable, k_t, increases. Accordingly, if the bank's performance is poor, which is represented by the state variable, k_t, the subsidy will keep the bank's equity greater than the related state variable, k_t, and will depend on the level of deposit insurance premium, y, and closure point, $\underline{k}$, chosen by the regulator; but moral hazard exists. The subsidy should be treated as an equity support scheme adopted by regulators at minimum cost. Certainly, the deposit insurance premium may be expected to get higher when the bank's financial performance is poor.

For shareholders, however, this kind of subsidy policy may be unattractive because it involves considerable intervention by the regulators, who pay the bank positive or negative subsidies for a wide range of k_t values. To overcome this problem, an equity support scheme implemented by the regulators at minimum cost to the deposit insurance agency can adopt a subsidy function $b_m(k_t)$, which ensures that $V(k_t) \geq \eta\left(k_t - \underline{k}^{**}\right)$ for some constant η >0. The subsidy policy $b_m(k_t)$ will be defined by:

$$b_\eta(k_t) \equiv \begin{cases} \left[\eta(s-\mu_g)-1\right]k_t + s + \gamma - (s-\mu_D)\eta k^{**} + \nu & \forall k_t \in \left(\underline{k}^{**}, k_B\right) \\ 0 & \forall k_t \geq k_B \end{cases} \tag{11}$$

where the closure rule with subsidy is given by:

$$k_b = \frac{-\lambda}{1-\lambda}\left[\frac{s+y}{s-\mu_D} - \eta\,\underline{k}^{**}\right]\left[\frac{1}{s-\mu_g} - \eta\right]^{-1} \tag{12}$$

and where η > 0 is an arbitrarily chosen small number. The value of the bank's equity and the deposit insurance corporation's liability under the subsidy rule, $b_n(k_t)$, are defined as $U_i(k_{t,}D_t) = V_{i(}(k_t)D_t and\ M_i(k_t, D_t) = L_i(k_t)D_t, i = 1,2,$ respectively for the two intervals $I_1 \equiv \left[\underline{k}^{**}, k_b\right]$ and $I_2 \equiv \left[k_b, +\infty\right]$. Fries, Mella-Barral and Perraudin (1997) also note that:

$$V_1(k_t) = \eta\left(k_t - \underline{k}^{**}\right), \tag{13}$$

$$V_2(k_t) = \frac{k_t}{s-\mu_g} - \frac{s+y}{s-\mu_D} - \left[\frac{k_B}{s-\mu_g} - \frac{s+y}{s-\mu_D}\right]\left(\frac{k_t}{k_B}\right)^\lambda + \eta\left(k_B - \underline{k}^{**}\right)\left(\frac{k_t}{k_B}\right)^\lambda, \tag{14}$$

$$L_1(k_t) = \frac{k_t}{s-\mu_g} - \frac{s}{s-\mu_D} - \eta\left(k_t - \underline{k}^{**}\right) - c\left(\underline{k}^{**}\right)\left(\frac{k_t}{\underline{k}^{**}}\right)^\lambda - \frac{\xi_m}{s-\mu_D}\left(1 - \left(\frac{k_t}{\underline{k}^{**}}\right)^\lambda\right) \text{and} \tag{15}$$

$$L_2(k_t) = \frac{y}{s-\mu_g} + \left[\frac{k_B}{s-\mu_g} - \frac{s+y}{s-\mu_D}\right]\left(\frac{k_t}{k_B}\right) - c\left(\underline{k}^{**}\right)\left(\frac{k_t}{\underline{k}^{**}}\right)^\lambda - \frac{\xi_m}{s-\mu_D}\left(1 - \left(\frac{k_t}{\underline{k}^{**}}\right)^\lambda\right) - \eta\left(k_B - \underline{k}^{**}\right)\left(\frac{k_t}{k_B}\right)^\lambda \tag{16}$$

Thus,

$b_\eta(k_t)$ is the subsidy rule that supports $\underline{k}^{**}$ and maintains $(V(k_t) \geq \eta\left(k_t - \underline{k}^{**}\right)$ while imposing the minimum financial liability on the regulator.

4. Application of the Dynamic Contingent Claims Model to the Indonesian Banking Industry.

4.1 Model Specifications

To implement the models empirically, several choices had to be made and the procedures adopted are set out below.

4.1.1 Banks' Earnings

The cash flow of earnings of a bank is assumed to be the total interest income arising from credit activities, since the main activity of Indonesian banks is lending. These earnings are assumed to be paid out instantaneously to shareholders. The bank's risky interest loan income, g_t, and the bank's deposits, D_t, are assumed to be correlated geometric Brownian motions and are estimated by allowing for links between the stochastic process of the bank's stock market price and the process for the payment of earnings, under the assumption of risk neutrality. However, to allow for non-constant volatility in the stock prices and fluctuating interest rates, stochastic volatility is chosen by applying empirically the GARCH model and the VAR model.

4.1.2 Interest Rates

Contrary to the FMP model, the risk free interest rate (i.e. the Certificate of Bank Indonesia interest rate rather than the rate on Treasury Bills) and the deposit interest rate are not assumed constant, allowing actual interest rates to influence the values of shareholders' equity and government liabilities.

4.1.3 Estimation of the Model

Recall equation (1) on page 13 showing that a bank's stock market value is a function of g_t and D_t. The empirical survey tests the null hypothesis that the bank's stock market value is a function of the two variables g_t and D_t for some function of $V(.)$ of a single argument $k_t \equiv g_t / D_t$, where V is the value of the bank's equity per deposits.

4.1.4 Conditions

Additional conditions for implementing these models are: (a) that the authorities conduct a financial reorganization when a bank's loan interest income, g_t, per rupiah of deposit, falls to a given closure point, $\underline{k}$; and (b) that the bank's stock market value is free from bubbles, whereby the stock market value of the bank would not jump at the moment of financial reorganization, and would not create arbitrage profits for speculators. The first condition implies that, in a financial reorganization, since the shareholders relinquish their claims on the bank's earnings, the value of equity, $U(k_t)$, = 0. If there is no bubble in the stock market price, then it is assumed that as $k_t \rightarrow \infty$ and $V(k_t)$ also $\rightarrow \infty$, the bank's equity value can be written as: $U(k,D) = DV(k) \rightarrow E_t[\exp[-\tau(z-t)]](g_z - (r_D)d_z$, where the right hand side is the unlimited liability value of the bank's cash flow of earnings. The bank's value is expected to be unlimited as the bank's cash flow of earnings, k_t, improves, so that the probability of bankruptcy will become smaller and smaller. In other words, $V(k_t)$ becomes linear in k_t as $k_t \rightarrow \infty$.

4.1.5 Equity Values and the Government's Liabilities

If a bank's stock market price, deposits, and earnings follow the properties of equation (1), then the models can be used to calculate the bank's equity value based on the relationships between the cash flow of total earnings and deposits, and the market value of the bank. These crucial procedures are included in the calculation of the government's liabilities too, since calculation of the government's liabilities is essentially a similar type of implementation based on the procedures described above. To calculate the value of the government's liabilities, however, there are some differences, as follows: (i) in the calculation of the government's liabilities, the government replaces the function of the shareholders, so that the earnings of the government are deposit insurance premia; (ii) the government incurs costs in undertaking its monitoring function; and (iii) bank failure costs, including disruption to financial stability, are represented by bankruptcy costs. As a result, following the FMP model, the value of the government's liabilities is calculated as in Equation (2).

In addition, following the suggestion of Fries and Perraudin (1993), we assume that economic agents (i.e. bank managements) are risk averse, so we can estimate the parameters of stock market prices, deposits and the state variable. This can be achieved by making assumptions about the utility function of the agent and the stochastic endowment stream of a representative agent. Hence, suppose there is a representative agent with logarithmic utility, and that the endowment stream of the economy at T (T denotes some date after the end of our sample) is the level at T of an endowment process, M_t, that follows the following stochastic differential equation:

$$dM_t = \mu_M M_t d_t + \sigma_M M_t dB_{12t} \tag{17}$$

where, $dB_{12t}dB_{11t} = \zeta_{kM}$, and $dB_{12t}dB_{10t} = \zeta_{DM}$.

We also assume that M_t is 'news' about the level of consumption at the single date, T. With logarithmic utility and a geometric Brownian motion for the endowment process, the pricing kernel in this economy equals $\exp\left[-\sigma_M^2 / 2t - \sigma_M B_{12t}\right]$. Given this Kernel assumption, Girsanov's theorem [see Oksendhal, (1985)] implies that the risk-adjusted processes for k_t and D_t are:

$$dk_t = (\mu_k - \sigma_k \sigma_M \zeta_{kM})k_t dt + \sigma_k k_t dB_{11t} \tag{18}$$

and

$$dD_t = (\mu_D - \sigma_D \sigma_M \zeta_{DM})D_t dt + \sigma_D D_t dB_{10t} \tag{19}$$

Finally, we make a critical assumption that a market index of the Stock Jakarta Exchange is the Continuous Time Capital Asset Pricing Model (C-CAPM), as suggested by Merton (1976b), where CAPM can not only be derived in a discrete time framework but can also be derived in a continuous time framework, under the assumption that trades can be executed at any time and that the return-generating process for stock prices is smooth, with no jump in prices [i.e. it behaves like a diffusion process [Lhabitant, (2000); and Greene (2003)], so that it follows Brownian motion].

4.2 Empirical Methodology

In the implementation of the FMP model for Indonesian banks, we have used VAR and GARCH models to estimate the parameters with lags of the model, and to allow for measurements of stochastic volatility in order to explain the banks' stock prices and changes in interest rates. This approach is more realistic than the traditional Black-Scholes model, where the volatility is assumed to be constant over the life of the investments. The Black-Scholes model assumes that the stock prices follow geometric Brownian motion with constant volatility and constant interest rates. However, in real markets, volatility is far from constant. Hence, if volatility is assumed to be driven by some stochastic process, then the Black-Scholes model no longer describes a complete market. Besides, as one can see in the descriptive statistics of banks' market values and liabilities in Section 4.4.1, $\log(V_t)$ and $\log(D_t)$ are not normally distributed. Consequently, in our empirical study, we estimate a model of V_t, D_t and k_t using the Maximum Likelihood techniques of the Vector Autoregression (VAR) and /or Vector Error Correction (VEC) Models, [as suggested by Sims (1980) and Litterman (1979,1986), and noted by Greene (2003)] and the GARCH model [following the suggestions of Harvey (1976), Brooks (2002), and Lhabitant (2000)].

