

# The Factors Influencing Credit Quality: Capital Adequacy of Credit Risks Indonesia Banking to Fulfill Their Role in Economy to Transform Risks

**Natali Ikawidjaja**

Doctoral Program, Postgraduate Program in Economics  
University of Hasanuddin  
Makassar, Indonesia

**Eka Afnan Troena**

Professor, Faculty of Economics and Business  
University of Brawijaya  
Malang, Indonesia

**Muhammad Ali**

Professor, Faculty of Economics and Business  
University of Hasanuddin  
Makassar, Indonesia

**Abd. Rakhman Laba**

Assistant Professor, Faculty of Economics and Business  
University of Hasanuddin  
Makassar, Indonesia

**Abstract-** There is several factors that could influence credit quality in Indonesian banking. Of these factors, capital adequacy and credit risk are two of the major factors that were focused in many studies. This paper reviews prior research on credit risk analysis mainly focusing on structural models. Structural default model used is related with the credit quality of a firm and the firm's economic and financial conditions as introduced by Merton (1974). This model is, in contrast to the reduced-form models where default is given exogenously. The structural models in this study used the evolution of a firm's structural variables, such as asset and debt values, to determine the timing of default. This study argued that Merton's model considers a firm as failure if, at the time of servicing the debt at maturity, its assets are below its outstanding debt. The basic idea is that the firm's equity is seen as a European call option with maturity  $T$  and strike price  $D$  on asset value  $V$ . The firm's debt value is the asset value minus the equity value seen as a call option. This method presumes a very simplistic capital structure and implies that default can only occur at the maturity of the zero-coupon bond. This study concludes inter alia that the challenge ahead for Indonesian financial authority now is to appreciate the central position of Indonesia's banking and finance industries in the country's ongoing development.

**Index Terms—** Structural model, Credit Quality, Capital Adequacy, Credit Risk, Indonesian Banking

## I. INTRODUCTION

Banks, by virtue of their role in the economy worldwide is to transform risks. The common risks transformed are those of

credit and liquidity, which are also the risks that banks have been assuming for the longest periods of time. Hall (1993) provides a list of statutes relating to the financial sector of the economy for Japan, UK, and USA, including some legislation still in place from the 1930s. Many banks have extended their financial intermediation role and risk taking from traditional activities to include many forms of market risk. This is an indication of the continuing evolution of banks and their role in the economy.

Studies focusing on the credit risk and the suitable level of capital adequacy have been topical for many years. The concern on these issues still continues until now. In fact, it attracts not only among academics, but also practitioners and regulators worldwide. In recent years, due to the collapse of many large global corporations, including Enron, Worldcom, Global Crossing, Adelphia Communications, Tyco, Vivendi, Royal Ahold, HealthSouth, and, in Australia, HIH, One.Tel, Pasminco and Ansett, concern on this issues becomes mounting. This is simply because the failure of the above corporations has led to significant economic, social and political costs.

As the above problems were beginning to fade away in the public memory, crisis struck again in June 2007. This crisis happened due to the collapse of the 'sub-prime' mortgage market in the United States, and the subsequent turmoil in world equity and bond markets that led to fears of an impending international liquidity and credit crisis, which could

affect the fortunes of many financial institutions and corporations for some time to come.

Based on the above brief background, this study examined the first structural models introduced by Merton in 1974. The basic idea is that the firm's equity is seen as a European call option with maturity  $T$  and strike price  $D$  on asset value  $V$ . The firm's debt value is the asset value minus the equity value seen as a call option. This method presumes a very simplistic capital structure and implies that default can only occur at the maturity of the zero-coupon bond.

Apart from the first model, there is a second approach within the structural framework introduced by Black and Cox (1976). In this approach, the default occurs when a firm's asset value falls below a certain threshold. There were subsequent studies that have explored more appropriate default boundary inputs, while other studies have relaxed certain assumptions of Merton's model such as stochastic interest rates and early default. This paper aims at discussing and critically reviewing subsequent research on the main structural credit risk models, such as models with stochastic interest rates, exogenous and endogenous default barrier models and models with mean reverting leverage ratios, taking Indonesia's banking as case.