4.2.1 Mapping Process

Let us consider the state variable, k_t, for the bank's equity-to-deposits ratio, V_t. We can obtain k_t if we know the parameters of the model by inverting $V(k_t)$ for each sample point. The bank's mapping process of state variable, k_t, to its equity value was found by estimating the parameters μ_g, μ_D, k_t, and their volatilities. If k_t is a geometric Brownian motion, then we expect log k_{t+1t} $-$log k_t to be normally distributed. Moreover, if k_t, D_t, and V_t are correlated, geometric Brownian motions, then taking logarithms yields a trivariate Brownian motion.

The state variable k_t will be absorbed at log($\underline{k}$). As the model suggests, equity value is generated by a mapping process of the non-linear cash flow of a bank's earnings. In other words, the value of the bank can be observed for any set of the earning process parameters, V_t, D_t, and k_t; so we can derive the exact conditional joint density function of the equity-to-deposits ratio, deposits, and market value of the portfolio by making a change of variable in the joint density (or joint probability) of deposits, D_t, market value of the portfolio, M_t, and k_t. Using this density, we can estimate a model of V_t, D_t, and k_t using the exact maximum likelihood technique, as originally suggested by Fisher (1925) and discussed in the next section.

4.3 Data and Estimation

This empirical study was designed to cover a representative sample (statistics relating to the 30 banks included in this study are reported in Table 3) of Indonesian banks, including some foreign banks due to their significant shares of total assets. Monthly data on the banks was gathered from Bank Indonesia and the Jakarta Stock Exchange (JSX). The monthly observations are limited to the 10 years (i.e. 120 observations) from January 1991 to December 2000. This is deemed reasonable as the Indonesian banking industry had been deregulated in October 1988 (Bank Indonesia, 1988) when a package of bank deregulations resulted in big changes in the banks' operations in terms of their permissible activities, product range, and the number of branches they could operate. The big changes had resulted in fierce competition in the mobilization of funds and lending activities.

The parameters /variables set out in the theoretical model are as follows:

g_t = Risky loan interest income at time *t*

k_t = g_t / D_t at time *t*

M_t = Share price series of each bank obtained from monthly data of the JSX

D_t = Deposits at time *t*

U_t = Value of Equity at time *t*

V_t = Bank's equity to deposits ratio at time *t*

CPI_t = Consumer Price Index at time *t*

s_t = Interest rate on Certificates of Bank Indonesia at time *t*

r_D = Deposit interest rate at time *t*

c_t = Lump sum cost of bankruptcy at time *t*

ξ_m = Monitoring cost

γ_t = Fair flat of deposit insurance premium at time *t*

L_t = Liability of Government at time *t*

μ_D = Drift parameter of Deposits

μ_g = Drift parameter of loan interest income

μ_k = Drift parameter of state variable g_t / D_t

σ_D = Volatility of deposits

σ_g = Volatility of earnings provided by the government at time *t*

σ_k = Volatility of state variable k_t

b_t = Subsidy provided by the government at time t

Banks' risky earnings, g_t, are monthly loan interest incomes, so that their volatilities can represent the riskiness of the banks' activities.

Deposits of a bank include deposits and savings accounts. Between 1991 and 1997 Indonesia had no deposit insurance scheme. Bank regulators in Indonesia have implicitly adopted a blanket guarantee scheme (i.e., an ad hoc deposit insurance scheme) to protect small depositors since the end of 1997, after a multi dimensional crisis hit Indonesia in mid July 1997. I assume that all deposits are insured at face values.

Monthly data on the stock price of each bank was collected from the Jakarta Stock Exchange. The banks' values of equity outstanding were calculated as the number of shares multiplied by the stock price. These equity values and deposits are then divided by the consumer price index, using a base period of 1989, so one can get values in constant price terms.

Estimation of the models was conducted using maximum likelihood techniques. Because there is a non-linear relationship between V_t (i.e. which is observed) and the state variable k_t, which is not observed, at each evaluation of likelihood it is necessary to invert the non-linear relationship. To implement the model, deposit interest rates and interest rates on Certificates of Bank Indonesia were used. The data was obtained from Bank Indonesia based on the banks' monthly reports. The choice of the rates on Certificates of Bank Indonesia as the benchmark risk-free interest rates was due to the fact that Indonesia has not issued marketable government securities, such as the USA's Treasury Bill, which has been widely used as a benchmark of investment in the USA because it pays market rates of interest, is free of default risk, and is marketable in the secondary market (Koch and MacDonald, 2000). All these features, however, exist in a Certificate of Bank Indonesia.

Lump sump bankruptcy costs should include legal administrative costs incurred by the regulatory authorities in reorganizing the banks. For Indonesia, however, this data is not readily available. Thus, for the empirical analysis, we had to use some approximations i.e. we used the bankruptcy cost of general firms, equal to 18% of the firm's estate (World Bank, 2003). This number is more than three times the size of the USA's estimated bankruptcy costs, of 5%, so the percentage is regarded as reasonable for the Indonesian banking industry. Similarly, the costs incurred in monitoring banks kept open are not readily available. We decided, therefore, to adopt the estimates of Acharya and Dreyfus (1989) for the costs of monitoring banks in the USA - 0.2% of the deposit base. However, the drift parameters μ_D, μ_g, and μ_k and their volatilities were estimated freely without any restriction using the maximum likelihood techniques. These parameters were used to calculate the banks' equity values, the fair flat deposit insurance premium, the government's liability values, the banks' closure points, and the subsidies.

4.4 Results

4.4.1 Descriptive statistics

The results of the empirical study are reported in the form of tables at the end of the paper. Descriptive statistics for equity values and deposits are reported in Table 4. This table summarizes the descriptive statistics of the monthly series for the differences in the log of the equity values, Log (V_t), and that of the log of the deposits, Log (D_t), which represent the estimates of banks' equity values and the government's liabilities respectively. The results show that almost all of the banks' data are definitely not normally distributed, with most banks having positive skewness, which implies that the distributions have long, right-hand tails. The only banks with negative skewness, which implies that the distribution has a long left tail, are Bank TSK, for its log liability values, and Bank ABX, for its log equity values. The sample distributions of liabilities (or deposits) and equity values of almost all banks have a kurtosis value that exceeds 3, which means that the distributions are peaked (leptokurtic) relative to the normal. Only the sample distributions of the equity values of Bank LKY and Bank PTX have a kurtosis of less than 3, which shows flat distributions (platykurtic) relative to the normal distribution. Another normality test is the Jarque-Bera test, with the null hypothesis that the distributions of deposits and equity values are normally distributed. It also shows that almost all banks have statistics with probability (p-values) = 0.0000 at the 5% significant level, leading to the rejection of the null hypothesis of a normal distribution for the banks' distributions of liabilities and equity values.

Given these results, it can be concluded that the distributions of liabilities and equity values do not follow the normality assumptions. These findings are consistent with the conclusions of most of the literature on stock return distributions; see, for example, Giannopoulos (2000), Brooks (2002), and Greene (2003). This leads to the use of GARCH models to estimate the parameters to capture the leptokurtosis in the unconditional distribution of the banks' stock returns and deposits.

4.4.2 Results of Tests

To estimate the parameters, using VAR / VEC Models and GARCH, we carried out the unit root tests, the cointegration tests, and the Granger causality tests. The results of these tests are presented below.

4.4.2.1 Results of the Unit Root Tests

As shown in the results of the Augmented Dickey Fuller (ADF) test summarized in Table 5, most banks' data series are either first differenced stationary series (or unit roots), the so called I(1) (i.e. Δk, ΔM, and ΔD), or second differenced stationary series, the so called I(2) (i.e. $\Delta^2 k$). The remaining data series led to rejection of the null hypothesis of a unit root in the log levels, the so-called I(0), [i.e. k_t, D_t, M_t], which means the series are stationary, and hence some variables of some banks were not differenced. For example, Bank TDF's k_t was differenced once since its ADF statistic (-2.58) is larger than its critical value (-3.45), which means that the ADF statistic falls in the no rejection area at a significance level of 5%, leading to no rejection of the null hypothesis that the series is not stationary (unit root). The bank's k_t stationary process is obtained at Δk with an ADF statistic of –3.70, which is less than the critical value of -3.45. On the other hand, Bank KTP's k_t series is stationary at the log level of k_t, since its ADF test statistic = -4.85 is less than the critical value = -3.45, meaning that the ADF statistic falls in the rejection area leading to the rejection of the null hypothesis that the level data k_t is not stationary. Similar analysis can be employed with respect to the other banks and the other series (D_t, M_t), reported in Table 5, so that we can determine whether level series data or differenced series data of the banks should be used to run the regressions.

4.4.2.2 Results of the Cointegration Tests

Cointegration tests on k_t and D_t, as well as on k_t and M_t, were conducted using the Engle-Granger (1987) method, with the aim of determining whether the VAR or VECM model should be employed in the regressions. The results of the Augmented Dickey Fuller Tests on the *residuals of the regressions* are summarized in Table 6, which contains the banks' ADF statistics, their critical values and the conclusions. The results indicate that most of the banks' residuals of regressions of both k_t on D_t, and D_t on M_t have ADF statistics which are greater than the critical values (or statistically not significant), meaning that the ADF statistics fall within the no rejection area, leading to no rejection of the null hypotheses that the regression residuals series have unit roots (i.e. are not stationary). Therefore, most of the banks' k_t and D_t, as well as k_t and M_t are not cointegrated. This also means that the error correction model (i.e. the VEC Model) cannot be estimated, as there are no linear combinations of the logs of L_t and k_t, as well as k_t and M_t, that would be stationary, resulting in the use of a VAR model. For cointegration tests of k_t and M_t, the table shows that only 1 out of 30 is a cointegrated series [i.e. Bank SRH's, with an ADF statistic (-2.99) that is statistically significant and smaller than its critical value (-2.89) at a significance level of 5%, meaning it falls within the rejection area, leading to the rejection of the null hypothesis that the series is not stationary]; hence we could use the VEC Model in this case.

Similarly, the table also indicates that there are 8 out of 30 cointegtrated series of k_t and D_t, [i.e. Bank TSK's, Bank KTP's, Bank DLK's, Bank LRH's, Bank MJQ's, Bank NPT's, Bank USK's, and Bank RPA's, where their ADF statistics are statistically significant and smaller than their critical values]. This means that the 8 banks' ADF statistics fall within the rejection area, leading to rejections of the null hypothesis that the series are not stationary, and hence we should also use the VEC Model.

4.4.2.3 Results of the Granger Causality Tests

The results of the Granger causality test (*F*-test) in VAR of bivariate regressions are reported in Table 7. The table indicates that most of the banks' probabilities (*p*-values) for *k* and *M* are not statistically significant at the 5% significance level, which means the values fall within the no rejection area and hence lead to no rejection of the null hypothesis that both *k* does not Granger cause *M,* and *M* does not Granger cause the *k*. Therefore, the Granger causality runs two-ways from *k* to *M* and from *M* to *k*. In other words, the past values of *k* do not correlate with the current values of *M*, and the past values of *M* do not correlate with the current values of *k*, which means that for most of the banks *k* and *M* are independent i.e. both of them can be treated as either endogenous or exogenous variables, so that we can run any regressions using VAR techniques on them. The banks in question comprise SPW, TSK, JSL, GXT, DLK, LRH, TLR, and KRP.

One-way Granger causality for *k* and *M* occurs in only two banks' series, that is in Bank SRH's and Bank ABX's, i.e. *M* Granger causes *k* and not the other way round, for Bank SRH and *k* Granger causes *M* and not the other way round for Bank ABX. This is because, firstly the *p*-values of the relationship between *M* and *k* for Bank SRH (i.e. 0.0485) and between *k* and *M* for

Bank ABX (i.e. 0.0011) are statistically significant at the 5% significance level, meaning the values fall within the rejection area leading to rejection of the null hypothesis that *M* does not Granger cause *k* for Bank SRH and *k* does not Granger cause M for Bank ABX. And secondly, the *p*-values of the relationship between *k* and *M* is 1.232 for Bank SRH and between *M* and *k* is 0.422 for Bank ABX respectively at the 5% significance level, meaning the values fall within the no rejection area, leading to the non-rejection of the null hypothesis that *k* does not Granger *M* for Bank SRH and *M* does not Grange cause *k* for Bank ABX. This means that the past values of *k* do not correlate with the current values of *M* for Bank SRH, and past values of *M* do not correlate with the current values of *k* for Bank ABX, so that we can run VAR models with *k* as a dependent variable and *M* as an independent variable for Bank ABX and with *M* as a dependent variable and *k* as an independent variable for Bank SRH.

More than half of the banks' *p*-values for *k* and *D* are not statistically significant at the 5% significance level (i.e. p-values > 0.05), which means the values fall within the no rejection area and lead to no rejection of the null hypothesis that both *k* does not Granger cause *D* and *D* does not Granger cause the *k*. Therefore, the Granger causality runs two-ways: from *k* to D and from *D* to *k*. In other words, we can run VAR regressions using either *k* or *D* as a dependent variable. The 15 banks include TDF, LKY, JSL, RSW, GXT, DLK, KBN, LDO, BKG, ABX, KRP, MJQ, GHZ, RPA, and PRM. In addition, there are three banks with *p*-values being statistically significant (or p-values < 0.05), at the 5% significance level, which means the values fall within the rejection area, and lead to rejection of the null hypothesis that both *k* does not Granger cause *D* and *D* does not Granger cause *k*. Therefore, the Granger causality runs two-ways from *k* to D and from *D* to *k*. In other words, we can also run VAR regressions using either *k* or *D* as a dependent variable. The banks comprise Bank KTP, Bank PTX and Bank MJB.

One-way Granger causality for *k* and D occurs for the rest of the 12 banks' series, i.e. *D* Granger causes *k* and not the other way round. This means that the past values of *k* do not correlate with the current values of *D* for the 12 banks, so that we can run VAR models with *D* as a dependent variable and *k* as an independent variable. The 12 banks in question are SPW, TSK, SRH, LRH, DSP, TLR, EJK, NPT, HEA, USK, FKE, and TUP.

4.4.3 Parameter Estimates

The parameter estimates of the banks' equity values (*U*), deposits (*D*), and state variables (*k*) for the 30 individual banks, comprising the standard deviations and correlations σ_M, σ_k, σ_D, ξ_{km}, and ξ_{kD} respectively and the betas of k_t to M_t, and k_t to D_t created using the VAR and VEC Models discussed in the previous paragraphs, are presented in Table 8. This table also contains the standard errors for each parameter, which are presented in parentheses. The relationship analysis between the volatility and level of the state variable and those of both equity and deposits could explain the links between the three parameters. In this analysis, the crucial parameter is the standard deviation of the bank's earnings to deposits, k_t, i.e. σ_k. The sample banks' σ_k' s range from 0.68% per annum for Bank FKE to 1.26% for Bank TUP. Most banks have σ_k's of around 1%. An important finding is that the σ_k's across banks are quite different from those of the standard deviations for the log equity values, M_t, depicted in Table 4. These decisively show that the mapping process from k_t to M_t is far from a simple proportional relationship. In other words, because the M_t's are not approximately proportional to k_t, then the standard deviations of $\log(k_t)$ and $\log(M_t)$ are not roughly equal. This means that deposits are certainly unstable. The results of the mapping process for the ratio of earnings to deposit, (i.e., $k_t - (r_D + \gamma)$) includes a constant, which means that k_t is most likely to be an important parameter in the FMP model.

As mentioned earlier, the relationship analysis between the volatility and level of the state variable and those of equity explain the links between the three parameters. Most banks have different characteristics of the link. For example, Bank TSK, Bank GXT, Bank LRH, and Bank KRP have roughly the same σ_k (see Table 8) and relatively small volatility of equity, σ_M. On the other hand, Bank SRH, Bank TLR, and Bank ABX have roughly the same σ_k, and relatively big volatility of equity. These findings are consistent with the risk management literature, where every bank has a different level of risk.

Table 8 also reveals that most of the parameters for σ_M, σ_k, σ_D, ξ_{km}, ξ_{kD}, β_{kM} have relatively small variation across banks. Estimates of σ_M range from 20.01% to 73.35%, for example, whilst most banks' standard errors for the σ_M's approach 2%, except for Bank JSL (4.00%), Bank ABX (8.00%), and Bank RPA (6.8%). This means that almost all estimates are within two standard errors of the average across banks. The correlations between k_t and M_t (ξ_{km}), and k_t and D_t (ξ_{kD}), were analysed to explain how the state variable's volatility can affect the bank's equity value, and the government's liabilities. The statistics indicate that correlations between k_t and M_t vary across banks. This is not surprising because it is consistent with the large literature that stock returns depend on the variance of firms' earnings. Somewhat surprising, however, are the figures for the correlations between k_t and D_t, which exhibit only a small amount of variation; whilst the beta, β_{kM}, which equals $\sigma_k\, \xi_{kM} / \sigma_M$, and ξ_{kD} which equals $\sigma_g\ \underline{k}\ / \sigma_M$, also vary considerably across banks. The discounted value of the income streams, $\underline{k}^*$, under risk neutrality is $\dfrac{k_t}{s-\mu_g}$, which, for a fixed D_t, is proportional to μ_D. As a result, the β_{kM}'s are also the "Capital Asset Pricing Model's (CAPM) betas",[7] showing the trade off between the returns and risk of banks' assets if they are traded directly. These findings are also consistent with the finance literature and practice, where portfolio analysis has become an important analytical assumption used in risk management, in particular in risk return analysis, as originally suggested by Markowitz (1959) and, in its extension to the aggregate market portfolio, by Sharpe (1964) and Lintner (1965b).

4.4.4 Valuations of deposit insurance guarantees, subsidies and bankruptcy imminence.

The results of the study show how the subsidy policy interacts with the valuation of deposit insurance guarantees and the closure rules that could be represented by the imminence of bankruptcy. Table 9 depicts one of the most important results, which relates to the values of the deposit insurance guarantee per insured deposit (i.e. the ratio of the guarantee to deposits in per cent) across the 30 banks under the optimal closure rules. The guarantee (i.e. "liabilities") values vary considerably across the banks, ranging from –102.09% for Bank EJK to 758.03% for

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[7] The CAPM of finance specifies that, for a given security, $r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it}$, where $\underline{k}^*$ is the return over period t on security U_i, r_{ft} is the return on a risk-free security, r_{mt} is the market return, and k_t is the security's beta coefficient. The disturbance is certainly correlated across securities. Excess return can be gained when the return on security i exceeds the risk-free rate, k_t. Hence, a joint estimate of equations is more useful than an individual estimate (see Greene, 2003). This has wide implications, both for risk management and bank regulation, in particular for the risk-based capital requirements.

Bank PRM. Only three banks, i.e. Bank KBN, Bank MJB and Bank TDF, have deposit guarantee values ranging from 7% to 21% of insured deposits. The wide range of deposit guarantee values indicates a considerable degree of cross-subsidization when banks pay a zero flat deposit insurance premium. For example, with a zero deposit insurance premium, the subsidy approaches 1% of deposits for some banks, i.e. for Bank SRH and Bank DSP. For Bank TUP, the subsidy amounts to 3.82% of deposits, yet for Bank HEA it is -810% of deposits.