## II. LITERATURES REVIEW

### *Credit Risk*

Credit Risks are often described as "qualitative" when it is difficult to provide an accurate value as to their impact. This is in contrast to those risks that are seen as quantitative. An example of a qualitative risk is settlement risk where, although the amounts at risk can be measured, the probability of loss is difficult to assess. An illustration of settlement risk was provided by the demise of the Herstatt Bank in Germany during 1974. In order to alleviate this particular risk there has been a concerted effort to promote real-time payment settlement systems and a general reduction in settlement times. In this case the interested parties have not only been the supervisors, but also industry bodies and individual firms in the financial sector.

Another example of a qualitative risk is reputational risk, affecting either one particular bank or an entire sector of the banking community. Other risks in this category involve various management and systems issues, including valuation methods and risk management for complex products, as well as acts that are potentially criminal. Some commentators would suggest that there are no new risks in the system, but it would appear that certain types of products and activities amplify the impact of a given risk; an example would be some forms of derivative contracts.

While derivatives may be a relatively recent tool by which banks intermediate risk, capital adequacy standards have also evolved to reflect their development. Some of the standards are based upon holding given quantities of capital for a given risk, while other standards may be qualitative. The Basle Supervisors Committee issues statements on qualitative standards, such as the paper on risk management guidelines for derivatives, as well as minimum quantitative standards, such as the Basle Accord.

Banks and securities firms are required to hold capital against their quantitative and qualitative risks. Until recently the main capital requirements, for banks, have addressed credit and counterparty risk. For securities firms the focus has been

upon market risk. However, with the implementation of the Capital Adequacy Directive (which applies to banks and securities firms in the EU) and proposed amendments to the Basle Accord, banks will be required to hold capital against some of their market risks (Stone and Zissu, 1994a).

Both the Basle Accord and the Capital Adequacy Directive represent minimum standards and local supervisors have the ability to impose higher requirements. For example, the Basle Accord has 8 percent as the minimum ratio between capital- and risk-weighted assets, but some supervisors impose higher ratios which typically reflect qualitative risks at individual banks.

Capital may be in the form of equity, tier 1 capital, and various forms of subordinated debt, upper and lower tier 2 capital, and must be capable of absorbing losses either on a continuing basis or at least in the event of a bank's liquidation. Supervisors normally impose limits on the contribution that different forms of capital can make to the composition of the capital base.

It should be noted that the quantitative capital standards are based upon the values of the positions held by the firms in the financial sector. Often national bodies produce guidelines and recommendations on the application of accounting principles to banks and financial firms, such as the British Bankers' Association statements of recommended practice. Differences can occur between countries, in the capital required for an exposure, or position, due to different accounting standards. This is a feature of on- and off-balance sheet items. However, the International Accounting Standards Committee is in the process of producing international guidance.

### *Capital Adequacy*

Capital adequacy affects all corporate entities, but as a term it is most often used in discussing the position of firms in the financial sectors of the economy, and in particular whether firms have adequate capital to guard against the risks that they face. A balance needs to be struck between the often conflicting perspectives of the various stake-holders. Lenders require capital to ensure that there is a cushion against possible losses at the borrowing firm, while shareholders often focus upon return on capital. For firms operating in the financial sector, the general public also has a stake in the firm as failure may have implications for the financial stability of the system as a whole.

The focus of financial stability is primarily upon banks because of the functions that they perform. Banks not only provide a significant proportion of the financing required by the economy, but they also act as a conduit for payments. Further, the financial sector is used by central banks as a mechanism for transmitting changes in monetary policy through to the real economy. The focus of financial stability is the financial system itself, rather than an individual institution, but the means by which financial stability is achieved is through the review of individual institutions (George, 1994).

Users of the financial sector of the economy benefit from the competition within this sector, and in response banks, and other firms, seek to optimize their business mix. In order to allow competition within the financial sector those agents responsible for monitoring capital adequacy need to give firms the freedom to take risks. On occasions, this means that firms in the financial sector will fail. If this never happened either the costs to the users of banking services would be prohibitive

(and/or the range of services themselves extremely limited) or the lender of last resort would effectively be taking all of the risks, but have no influence over which risks it acquired.