Furthermore, if shareholders are unable and /or unwilling to inject new capital, the results of my study suggest that banks may receive different levels of subsidy for different deposit insurance premiums, γ_f, (i.e. 0b.p; 15b.p; 30b.p; and 50b.p). Positive subsidies represent gains to the banks when they are moving from a situation of unlimited liability with no insurance premia to a condition with a limited liability equity claim at the different deposit insurance premiums. A flat fair deposit insurance premium, γ_f (which the results suggest lies around the 20 basis points level for most banks), which eliminates moral hazard problems in an optimal financial reorganization where the authorities act as a social planners, induces a lower subsidy than a higher deposit insurance premium, γ_f. In other words, there is a positive correlation between the deposit insurance premium and the level of subsidy i.e. if the deposit insurance premium increases, then the subsidy increases. Consequently, the authorities could limit the subsidy provided to an ailing bank to a certain level by setting an appropriate flat deposit insurance premium which eliminates moral hazard problems and meets social objectives.

The standard deviation of the state variable, σ_k, and the terminal $k_t / \underline{k}$ ratio, explain the pattern of guarantee values across banks. These together provide a measure of imminence to bankruptcy, $\underline{k}$. The terminal $k_t / \underline{k}$ ratio measures the distance from the closure point $\underline{k}$ because k_t is a geometric Brownian process, so proportional changes in k_t occur with equal probability whatever the level of the process. As depicted in Table 9, the terminal $k_t / \underline{k}$ ratio also varies considerably across the banks, ranging from 0.15 for Bank TUP to 8.73 for Bank EJK. Most banks (10 banks) have a terminal $k_t / \underline{k}$ ratio of between 1 and 1.76, but some banks (7 in total) have ratios of between 0.20 and 0.51. The annualised measures of the imminence of bankruptcy, measured by $k_t / \underline{k}$ plus annualised standard deviation σ_k, which is a probability distance to bankruptcy with the standard deviation of k_t from the closure point, also vary widely across the banks. We find that the three most likely to face imminent bankruptcy are Bank MJB (1.21), Bank USK (1.32), and Bank ABX (1.32); whilst, the three least likely to face imminent bankruptcy are Bank EJK (9.51), Bank FKE (6.55), and Bank SRH (4.78). The policy implications are that bank regulators should allocate resources to monitor more closely the first set of banks and draft action plans to reorganize the banks.

5 Policy Implications

The policy implications of the empirical analysis are as follows:

(i) The Indonesian banks need to focus more on the implementation of the best practices of Enterprise Risk Management (ERM), consistent with the modern banking approach that emphasises risk management. This, in turn, will reduce the probability of bankruptcy, as implied by Basel II, and enhance shareholder value. Since the main determinants of the value of deposit guarantees to a bank are the volatility of k_t and the ratio of k_t at the end of sample to the closure point $\underline{k}$, the banks and bank regulators should pay more attention to improve these performance measures under the ERM framework.

(ii) The Indonesian authorities should adopt the optimal financial reorganization model promoted by FMP. This study has identified the optimal closure rules, the bail out rules, the amount of the banks' contributions in the event of bank failure in the form of deposit insurance premiums, the government's liabilities arising from the operation of the deposit insurance scheme, and the banks' imminence of bankruptcy, which could all be used to enhance the efficiency and cost-effectiveness of bank regulation in Indonesia.

(iii) Bail out rules could be used to reduce social costs significantly, since an optimal subsidy policy takes into account the deposit insurance premiums, interest rates, banks' performance (i.e. returns and capital values), bankruptcy costs, and monitoring costs. The use of such rules, however, should be approved by Parliament.

(iv) It is sensible that the authorities consider the establishment of an explicit deposit insurance scheme to protect small depositors and to reduce systemic risk in the form of both bank panics and disruptions to the payments system. A "fair" flat deposit insurance premium would be around the 20 basis points level.

(v) If a variable rate system is introduced, the authorities should limit the deposit insurance premiums to be levied on the Indonesia banks to between zero and 30 basis points, ceteris paribus, depending on the banks' performance and financial condition, as measured by capital, earnings and level of risk. In this way, subsidies given to financially-ailing banks can be limited.

(vi) Since the imminence to bankruptcy can be identified for each bank, the authorities should allocate resources to monitor more closely and draft action plans to reorganize those most likely to face imminent bankruptcy, so that regulators can supervise the banks more cost- effectively.

(vii) Interest rates are important factors influencing the value of banks' equity, the government's liabilities, the subsidy, and the deposit insurance premiums. A high interest rate would reduce the value of a bank's equity since it decreases the net present value of the banks' cash flow of earnings. In addition, high interest rates with high volatility adversely affect the banks' efficiency, as they would be forced to operate with high margin resulting in higher risks. Therefore, without prejudice to securing its monetary objectives, the monetary authority should try to keep the interest rates low and maintain their stability so that they can accommodate the achievement of both shareholder value and monetary targets.

6. Summary and Conclusions

The objectives of bank regulation are to provide protection to small depositors, to ensure stability of the financial system, and to support the efficiency of the banking industry. We suggest that an optimal combination of the regulatory regime - consisting of rules, monitoring and supervision, incentive structures, market discipline, intervention arrangements, corporate governance and disciplining and accountability of regulatory agencies – necessary to fulfil the objectives, has been found through the implementation of the closure rules suggested in FMP's bank reorganization model. Bank managements are threatened by interference from shareholders and regulators when performance is bad, and are rewarded when performance is good. The shareholders will be allowed to continue to control the bank if performance is good (i.e. the bank is well capitalized). The threshold for the transfer of control from shareholders to creditors or regulators can be interpreted as a closure rule for the bank, and shareholders must inject new capital to keep a bank operating as a going concern. Regulators also try to control the risk behaviour of banks by using capital requirements. The bank's value can be affected by a prompt correction measure and /or financial reorganization to reduce the probability of insolvency, which can limit bank failures and externalities which, in turn, will protect depositors and ensure public confidence.

More specifically, we have analysed a policy of efficient regulation, namely the FMP model of optimal closure rules of a social-planner regulator that balances the lump-sum bankruptcy costs against the cost of monitoring to keep a bank operating as a going concern, using data for the Indonesian banks. We have also analysed a series of different possible closure rules and subsidy policies the bank regulators may apply at different deposit insurance premium rates. The authorities may wish to postpone closing a bank if shareholders inject capital and /or the authorities wish to subsidize the bank in such a way as to avoid moral hazard problems created for banks' management and shareholders.

The deposit insurance liabilities incurred by regulators' guarantees have also been estimated under the FMP model. The FMP model, which we adopt, uses the American-style option model to calculate the authorities' liabilities arising from the provision of depositor protection in the form of deposit insurance, rather than the European-style option pricing methods originally suggested by Merton (1976a, b), which rely on bank audits. This means the authorities' liabilities are independent of audit frequency, so that deposit insurance valuation is not dependent on the arbitrary and unobservable frequency of the audit. It also means that asymmetric information problems between investors and regulators can be avoided, so that inconsistent assumptions about the availability of information concerning banks' prospects between investors and regulators are not used.

However, our model has some important differences compared with past studies. For example, in the application of the FMP model to the Indonesian banks, we have used VAR and GARCH models to estimate the parameters with lags of the model, to allow for measurement of stochastic volatility and to explain the banks' stock prices and liabilities. The use of these methods is more realistic compared to the traditional Black-Scholes model, where the volatility is assumed to be constant over the life of the investments. As a result, the government's liabilities (as a proportion of deposits) which arise under the deposit insurance scheme, the shut-down level of the state variable, the subsidies involved at different deposit insurance premiums, and the banks' imminence to bankruptcy can all be calculated. The main determinants of the value of the government's liabilities are the volatility parameter of the banks' risky loan earnings per rupiah of deposit, σ_k, and the end of sample ratio of the cash flow of banks' risky loan earnings per rupiah of deposits (or state variable), k_t, to the closure point $\underline{k}$.

The results show that capital is clearly a crucial factor for the banking industry in a financial reorganization /recapitalization to restructure the financially ailing banks, which is why it has become the primary focus of central bankers and other regulators. Another crucial factor is risk management, where the risk-adjusted returns of agents generating sustainable cash flows to promote and sustain shareholder value will reduce the probability of bankruptcy, so that capital requirements can be achieved. The injection of new capital is not a panacea for an ailing bank if it does not apply best practices of risk management to generate internal earnings to enhance and sustain shareholder value. This can be seen as a product of the risk management process, which creates a cash flow of earnings.

The optimal subsidies (bail-out) for Indonesian banks vary widely, indicating a considerable degree of cross-subsidization when banks pay a uniform deposit insurance premium (at a zero deposit insurance premium rate). Most banks would face a fair deposit insurance premium at around the 20 basis points (or 0.2%) level. For a zero deposit insurance premium, the subsidies vary widely across the banks. There is a positive correlation between the deposit insurance premium and the subsidy, whereby if the deposit insurance premium increases, then the subsidy increases, other things being equal. Moreover, the authorities face the dilemma that subsidy rules applied to the banks to diminish the moral hazard problem create a conflict between the authorities' objective of closing the banks early and the banks' desire to improve performance as the level of profitability and capital decreases. Banks categorized as the most likely and least likely to face imminent bankruptcy have also been identified.