Permitting banks to fail indicates a possible conflict between capital adequacy, deposit protection (see Stone and Zissu, 1994a), and the perspective of other stakeholders such as shareholders. Deposit protection schemes are operational in many countries, but most do not protect the full value of every depositor's claim. The intention is usually to ensure that depositors bear some responsibility for their actions when a bank is liquidated. If the deposits were entirely risk free then a significant group of stakeholders would have no interest in the risks being taken and banks might be tempted into acquiring inappropriate types and levels of risk.

Capital adequacy is intended to aid financial stability and, as a result, the role of an individual institution in the system is the overriding concern, rather than individual institutions *per se*. As the relationship between banking activities and other parts of the financial sector is increasing in breadth and depth, there is the possibility of financial stability being disrupted by non-banking activities. It is also the case that some sources of disruption could originate from international activities. These developments have encouraged greater discussion among supervisors of different financial sectors, both domestically in Indonesia and internationally in the World.

Agents and agencies responsible for monitoring capital adequacy vary from country to country, and on occasions within countries. Hall (1993) describes the banking regulation and supervisory framework for Japan, the UK, and the USA. In some countries a single agency is responsible for capital adequacy of all participants in the financial sector of the economy. In other countries several agencies may be responsible for a given constituency. The lender of last resort is not necessarily the same as the agency responsible for the monitoring of the capital adequacy of banks or other parts of the financial sector.

Although capital adequacy frameworks operate in, and are shaped by, the national environment, they may also be influenced by international fora. The Basle Supervisors Committee, with representatives from the G10 countries plus Luxembourg and Switzerland, has been meeting at the Bank of International Settlements since 1975 to address international banking issues. Some countries that are not members of the Basle Committee nevertheless adopt their standards.

The European Union (EU) also has an interest in developments in capital adequacy standards, setting common minimum standards to enable the free flow of services and capital within the Community (the Single Market initiative). However, while the standards issued by the Basle Supervisors Committee may be considered as "guidance," the EU initiatives are in the form of directives which are legal in nature and as a result influence the balance between supervision and regulation. The International Organization of Securities Commissions (IOSCO) through its technical committee, which has been meeting since 1987, also has convergence of capital standards as one of its aims.

Both the Basle Committee and the EU have significantly altered the capital adequacy standards that apply to banks in the past fifteen years. The Basle Committee issued the Basle Accord in July 1988 and this was followed by the EU Directive on the Solvency Ratio for Credit Institutions (89/647/EEC) in 1989. These two comparable initiatives led to an 8 percent

minimum capital requirement to support credit risk at banks being adopted by the members of G10, the EU and more widely.

The list of EU directives (below) provides a perspective of the range of quantitative and qualitative issues that comprise current capital adequacy standards for banks. Some also apply to securities firms, while others describe the roles and responsibilities among the supervisors of a global banking or securities group. Broader descriptions of some of these issues are contained in Maisel (1981), and Stone and Zissu (1994b).

Modernizing capital adequacy standards tends to create step changes in requirements. Very often the changes in capital requirements are derived or generated in international fora, such as Basle or the EU, and negotiations and consensus building take time and resources. When the Basle Accord was released in July 1988, it was recognized that market risk also needed to be addressed. It is likely that the Accord will be amended to encompass market risk during 1996.

The process of updating capital adequacy standards is made more complex as the techniques used by banks to manage particular risks may evolve during the discussion of the requirements to address that particular risk. The step changes in capital adequacy standards often arise due to the time taken to build the necessary consensus not just among the supervisors, but also between the banks and the supervisors.

The occasionally abrupt changes are in contrast to the more evenly paced evolution of developments within individual banks and the financial sector as a whole. Although capital standards may lag behind market developments and the activities of banks, it does not necessarily mean that the supervisors are unaware of developments, or have not devised interim treatments until the developments are formally addressed in revised standards.

While the revisions to capital adequacy standards may not always be at the cutting edge, in contrast to the position of some individual banks, the standards apply to a diverse range of banks. As a result they need to be capable of being applied to the majority of banks, even if they are less technically advanced than methods used by a small minority of banks.

As the purpose of capital adequacy is not necessarily to protect a bank from failure, but to promote financial stability in the system, supervisors consider losses in that context. Significant losses published by firms in the financial sector serve to remind everybody that risks need to be actively managed and the response to these losses by the marketplace often reinforces the qualitative aspects of capital adequacy standards.

As a generalization there is probably a trend towards the greater use of qualitative standards for capital adequacy. This brings with it the ability to adjust the demands and expectations of those responsible for monitoring capital adequacy to the activity and needs of individual banks. No two banks are exactly the same. These qualitative standards are underpinned by the quantitative standards which require specific amounts of capital to support a given volume of a particular form of risk, or provide outright limits on certain activities and exposures.

### III. RESULTS AND DISCUSSION

#### *The Riskiness of Banking in Indonesia and the World*

Moreover, banking appears inherently risky. In Reinhart and Rogoff (2009: xxvii) survey of financial crises throughout

history, Reinhart and Rogoff draw attention to the serial nature of banking crises in advanced economies over the two centuries from 1800 to 2008. Far from being a phenomenon peculiar to developing countries with nascent banking systems, the developed world's financial centres have been hit repeatedly by banking crises. Thus, banking crises 'remain a recurring problem everywhere. They are an equal-opportunity menace, affecting rich and poor countries alike' including Indonesia.

The very nature of banking in Indonesia (borrowing money in the short term, to lend out over the longer term) makes it vulnerable to runs, or losses of confidence, where depositors (or those who have made short-term money available, including in wholesale markets) all seek to withdraw funds at once. These runs need not be wholly justified, and can be indiscriminate between good banks and bad banks, but can devastate an entire financial sector.

Bank runs in Indonesia, and in general the world, are simply one important example of the fragility of highly leveraged borrowers, public and private. The implosion of the US financial system during 2007–8 came about precisely because many financial firms outside the traditional and regulated banking sector financed their illiquid investments using short-term borrowing. In modern financial systems, it is not only banks that are subject to runs, but also other types of financial institutions that have highly leveraged portfolios financed by short-term borrowing (Reinhart and Rogoff, 2009: 145).

Several common factors emerge when Reinhart and Rogoff (2009:155) consider banking crises over the longer term. One is that periods of high international capital mobility are linked to banking crises. In the period after 1970, in 18 of the 26 banking crises studied the financial sector had been liberalised within the preceding five years. In the 1980s and 1990s most liberalisation episodes were associated with financial crises of varying severity, and only in a small minority of countries (such as Canada) did liberalisation proceed smoothly.

Looking back over the longer term since 1800, periods of high international capital mobility have repeatedly produced international banking crises, not only famously, as they did in the 1990s, but historically. This is similar to Kindleberger and Aliber (2011:1) who also associate the four large international credit bubbles since the 1970s with cross-border capital flows.

A second feature is the severe impact of banking crises on public finances. The cost of bailing out banks, added to the reduction in tax revenues and increased public expenditure through countervailing welfare payments and other fiscal measures, mean that on average, during the modern era, real government debt rises by 86% during the three years following a banking crisis.

Third, banking crises lead to a slowdown in real economic activity in the countries in question. Particularly severe episodes include the Great Depression in the United States after the collapse of the financial system, and stagnation in Japan following a collapse in land prices in 1990, but the effect is general: 'there is indeed significant theoretical and empirical support for the view that a collapse in a country's banking system can have huge implications for its growth trajectory' (Reinhart and Rogoff, 2009: 147).

The inherent riskiness of banking in developed market economies is examined in depth by Minsky (1986, 2008). An important cause of instability is the need for financing in

industrial and industrialising economies, not just in the modern post-war economy but, generally, over the past century and a half. Industrial economies rely on large-scale capital assets for production, but investment in, and the ownership of, capital assets with long lives normally obliges firms to use external finance. This means that a 'lack of synchronization' arises between the contractual payments on debts and the receipts from operations built into the banker-business relationship, as positions in long-lived assets are financed by short-term liabilities.