The policy implications which can be drawn from these findings, are as follows. Firstly, bail out rules could be used to reduce social costs significantly, since an optimal subsidy takes into account the deposit insurance premiums, interest rates, banks' performance (i.e. returns and capital values), bankruptcy costs, and monitoring costs. Secondly, since the bail out rules under the social planner approach would be billing the taxpayers, use of the subsidy rules should be approved by and reported to parliament, and incorporated in legislation. Thirdly, it is sensible that the authorities consider the establishment of an explicit deposit insurance scheme to protect small depositors and to reduce systemic risk. A "fair" flat deposit insurance premium would be around the 20 basis points level. Fourthly, if a variable rate system is introduced, the authorities should limit the deposit insurance premiums to be levied on the Indonesian banks to between zero and 30 basis points, ceteris paribus, depending on the banks' performance and financial condition, as measured by capital, earnings and level of risk. In this case subsidies given to financially ailing banks can be limited. Fifthly, since the imminence to bankruptcy can be identified for each bank, the authorities should allocate resources to monitor more closely and draft action plans to reorganize those most likely to face imminent bankruptcy, so that regulators can supervise the banks more cost effectively. Sixthly, since interest rates are important factors influencing the value of banks' equity, the government's liabilities, the subsidy, and the deposit insurance premium, the monetary authority should, without prejudice to securing its monetary objectives, try to keep the interest rates low and maintain their stability so that they can accommodate the achievement of both shareholder value and monetary targets. Finally, the bank regulators should refocus their strategies to develop the Indonesian banking industry based on the optimal bank regulations derived in this study.

Our study, however, has some limitations, which are as follows: (i) the study does not include a study of the correlation between risk-based capital and closure rules to measure the sensitivity of the correlations; if the sensitivity level is high we have to focus on capital and if the sensitivity is low we should focus on the closure rules; (ii) the time series data has not been subjected to independent audit; (iii) the measures of bankruptcy cost and monitoring cost used are based on approximations, since there is no readily available data; and (iv) the study does not relate the closure rule to macroeconomic variables, such as the growth rate of GDP. Given these limitations, further study is necessary in each area to deal with the drawbacks noted.

Table 3 Details of the Banks Included in the Study

No	Type of License	All Indonesian Banks				Banks Included			
		Number of banks	%	Total Assets (in billions)	%	Number of banks	%	Assets (in billions	%
	Commercial banks	145	100,0	1,071,230	100,0	30	21,37	620,570	57.93
1	State Banks	5	3.45	504,218	47.07	3	60,0	257,513	51.07
2	Foreign Exchange Banks	38	26.21	336,683	31.43	13	34.21	312,220	92.73
3	Non-Foreign Exchange Banks	42	28.97	22,689	2.12	4	9.50	5,914	26.07
4	Regional Development Banks	26	17.92	83,562	7.80	4	15.38	10,736	12.85
5	Foreign Banks	10	6.90	80,045	7.47	3	30.00	23,709	29.62
6	Joint banks	24	16.55	44,033	4.41	3	12.50	10,478	23.80

*) Including one merged bank

Source: Bank Indonesia, Financial Publication Report as of 31.12.2000 and Survey.

Table 4 Descriptive Statistics of Equity Values and Deposits for Observations from January 1991 to December 2000

No	Bank	Delta Log Liabilities						Delta Log Equity Values					
		Statistics				Jarque-Bera		Statistics				Jarque-Bera	
		Mean	Std. Dev.	Skewness	Kurtosis	Statistics	Probability	Mean	Std. Dev.	Skewness	Kurtosis	Statistics	Probability
1	TDF	0.001	0.004	6.207	57.550	15949.39	0.00000	*)	*)	*)	*)	*)	*)
2	SPW	0.001	0.005	3.109	16.427	1422.00	0.00000	0.838	14.877	6.105	56.543	10533.94	0.00000
3	LKY	0.001	0.005	1.222	30.281	4229.88	0.00000	0.112	0.261	0.480	0.135	0.30	0.86052
4	TSK	0.001	0.010	-0.964	14.149	931.52	0.00000	0.444	4.880	6.237	51.519	10717.03	0.00000
5	KTP	0.001	0.006	1.568	15.167	1097.47	0.00000	*)	*)	*)	*)	*)	*)
6	JSL	0.002	0.011	2.468	13.566	958.07	0.00000	0.662	12.032	5.936	61.555	14972.98	0.00000
7	RSW	0.002	0.005	3.982	30.163	4476.99	0.00000	*)	*)	*)	*)	*)	*)
8	GXT	0.001	0.005	4.783	40.788	8076.01	0.00000	0.144	3.506	2.125	14.992	922.54	0.00000
9	DLK	0.001	0.005	2.555	18.255	1650.39	0.00000	1.101	14.017	5.885	55.673	12340.54	0.00000
10	SRH	0.001	0.007	2.855	14.930	1176.74	0.00000	0.823	12.816	6.320	65.726	17069.18	0.00000
11	LRH	0.001	0.007	2.398	17.611	1529.63	0.00000	4.028	40.103	5.510	33.451	1513.88	0.00000
12	DSP	0.002	0.013	0.643	6.323	188.87	0.00000	*)	*)	*)	*)	*)	*)
13	TLR	0.001	0.007	1.609	10.911	592.50	0.00000	1.856	20.341	3.309	18.680	1498.72	0.00000
14	PTX	0.001	0.006	4.558	30.919	4786.21	0.00000	-0.145	0.164	0.728	0.803	0.33	0.84721
15	KBN	0.001	0.008	1.672	10.859	591.22	0.00000	*)	*)	*)	*)	*)	*)
16	LDO	0.002	0.015	4.765	35.996	6380.69	0.00000	*)	*)	*)	*)	*)	*)
17	BKG	0.003	0.008	3.071	17.873	1228.84	0.00000	*)	*)	*)	*)	*)	*)
18	ABX	0.003	0.008	3.071	17.873	1228.84	0.00000	-0.333	3.707	-1.647	9.301	132.18	0.00000
19	KRP	0.001	0.005	5.112	45.410	9967.39	0.00000	0.885	15.062	5.602	50.412	7179.61	0.00000
20	MJQ	0.002	0.013	2.640	12.943	899.57	0.00000	*)	*)	*)	*)	*)	*)
21	EJK	0.001	0.008	0.100	21.077	2032.07	0.00000	*)	*)	*)	*)	*)	*)
22	MJB	0.001	0.005	5.594	49.634	11916.79	0.00000	*)	*)	*)	*)	*)	*)
23	NPT	0.001	0.005	6.958	65.794	20814.76	0.00000	*)	*)	*)	*)	*)	*)
24	HEA	0.001	0.014	1.760	8.057	355.02	0.00000	*)	*)	*)	*)	*)	*)
25	USK	0.001	0.006	5.368	47.782	11032.60	0.00000	*)	*)	*)	*)	*)	*)
26	GHZ	0.002	0.007	2.920	25.003	3027.65	0.00000	*)	*)	*)	*)	*)	*)
27	FKE	0.007	0.019	1.804	6.252	170.99	0.00000	*)	*)	*)	*)	*)	*)
28	RPA	0.007	0.023	0.846	5.215	79.21	0.00000	9.707	64.279	3.645	15.031	121.68	0.00000
29	TUP	0.002	0.009	1.225	11.001	580.25	0.00000	*)	*)	*)	*)	*)	*)
30	PRM	0.004	0.055	1.630	5.934	149.95	0.00000	*)	*)	*)	*)	*)	*)

Note:
Jarque-Bera statistic is given by $N((\sigma^3)^2/6+(\sigma^4-3)^2/24)$
*) Not listed on the Jakarta Stock Exchange
Data are monthly log changes in constant prices using the CPI deflator

Table 5 Results of the Augmented Dickey Fuller Tests on the FMP model

No	Bank	M	ΔM	$\Delta^2 M$	k	Δk	$\Delta^2 k$	D	ΔD	$\Delta^2 D$
1	TDF									
	lag	*	*	*	12.00	12.00	-	2.00	1.00	-
	ADF stat.	*	*	*	-2.58	-3.70	-	-1.71	-6.30	-
	Crt. Value	*	*	*	-3.45	-3.45	-	-3.45	-3.45	
2	SPW									
	lag	0.00	0.00	-	12.00	12.00	11.00	0.00	1.00	-
	ADF stat.	-2.43	-7.51	-	-2.31	-2.97	-13.34	-1.82	-9.71	-
	Crt. Value	-3.50	-3.51	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
3	LKY									
	lag	a)	a)	a)	12.00	12.00	11.00	0.00		-
	ADF stat.	a)	a)	a)	-1.48	-2.26	-11.49	-2.96	-10.39	-
	Crt. Value	a)	a)	a)	-3.45	-3.45	-3.45	-3.45	-3.45	-
4	TSK									
	lag	0.00		-	0.00	11.00	10.00	2.00	1.00	-
	ADF stat.	-2.01	-10.77	-	-3.76	-1.87	-12.46	-3.07	-9.06	-
	Crt. Value	-3.45	-3.46	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
5	KTP									
	lag	*	*	*	12.00	-	-	12.00	-	-
	ADF stat.	*	*	*	-4.85	-	-	-3.69	-	-
	Crt. Value	*	*	*	-3.45	-	-	-3.45	-	-
6	JSL									
	lag	0.00	-	-	12.00	11.00	10.00	0.00	-	-
	ADF stat.	-4.20	-	-	-2.39	-2.07	-32.73	-4.12	-	-
	Crt. Value	-3.45	-	-	-3.45	-3.45	-3.45	-3.45	-	-
7	RSW									
	lag	*	*	*	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.61	-2.09	-25.13	-1.53	-12.08	-
	Crt. Value	*	*	*	-3.45	-3.45	-3.45	-3.45	-3.45	-
8	GXT									
	lag	1.00	0.00	-	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	-3.04	-13.74	-	-2.40	-1.91	-19.76	-1.57	-12.20	-
	Crt. Value	-3.46	-3.46	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
9	DLK									
	lag	0.00	1.00	-	12.00	11.00	10.00	0.00	2.00	-
	ADF stat.	-1.98	-11.01	-	-3.29	-1.79	-36.78	-3.51	-10.42	-
	Crt. Value	-3.45	-3.46	-	-3.45	-3.45	-3.45	-4.04	-4.04	-
10	SRH									
	lag	0.00	-	-	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	-3.54	-	-	-2.91	-2.03	-49.30	-2.23	-10.82	-
	Crt. Value	-3.45	-	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
11	LRH									
	lag	0.00	0.00	-	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	-1.86	-5.22	-	-3.13	-2.13	-13.20	-2.88	-11.07	-
	Crt. Value	-3.53	-3.54	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
12	DSP									
	lag	*	*	*	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.56	-2.44	-17.07	-3.20	-11.36	-
	Crt. Value	*	*	*	-3.45	-3.45	-3.45	-3.45	-3.45	-
13	TLR									
	lag	0.00	0.00	-	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	-3.16	-11.37	-	-2.13	-1.65	-48.59	-1.57	-10.37	-
	Crt. Value	-3.45	-3.46	-	-3.45	-3.45	-3.45	-2.89	-3.45	-

Table 5 Results of the Augmented Dickey Fuller Tests on the FMP model

No	Bank	M	ΔM	$\Delta^2 M$	k	Δk	$\Delta^2 k$	D	ΔD	$\Delta^2 D$
14	PTX									
	lag	a)	a)	a)	12.00	11.00	10.00	2.00	2.00	-
	ADF stat.	a)	a)	a)	-2.20	-2.24	-30.93	-1.23	-7.68	-
	Crt. Value	a)	a)	a)	-3.45	-3.45	-3.45	-3.45	-3.45	-
15	KBN									
	lag	*	*	*	12.00	12.00	11.00	0.00	-	-
	ADF stat.	*	*	*	-2.20	-1.44	-12.29	-3.89	-	-
	Crt. Value	*	*	*	-3.45	-3.45	-3.45	-3.45	-	-
16	LDO									
	lag	*	*	*	12.00	11.00	11.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.58	-3.84	-10.92	-3.14	-12.39	-
	Crt. Value	*	*	*	-3.45	-4.05	-4.05	-3.45	-4.04	-
17	BKG									
	lag	*	*	*	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.85	-3.59	-16.38	-2.72	-10.47	-
	Crt. Value	*	*	*	-3.45	-4.05	-4.05	-3.45	-3.45	-
18	ABX									
	lag	0.00	-	-	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	-4.95	-	-	-2.16	-1.98	-11.43	-1.92	-10.75	-
	Crt. Value	-3.52	-	-	-3.47	-3.47	-3.47	-3.46	-3.46	-
19	KRP									
	lag	0.00	0.00	-	12.00	12.00	11.00	0.00	0.00	-
	ADF stat.	-2.85	-8.95	-	-3.30	-2.24	-7.66	-1.19	-9.48	-
	Crt. Value	-3.47	-3.47	-	-3.45	-3.45	-3.45	-3.45	-3.45	-
20	MJQ									
	lag	*	*	*	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.73	-3.80	-25.33	-2.34	-10.93	-
	Crt. Value	*	*	*	-3.45	-4.05	-4.05	-4.04	-4.04	-
21	EJK									
	lag	*	*	*	12.00	11.00	-	0.00	0.00	-
	ADF stat.	*	*	*	-1.78	-4.39	-	-3.45	-12.80	-
	Crt. Value	*	*	*	-3.45	-4.05	-	-3.45	-3.45	-
22	MJB									
	lag	*	*	*	12.00	11.00	-	0.00	0.00	-
	ADF stat.	*	*	*	-0.95	-4.64	-	-2.84	-12.81	-
	Crt. Value	*	*	*	-3.45	-3.45	-	-3.45	-3.45	-
23	NPT									
	lag	*	*	*	12.00	-	-	0.00	0.00	-
	ADF stat.	*	*	*	-4.97	-	-	-1.23	-8.80	-
	Crt. Value	*	*	*	-3.45	-	-	-3.45	-3.45	-
24	HEA									
	lag	*	*	*	12.00	11.00	10.00	0.00	0.00	-
	ADF stat.	*	*	*	-2.69	-3.73	-28.65	-2.09	-10.58	-
	Crt. Value	*	*	*	-3.45	-4.05	-4.05	-3.45	-3.45	-
25	USK									
	lag	*	*	*	12.00	-	-	0.00		-
	ADF stat.	*	*	*	-4.13	-	-	-1.60	-9.96	-
	Crt. Value	*	*	*	-3.45	-	-	-3.45	-3.45	-
26	GHZ									
	lag	*	*	*	12.00	11.00	10.00	0.00	-	-
	ADF stat.	*	*	*	-1.89	-1.90	-59.40	-4.53	-	-
	Crt. Value	*	*	*	-3.45	-3.45	-3.45	-3.45	-	-

Table 5 Results of the Augmented Dickey Fuller Tests on the FMP model

No	Bank	M	ΔM	$\Delta^2 M$	k	Δk	$\Delta^2 k$	D	ΔD	$\Delta^2 D$
27	FKE									
	lag	*	*	*	12.00	11.00	-	0.00	0.00	-
	ADF stat.	*	*	*	-1.23	-10.05	-	-2.85	-8.97	-
	Crt. Value	*	*	*	-3.47	-3.47	-	-3.46	-3.46	-
28	RPA									
	lag	6.00	-	-	0.00	-	-	0.00	0.00	-
	ADF stat.	-6.05	-	-	-5.17	-	-	-3.23	-8.15	-
	Crt. Value	-3.88	-	-	-3.47	-	-	-3.47	-3.47	-
29	TUP									
	lag	*	*	*	12.00	11.00	10.00	0.00	1.00	-
	ADF stat.	*	*	*	-1.86	-1.71	-52.47	-1.58	-9.78	-
	Crt. Value	*	*	*	-3.45	-3.45	-3.45	-3.45	-3.45	-
30	PRM									
	lag	*	*	*	0.00	-	-	0.00 -		-
	ADF stat.	*	*	*	-4.75	-	-	-4.47 -		-
	Crt. Value	*	*	*	-3.46	-	-	-3.46 -		-

Notes:

a) Insufficient observation since the banks had just been listed on The Jakarta Stock Exchange

* Bank is not listed on the Jakarta Stock Exchange

Table 6 Results of The Cointegration Test Based on The ADF Test on The Regression Residuals (The Residual-Based Approach)

No	Bank	*k* and *M*		Conclusions	*k* and *D*		Conclusions
		ADF stat.	Crt. Value		ADF stat.	Crt. Value	
1	TDF	*	*	-	-2.75	-2.89	NC
2	SPW	-2.60	-2.89	NC	-2.60	-2.89	NC
3	LKY	a)	a)	-	-1.66	-2.89	NC
4	TSK	-1.60	-2.89	NC	-3.45	-2.89	C
5	KTP	*	*	-	-4.52	-2.89	C
6	JSL	-0.56	-2.89	NC	-2.50	-2.89	NC
7	RSW	*	*	-	-2.69	-2.89	NC
8	GXT	-1.25	-2.89	NC	-2.40	-2.89	NC
9	DLK	-2.14	-2.89	NC	-3.29	-2.89	C
10	SRH	-2.99	-2.89	C	-2.84	-2.89	NC
11	LRH	-1.64	-2.89	NC	-3.18	-2.89	C
12	DSP	*	*	-	-1.84	-2.89	NC
13	TLR	-0.98	-2.89	NC	-2.31	-2.89	NC
14	PTX	a)	a)	-	-2.23	-2.89	NC
15	KBN	*	*	-	-2.26	-2.89	NC
16	LDO	*	*	-	-2.49	-2.89	NC
17	BKG	*	*	-	-2.41	-2.89	NC
18	ABX	-2.03	-2.90	NC	-2.25	-2.90	NC
19	KRP	-2.31	-2.91	NC	-3.25	-2.89	C
20	MJQ	*	*	-	-3.08	-2.89	C
21	EJK	*	*	-	-1.65	-2.89	NC
22	MJB	*	*	-	-1.00	-2.89	NC
23	NPT	*	*	-	-4.93	-2.89	C
24	HEA	*	*	-	-2.04	-2.89	NC
25	USK	*	*	-	-4.06	-2.89	C
26	GHZ	*	*	-	-2.27	-2.89	NC
27	FKE	*	*	-	-2.15	-2.90	NC
28	RPA	-2.63	-3.12	NC	-5.27	-2.90	C
29	TUP	*	*	-	-2.36	-2.89	NC
30	PRM	*	*	-	-2.57	-2.90	NC

Notes:
* Banks are not listed on the Jakarta Stock Exchange
a) Insufficient observations since the banks have just been listed on the Jakarta Stock Exchange
C = Cointegrated, use VERM
NC = Not cointegrated, use VAR