This 'lack of synchronisation' leads to increasingly precarious short-term liabilities for capital assets, created by a banking system driven by innovation and the search for profit. Capital assets may be financed in one of three ways (termed by Minsky 'hedge', 'speculative' and 'Ponzi' finance), with the thrust of financing tending towards the 'speculative' and 'Ponzi' methods, because of profit opportunities arising from an initially robust financial structure.

Hedge financing consists of using expected cash flow from operating capital assets to meet expected payment commitments; speculative financing consists of expected cash flow from capital assets to be less than payment commitments, so there is a rolling over of maturing debt; and Ponzi financing is the same as speculative financing, except that additional debt is incurred to pay for debt. While hedge financing is vulnerable only to shortfalls in actual receipts from capital assets, both speculative and Ponzi financing are vulnerable to changes in financial market conditions, throughout the long life period of the capital asset.

The mixture of hedge, speculative and Ponzi finance in an economy is therefore a major determinant of its stability. Hedge financing is vulnerable to unforeseen changes in real economy product and factor markets which affect output (and therefore receipts) from capital assets, but speculative and Ponzi financing are vulnerable to changes in interest rates and to financial market developments – as well as to any product and factor market events.

If interest rates increase unexpectedly this leads to higher cash-flow commitments without any increase in prospective receipts. Moreover, since they continually have to refinance their positions, firms financed in this way are also vulnerable to disruptions in financial markets. The greater the weight of speculative and Ponzi finance, the smaller the overall margins of safety in the economy and the greater the fragility of the financial structure (Minsky, 2008).

Indonesian Commercial banking is therefore associated with speculative financing, and, as periods of financial stability lead to financial innovations, speculative financing can shade into ever more fragile Ponzi structures. Another factor in play is the increasing use of leverage by banks, allowing profits to rise and increased retained earnings by minimising the equity held against assets.

By increasing leverage banks can grow faster through retained earnings, but at a rate that is faster than the real economy justifies, or can sustain. Nor are regulators of banks able to control, or even understand, the financing positions of the very large complex banks. In the view of Minsky, the riskiness of banking is inescapable. This is in line with Minsky statement (1986: 279) that the destabilizing aspect of banking should not be surprising – after all, bankers are specialists in providing short-term financing to business, government, and households, and the banker sells his services by teaching



customers how to use bank facilities. Bankers cannot make a living unless business, government, and households borrow; they are merchants of debt.

### ***The Need to Analyze Credit Risk and Capital Adequacy as Major Factors in Indonesian Banking Credit Quality***

Within the risky industry of banking certain functions are riskier than others. The OECD's reference to 'huge risks' from investment banking activities, including the use of derivatives, has already been mentioned above. Experience from the investment banking in the UK since Big Bang in 1986 developed in such a way that all the main independent firms who operated in the capital markets in London at the time of Big Bang had to exit, usually through being bought up by larger, better capitalised, firms.

The case of S G Warburg, probably the premier UK merchant bank in the post-war period, is instructive. Warburg's strength, developed over the postwar decades, lay in close knowledge of the industrial clients it advised, with innovations in the service of its clients (such as the first UK contested takeover in 1959, and the first Eurobond issue in 1963). It operated on a relatively small scale, and kept to business it knew. Managerial control was extremely tight (Ferguson, 2010).

With the advent of Big Bang in 1986 Warburg, like other merchant banks, decided it needed to move into capital markets or else risk losing clients. It acquired a jobbing firm and two brokers in London and became an integrated investment bank; indeed, initially, one of the most successful. It also expanded internationally. Augar (2001) mentions a small but telling detail. In the three years immediately following Big Bang, Warburg grew to become the leading broking firm in London, with the highest levels of profit – but the basis of this profit was fragile.

Profitability depended upon a small part of the securities business (futures contract trading, where a few traders had good short-term, 24 or 48 hour, strategic views of market behaviour), while the rest of the business was not profitable. According to an unnamed 'senior Warburg insider', 'There were forty or fifty market makers making no money and three or four of them producing a fortune'. The volatile nature of profitability in the securities business, and the need for high levels of capital to stay in it (particularly after losses in the bond market in 1994), led to Warburg eventually selling itself to Swiss Bank Corporation in 1995. Swiss Bank Corporation then itself merged with UBS in 1998.