Table 7 Results of the Granger causality tests in VAR on the FMP model

No	Bank	Variables	*k* and *M* F-Stat.	*k* and *M* Prob.	Conclusions	Variables	*k* and *D* F-Stat.	*k* and *D* Prob.	Conclusions
1	TDF	*k*	*	*	-	*k*	1.65409	0.09311	A
		M	*	*	-	*D*	1.19810	0.29884	A
2	SPW	*k*	0.28338	0.75467	A	*k*	0.68698	0.75940	A
		M	0.28722	0.75181	A	*D*	2.63870	0.00488	R
3	LKY	*k*	a)	a)	-	*k*	0.50844	0.60282	A
		M	a)	a)	-	*D*	0.51683	0.59783	A
4	TSK	*k*	0.86622	0.42387	A	*k*	0.24562	0.99502	A
		M	0.44187	0.64416	A	*D*	4.59100	0.00001	R
5	KTP	*k*	*	*	-	*k*	2.35171	0.01193	R
		M	*	*	-	*D*	2.75881	0.00340	R
6	JSL	*k*	0.17298	0.84142	A	*k*	1.07053	0.39566	A
		M	2.42913	0.09363	A	*D*	1.21728	0.28588	A
7	RSW	*k*	*	*	-	*k*	1.06196	0.40281	A
		M	*	*	-	*D*	1.31078	0.22872	A
8	GXT	*k*	0.65033	0.52421	A	*k*	0.81803	0.63137	A
		M	0.53717	0.58618	A	*D*	0.93980	0.51234	A
9	DLK	*k*	0.08669	0.91704	A	*k*	0.83598	0.61353	A
		M	0.29431	0.74573	A	*D*	1.35341	0.20587	A
10	SRH	*k*	0.04851	1.23257	A	*k*	0.35870	0.97392	A
		M	0.11713	0.04851	R	*D*	2.03508	0.03118	R
11	LRH	*k*	0.72580	0.49198	A	*k*	0.54174	0.88098	A
		M	2.01188	0.15083	A	*D*	2.10322	0.02546	R
12	DSP	*k*	*	*	-	*k*	1.20477	0.29429	A
		M	*	*	-	*D*	2.61587	0.00535	R
13	TLR	*k*	0.03267	0.96787	A	*k*	0.81858	0.63082	A
		M	2.70081	0.07236	A	*D*	5.03158	0.00000	R
14	PTX	*k*	a)	a)	-	*k*	2.00680	0.03389	R
		M	a)	a)	-	*D*	3.73809	0.00017	R
15	KBN	*k*	*	*	-	*k*	0.82682	0.62263	A
		M	*	*	-	*D*	1.80542	0.06084	A
16	LDO	*k*	*	*	-	*k*	0.67481	0.77057	A
		M	*	*	-	*D*	0.78294	0.66623	A
17	BKG	*k*	*	*	-	*k*	1.32952	0.21844	A
		M	*	*	-	*D*	0.83434	0.61516	A
18	ABX	*k*	8.31194	0.00111	R	*k*	1.10726	0.37405	A
		M	0.88453	0.42193	A	*D*	1.39675	0.19687	A
19	KRP	*k*	0.48855	0.61568	A	*k*	1.09270	0.37753	A
		M	0.28504	0.75289	A	*D*	1.22027	0.28390	A
20	MJQ	*k*	*	*	-	*k*	0.68346	0.76254	A
		M	*	*	-	*D*	1.57935	0.11423	A
21	EJK	*k*	*	*	-	*k*	1.09150	0.37831	A
		M	*	*	-	*D*	3.20109	0.00086	R
22	MJB	*k*	*	*	-	*k*	3.37300	0.00050	R
		M	*	*	-	*D*	2.06563	0.02831	R
23	NPT	*k*	*	*	-	*k*	1.82745	0.05689	A
		M	*	*	-	*D*	7.50827	0.00000	R
24	HEA	*k*	*	*	-	*k*	0.66203	0.78229	A
		M	*	*	-	*D*	2.60522	0.00553	R
25	USK	*k*	*	*	-	*k*	1.78463	0.06432	A
		M	*	*	-	*D*	3.67628	0.00020	R

Table 7 Results of the Granger causality tests in VAR on the FMP model

No	Bank	Variables	k and M F-Stat.	k and M Prob.	Conclusions	Variables	k and D F-Stat.	k and D Prob.	Conclusions
26	GHZ	k	*	*	-	k	0.58553	0.84784	A
		M	*	*	-	D	1.56838	0.11767	A
27	FKE	k	*	*	-	k	1.21865	0.29654	A
		M	*	*	-	D	4.53057	0.00006	R
28	RPA	k	a)	a)	-	k	1.60017	0.13425	A
		M	a)	a)	-	D	1.26259	0.28083	A
29	TUP	k	*	*	-	k	1.19366	0.30190	A
		M	*	*	-	D	6.31918	0.00000	R
30	PRM	k	*	*	-	k	1.05233	0.41837	A
		M	*	*	-	D	1.52853	0.14464	A

Notes:
* Banks are not listed on the Jakarta Stock Exchange
a) Insufficient observations since the banks have just been listed on the Jakarta Stock Exchange
A = Do not reject the null hypothesis
R = Reject the null hypothesis
The reported F-statitics are the Wald statistics for the following joint null hypothes:
(i) For k and M:
k does not Granger Cause M or all of the slope coefficients of M are zero
M does not Granger Cause k or all of the slope coefficients of k are zero
(ii) For k and D:
D does not Granger Cause k or all of the slope coefficients of k are zero
k does not Granger Cause D or all of the slope coefficients of D are zero

Table 8 Parameter Estimates in Per Cent

No	Bank	σ_M	σ_k	σ_D	ζ_{kM}	ζ_{kD}	β_{kM}
1	TDF	-	1.14	3.63	-	0.16	-
		-	(0.07)	(0.002)	-	(0.92)	-
2	SPW	23.54	1.13	113.41	-4.52	-0.39	1.21
		(0.02)	(0.07)	(0.07)	(0.23)	(0.66)	(0.60).
3	LKY	a)	1.02	6.46	-	-0.76	-
		a)	(0.07)	(0.004)	-	(0.33)	-
4	TSK	32.18	1.00	13.83	3.46	-1.87	-1.99
		(0.02)	(0.07)	(0.009)	(0.32)	(0.39)	(0.25)
5	KTP	-	1.20	6.43	-	-1.10	-
		-	(0.08)	(0.004)	-	(0.25)	-
6	JSL	60.92	1.14	103.29	1.36	1.26	33.47
		(0.04)	(07)	(0.067)	(0.56)	(0.22)	(0.116)
7	RSW	-	1.18	4.80	-	0.01	-
		-	(0.08)	(0.003)	-	(0.29)	-
8	GXT	39.11	1.18	4.71	7.31	-0.53	4.55
		(0.03)	(0.08)	(0.003)	(0.36)	(0.37)	(0.26)
9	DLK	23.13	1.12	6.15	1.69	-1.05	-28.66
		(0.02)	(0.07)	(0.004)	(0.24)	(0.21)	(0.41)
10	SRH	34.39	1.08	8.20	4.85	-1.13	-10.48
		(0.02)	(0.07)	(0.005)	(0.34)	(0.14)	(0.28)
11	LRH	25.50	1.14	7.68	6.30	-0.32	-11.04
		(0.03)	(0.07)	(0.005)	(0.25)	(0.50)	(0.73)
12	DSP	-	1.10	16.68	-	-2.68	-
		-	(0.07)	(0.011)	-	(0.38)	-
13	TLR	32.05	1.11	8.69	0.20	-1.46	132.77
		(0.23)	(0.07)	(0.006)	(1.40)	(0.12)	(0.07)
14	PTX	a)	1.08	5.99	a)	-0.28	a)
		a)	(0.07)	(0.004)	a)	(0.20)	a)
15	KBN	-	1.16	8.87	-	-1.25	-
		-	(0.08)	(0.006)	-	(0.19)	-
16	LDO	-	1.03	17.90	-	-2.42	-
		-	(0.07)	(0.012)	-	(0.84)	-
17	BKG	-	1.24	14.11	-	-3.67	-
		-	(0.08)	(0.009)	-	(0.46)	-
18	ABX	73.35	1.06	7.93	24.96	0.62	15.76
		(0.08)	(0.08)	(0.006)	(0.50)	(0.46)	(0.27)
19	KRP	20.01	1.10	4.70	-3.71	-0.95	39.75
		(0.02)	(0.07)	(0.003)	(0.20)	(0.12)	(0.55)
20	MJQ	-	1.12	15.59	-	-2.48	-
		-	(0.07)	(0.010)	-	(0.28)	-
21	EJK	-	0.78	9.03	-	0.16	-
		-	(0.05)	(0.059)	-	(0.37)	-
22	MJB	-	0.76	3.54	-	0.06	
		-	(0.05)	(0.002)	-	(0.31)	-
23	NPT	-	0.70	2.60	-	-0.07	-
		-	(0.05)	(0.002)	-	(0.06)	-
24	HEA	-	1.17	17.19	-	-3.40	-
		-	(0.08)	(0.011)	-	(0.24)	-
25	USK	-	0.81	3.93	-	0.22	-
		-	(0.05)	(0.003)	-	(0.31)	-

Table 8 Parameter Estimates in Per Cent

No	Bank	σ_M	σ_k	σ_D	ζ_{kM}	ζ_{kD}	β_{kM}
26	GHZ	-	1.11	88.70	-	-	-
		-	(0.07)	(0.057)	-	(0.11)	-
27	FKE	-	0.68	16.76	-	-1.13	-
		-	(0.05)	(0.013)	-	(0.27)	-
28	RPA	41.08	0.90	23.29	-0.24	-1.56	31.19
		(0.68)	(0.07)	(0.019)	(0.23)	(0.49)	(0.82)
29	TUP	-	1.26	8.92	-	-1.04	-
		-	(0.08)	(0.006)	-	(0.12)	-
30	PRM	-	1.25	88.79	-	-7.60	-
		-	(0.09)	(0.067)	-	(0.74)	-

Notes:
a) Insufficient observations since the banks had just been listed on The Jakarta Stock Exchange
- Bank is not listed on the Jakarta Stock Exchange
Standard error in parentheses
σ_M = Standard deviation of equity values
σ_k = Standard deviation of g_t/D_t
σ_D = Standard deviation of deposits
ζ_{kM} = Correlation of k and M
ζ_{gD} = Correlation of g and D
β_{kM} = CAPM's beta of k and M