It was also noted how the reality of capital markets practice has departed from the theory of market efficiency (Ikawidjaja, 2016). Particular features have been ever shorter holding periods of securities by market participants, and increased price volatility and synchronisation. Short-term or momentum pricing, based on the current views of market participants, has tended to displace long-term pricing, based on estimates of fundamental long-term value.

In capital markets which are prone to mispricing and instability tools have been developed by investment banks which attempt to manage their own risk. One such is 'Value at Risk' (VAR), which was (and is) a benchmark by which possible losses under various scenarios can be measured. However, although purporting to be forward-looking, VAR extrapolates from previous experience, under certain

assumptions. This may work so long as the future resembles the past, but not in situations of discontinuity.

In 2008, UBS (the bank which, as described above, became the ultimate owner of Warburg) noted in a report to shareholders immediately after the financial crisis that its business planning relied on VAR, as the 'key risk parameter' in the planning process. However, when the market dislocation unfolded, it became apparent that this risk measure methodology had not appropriately captured the risk inherent in the business having subprime exposures (Cassidy, 2009). This brings us to the next section to review some prominent models to predict credit quality.

### ***Comparison of Models to Predict Credit Quality***

The lack of a solid economic understanding of the factors that determine credit quality makes explanation and prediction difficult to assess. However, the accuracy of these predictors is essential for sound risk management and for evaluation of the vulnerability of corporations and institutional lenders. In recognition of this, the new capital adequacy framework (Basel II) envisages a more active role for banks in measuring the default risk of their loan books. The need for reliable measures of default or credit risk is clear to all.

The finance literature has produced a variety of models attempting to predict or measure default risk. There are two primary types of models that describe default processes in the credit risk literature: structural models and reduced-form models. Structural models use the evolution of a firm's structural variables, such as asset and debt values, to determine the timing of default. Merton's model (1974) is considered the first structural model.

In Merton's model, a firm defaults if, at the time of servicing the debt at debt maturity, its assets are below its outstanding debt. A second approach within the structural framework was introduced by Black and Cox (1976). In this approach default occurs when a firm's asset value falls below a certain threshold. In contrast to the Merton approach, default can occur at any time.

Reduced-form models do not consider the relation between default and firm value explicitly. In contrast to structural models, the timing of default is not determined based on the value of the firm but as the first jump in an exogenously given jump process. The parameters governing the default hazard rate are inferred from market data. Prior to 1977, various bankruptcy prediction studies were conducted for non-financial firms based primarily on linear discriminant analysis.

This research was originated with Beaver's (1966) univariate analysis model and culminated with the Zeta model of Altman et al. (1977). During this period, researchers attempted to improve the accuracy of multi-ratio predictive models by optimizing a set of predictor variables. After the mid-1970s, researchers focused primarily on the problems associated with the then prevailing methodological approaches (Eisenbeis 1977).

Related studies from this period include Beaver (1966), Altman (1968), Edmister (1972), Wilcox (1973), and Zmijewski (1984). Despite the criticisms expressed in these later studies, the main conclusion of this body of research was that financial ratios provided a significant indication of the likelihood of financial distress. However, later efforts to overcome the methodological difficulties associated with MDA

resulted in greater use of the logit model which relied on less restrictive assumptions than MDA (Zavgren, 1983).

Structural default models relate the credit quality of a firm and the firm's economic and financial conditions. Thus, in contrast to reduced-form models where default is determined exogenously, in structural models default is endogenously generated within the model. Also, the treatment of recovery rates for reduced-form models is exogenously specified, whereas in structural models recovery rates are determined by the value of the firm's assets and liabilities at default.

The literature on structural credit risk models was initiated by Merton (1974), who applies option pricing theory to the modelling of a firm's debt. In Merton's model, the firm's capital structure is assumed to be composed of equity and a zero-coupon bond with maturity  $T$  and face value  $D$ . The basic idea is that the firm's equity is seen as a European call option with maturity  $T$  and strike price  $D$  on asset value  $V$ . The firm's debt value is the asset value minus the equity value seen as a call option. This method presumes a very simplistic capital structure and implies that default can only occur at the maturity of the zero-coupon bond.

Black and Cox (1976) introduced the first paper of the so-called 'first passage' models. First-passage models specify default as the first time the firm's asset value hits a specified lower barrier, allowing default to take place at any time up to debt maturity. The default barrier  $V$ , exogenously given as in Black and Cox (1976) and Longstaff and Schwartz (1995), acts as a safety covenant that protects bondholders. Alternatively, it can be determined endogenously as a result of the stockholders' attempt to choose the default threshold which maximizes the value of the firm, as in Leland and Toft (1996).

In the Merton model a firm's equity is treated as a European call option written on the firm's asset value. It is assumed that the issuing firm has only one outstanding bond, and thus the firm does not default prior to the debt maturity date. In addition, the term structure of risk-free interest rate  $r$ , firm's asset volatility  $\sigma$  and asset risk premium  $\lambda$  are assumed to be constant. Black and Cox (1976) treat the firm's equity as a down-and-out call option on firm's value. In their model, firm defaults when its asset value hits a pre-specified default barrier,  $V_{\text{bar}}$ , which can be either a constant or a time-varying variable. The default barrier is assumed to be exogenously determined.

Prior structural models considered both deterministic interest rates (Black and Cox 1976, Geske 1979, Leland and Toft 1996) as well as stochastic interest rates (Ronn and Verma 1986, Kim, Ramaswamy and Sundaresan 1993, Nielsen et al. 1993, Longstaff and Schwartz 1995, Briys and de Varenne 1997, Hsu et al. 2004).

In first-passage models, default occurs the first time the asset value goes below a certain lower threshold and the firm is liquidated immediately after the default event. In more recent models, a default event does not immediately cause liquidation, but it represents the beginning of a liquidation process which might or might not lead to liquidation once it is completed.

This is consistent with Chapter 11 of the US Bankruptcy Law where the firm remains in control of the business throughout the reorganization process. As a consequence, equity has some value even when the firm is insolvent. However, the company's management is subject to detailed supervision by the courts, which may potentially limit its discretion to raise financing, sell assets, or even set the level of

salaries of managers. We refer to these models as 'liquidation process models'.

Nowadays, various researchers attempt to incorporate more real-life features into structural models, namely, 'State-dependent models' together with 'liquidation process models'. Although these models make good theoretical sense, they have not been subjected to extensive empirical testing. State-dependent models assume that some of the parameters governing the firm's ability to generate cash flows or its funding costs are state dependent, where states can represent the business cycle (recession versus expansion) or the firm's external debt rating.

#### IV. CONCLUDING NOTES

This paper reviews prior research on credit risk analysis mainly focusing on structural models. Structural default models used relate the credit quality of a firm and the firm's economic and financial conditions introduced by the seminal work of Merton (1974). This is in contrast to the reduced-form models where default is given exogenously.

Merton's model considers a firm as failure if, at the time of servicing the debt at maturity, its assets are below its outstanding debt. The basic idea is that the firm's equity is seen as a European call option with maturity  $T$  and strike price  $D$  on asset value  $V$ . The firm's debt value is the asset value minus the equity value seen as a call option. This method presumes a very simplistic capital structure and implies that default can only occur at the maturity of the zero-coupon bond. Subsequent research (Ikawidjaja, 2016) trying to evaluate several factors which could be considered in the main structural credit quality models and would be reported in the next paper.

The difficulty of calculating (and agreeing) safe capital levels for the risks facing today's remaining large in Indonesia and interconnected investment banks continues to preoccupy global regulatory authorities. It has become evident that capital adequacy rules under the various Basel Accords since 1988 have been inadequate (Ikawidjaja, 2016). Moreover, the practice since the 1990s of allowing banks to use their own internal risk models to calculate capital adequacy appears fundamentally flawed. Nonetheless, internationally agreed rules to replace the current system are not in place.

To conclude, the challenge ahead for Indonesian financial authority now is to appreciate the central position of Indonesia's banking and finance industries in the country's ongoing development. And to understand Indonesia's banking and finance industries is to appreciate Indonesia's challenges and opportunities, and to make real-world forecasts of Indonesia's economic, social and political trends requires real-world understanding of Indonesia's banking and financial markets.

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