Table 9 Deposit Guarantee Values, Subsidies and Bankruptcy Imminence

Number	1	2	3	4	5	6	7	8	9	10
Bank	TDF	SPW	LKY	TSK	KTP	JSL	RSW	GXT	DLK	SRH
Liabilities value*	20.44	-3.32	46.13	187.65	282.91	85.47	-20.07	599.69	52.96	-82.67
Standard error	5.43	3.20	5.80	44.65	20.38	8.36	10.61	31.36	8.09	25.76
Volatility kt	1.14	1.13	1.02	1.00	1.20	1.14	1.18	1.18	1.12	1.08
Standard error	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.07	0.07
Equity*	0.24	0.16	0.28	0.55	1.03	0.42	0.14	1.55	0.33	0.06
Liabilities/Equity ratio	83.56	-21.22	165.58	340.45	275.02	205.34	-140.22	387.12	162.05	-1,288.19
Terminal equity value**	-344.67	-391.42	-836.83	-892.79	-321.44	-629.06	-433.81	-958.00	-894.61	-629.31
Terminal $kt/\underline{k}$ ratio**	0.61	1.24	1.88	0.76	0.22	0.73	1.58	0.37	1.31	3.70
Shutdown point ($\underline{k}$)**	22.11	17.82	13.75	55.70	106.36	43.43	15.55	155.97	32.75	6.52
Closure rule ($\underline{k}$)**	0.12	0.00	0.58	1.85	0.18	1.81	1.23	1.07	0.06	0.10
Standard error	0.79	1.00	0.92	0.19	0.00	1.30	1.11	1.01	0.92	0.92
Subsidy (0 b.p. premium)*	-0.59	49.55	-4.09	0.00	0.00	-7.50	0.42	-10.62	-0.15	1.03
Subsidy (15 b.p. premium)***	14.41	49.77	12.31	0.00	0.00	11.15	15.22	11.87	14.94	15.65
Subsidy (30 b.p. premium)***	29.73	49.92	28.62	0.00	0.00	29.68	29.84	34.33	30.02	30.25
Subsidy (50 b.p. premium)***	50.12	50.12	50.22	0.00	0.00	54.22	49.05	64.24	50.12	49.70
Subsidy (fair flat premium)**	19.52	49.82	17.75	0.00	0.00	17.34	20.11	19.36	19.97	20.52
Imminence of bankruptcy	1.76	2.38	2.90	1.76	1.42	1.87	2.77	1.55	2.43	4.78

Number	11	12	13	14	15	16	17	18	19	20
Bank	LRH	DSP	TLR	PTX	KBN	LDO	BKG	ABX	KRP	MJQ
Liabilities value*	312.60	-65.45	118.68	-17.76	7.18	188.19	-16.70	333.54	70.16	130.61
Standard error	20.99	17.69	12.29	7.26	6.11	37.63	3.02	22.86	7.41	8.60
Volatility kt	1.14	1.10	1.11	1.08	1.16	1.03	1.24	1.06	1.10	1.12
Standard error	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.07	0.07
Equity*	0.89	0.08	0.46	0.24	0.21	0.57	0.12	0.94	0.37	0.48
Liabilities/Equity ratio	350.70	-791.46	256.64	-73.57	34.76	331.51	-137.18	353.26	190.56	271.34
Terminal equity value**	-437.41	-432.24	-1,306.64	-661.78	-441.64	-784.57	-389.03	-687.63	-1,037.96	-701.39
Terminal $kt/\underline{k}$ ratio**	0.20	1.75	1.09	1.13	0.87	0.37	1.13	0.27	1.48	0.56
Shutdown point ($\underline{k}$)**	89.88	8.50	46.58	21.79	20.71	58.42	12.73	95.95	37.22	49.79
Closure rule ($\underline{k}$)**	0.75	0.23	0.33	0.16	0.05	1.94	0.56	1.53	0.40	1.66
Standard error	1.10	0.98	0.90	0.89	0.91	0.99	0.71	1.53	0.98	1.02
Subsidy (0 b.p. premium)*	-14.40	1.15	-0.96	0.56	-0.06	-27.66	-0.06	-5.57	-2.95	-6.01
Subsidy (15 b.p. premium)***	11.11	15.64	14.56	15.35	14.97	-4.04	14.97	12.93	13.49	11.57
Subsidy (30 b.p. premium)***	36.56	30.11	30.07	30.11	29.99	19.47	29.99	31.40	29.87	29.09
Subsidy (50 b.p. premium)***	70.39	49.36	50.72	49.77	50.02	50.65	50.00	55.98	51.62	52.37
Subsidy (fair flat premium)**	19.60	20.46	19.73	20.27	19.97	3.80	19.98	19.09	18.96	20.03
Imminence of bankruptcy	1.34	2.85	2.20	2.22	2.03	1.40	2.38	1.33	2.58	1.67

Table 9 Deposit Guarantee Values, Subsidies and Bankruptcy Imminence

Number	21	22	23	24	25	26	27	28	29	30
Bank	EJK	MJB	NPT	HEA	USK	GHZ	FKE	RPA	TUP	PRM
Liabilities value*	-102.09	10.65	-58.70	-24.28	-44.67	-96.83	-90.34	-96.37	-46.44	758.03
Standard error	12.42	32.07	6.59	3.11	4.54	18.37	6.43	2.52	3.83	189.25
Volatility *kt*	0.78	0.76	0.70	1.17	0.81	1.11	0.68	0.90	1.26	1.25
Standard error	0.05	0.05	0.05	0.07	0.05	0.07	0.05	0.07	0.08	0.09
Equity*	0.04	0.18	0.14	0.15	0.13	0.03	0.02	0.02	0.19	1.69
Liabilities/Equity ratio	-2,763.93	58.36	-414.66	-164.04	-340.01	-2,930.82	-4,697.23	-5,660.93	-250.50	448.84
Terminal equity value**	-438.50	-288.87	-589.56	-197.26	-258.10	-197.61	-353.69	-338.88	-137.02	-24,546.15
Terminal *kt*/ $\underline{k}$ ratio**	8.73	0.45	1.50	0.20	0.50	1.38	5.87	0.97	0.15	2.55
Shutdown point ($\underline{k}$)**	2.32	19.41	14.22	15.88	13.28	3.37	3.16	2.56	18.86	180.89
Closure rule ($\underline{k}$)**	0.03	1.17	0.06	0.00	0.14	0.06	1.23	0.86	0.32	12.05
Standard error	0.84	0.74	0.95	0.38	0.89	0.92	28.29	28.55	1.14	1.12
Subsidy (0 b.p. premium)*	0.05	-1.58	0.77	-810.15	1.41	2.20	0.00	0.00	3.82	-3.92
Subsidy (15 b.p. premium)***	15.03	13.99	15.54	-795.15	16.02	16.62	0.00	0.00	17.69	14.02
Subsidy (30 b.p. premium)***	30.02	29.51	30.29	-780.15	30.61	31.02	0.00	0.00	31.52	31.94
Subsidy (50 b.p. premium)***	49.99	50.12	49.95	-760.15	50.03	50.20	0.00	0.00	49.88	55.83
Subsidy (fair flat premium)**	19.52	19.17	20.46	-790.15	20.89	21.42	0.00	0.00	22.30	19.99
Imminence of bankruptcy	9.51	1.21	2.20	1.37	1.32	2.50	6.55	1.87	1.41	3.80

Note:
All numbers are in % of liabilities unless otherwise indicated
* Assuming a zero deposit insurance premium
** Assuming actual deposit insurance premium
*** Assuming different actual deposit insurance premiums
Liabilities value = value of guarantee at zero deposit insurance premium and at optimal closure rule
Volatility = standard deviation of log (*kt*)
Equity = Value of bank given zero deposit insurance premium and at closure rule
Subsidy = government's bail-out on top of deposit insurance premium charged
Terminal equity value and terminal kt are *Vt* and *kt* at end of sample period
Shut-down point = *kt* level that triggers bank closure ($\underline{k}$)
Closure rule = $\underline{k}$ at optimal closure rule
Imminence of bankruptcy = probability distance to bankruptcy

Appendix 1

Principles and Components of a "Regulation Regime"

I. Regulation

1. **The objectives of regulation need to be clearly defined and circumscribed.**
2. **The rationale and motivation of regulation and supervision should be limited.**
3. **Regulation should be viewed in terms of a set of contracts.**
4. **The form and intensity of regulatory and supervisory requirements should differentiate between regulated institutions according to their relative portfolio risk and efficiency of internal control mechanism.**
5. **In some areas the regulator could offer a menu of contracts to regulated firms requiring them to self-select into the correct category.**
6. **Capital regulation should create incentives for the correct pricing of absolute and relative risk.**

II. Incentive Structures

7. **There should be appropriate incentives for bank owners.**
8. **There should be appropriate internal incentives for management.**

III. Monitoring and Supervision

9. **Official agencies need to have sufficient powers and independence to conduct effective monitoring and supervision.**
10. **Less emphasis should be placed on detailed and prescriptive rules and more on internal risk analysis, management and control system**

IV. Intervention Arrangements

11. **The design and application of safety-net arrangements (lender-of-last-resort and deposit insurance) should create incentives for stakeholders to exercise oversight and to act prudently so as to reduce the probability of recourse being made to public funds.**
12. **The extent and coverage of deposit insurance schemes should be strictly limited**
13. **There needs to be a well-defined strategy for responding to the possible insolvency of financial institutions.**
14. **There should be a clear bias (through not a bar) against forbearance when a bank is in difficulty.**
15. **Time-inconsistency and credibility problems should be addressed through pre-commitments and graduated with the possibility of over-rides.**
16. **Intervention authorities need to ensure that parties that have benefited from risk-taking bear a large proportion of the cost of restructuring the banking system.**
17. **Prompt corrective action should be taken to prevent problem institutions extending credit to high risk borrowers, or capitalizing unpaid interest on delinquent loans into new credit.**
18. **Society must create the political will to make restructuring a priority in allocating public funds while avoiding sharp increases in inflation. Use of public funds in rescue operations should be kept to a minimum and, whenever used, be subject to strict conditionally.**
19. **Barriers to market re-capitalization should be minimized.**
20. **Regulators should be publicly accountable through credible mechanisms.**

V. Market Discipline.

21. **Regulation should not impede competition but should enhance it and, by addressing information asymmetries, make it more effective in the market place.**
22. **Regulation should reinforce, not replace, market discipline, and the regulatory regime should be structured so as to provide greater incentives than exist at present for market to monitor banks.**
23. **Whenever possible, regulators should utilise market data in their supervisory procedures.**
24. **There should be a significant role for rating agencies in the supervisory process.**

VI. Corporate Governance

25. **Corporate governance arrangements should provide for effective monitoring and supervision of the risk-taking profile of banks.**

Source: Llewellyn, 1999c.

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