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**DISSERTATION**

**TOPIC: Internal Rating Based (IRB-Basle II) Advanced Approach  
in credit risk appraisal: *Case of Ecobank Ghana Limited Corporate  
portfolio***

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## ERRATUM

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## ABBREVIATIONS

**BIS** : bank of international settlement

**EAD**: earning at risk

**EL**: expected losses

**FRR**: facility risk rating

**IRB**: internal rating base

**LGD**: loss given default

**M**: maturity

**ORR**: obligor risk rating

**PD**: probability approach

**PET**: profit earning total

**RWA**: risk weight assets

**TNW**: turnover

## INTRODUCTION

“Once a wall flower, credit risk emerged in the late 1990s as the belle of ball”<sup>1</sup>, Michael B. Gordy underlines the importance of credit risk with this statement in one of his contribution within the credit risk framework. Credit risk is the oldest and the prominent risk in banking. In 1980’s banks strategies were based on the substantial growth of their assets regardless to the risks incurred by these operations. This context contributed to the collapse of famous banks such as “Texan Bank (1984)”, “Continental Illinois” (1985). The combination of these events and the outbreak of the financial crisis in 1987 led banking regulatory Committee known as Basle Committee to propose in 1988 a Capital regulatory accord: **Basle I**. Therefore, Banks have to determine the risk weighted assets (RWA) of a loan or commitment by multiplying their book value by references percentages, determined by banking regulators, according to the nature of the facilities and underpin this RWA with 8% of Capital (COOKE ratio).

The formula is as follows:

$$\text{Capital ratio} = \frac{\text{Regulatory capital}}{\sum \text{Risk weighted assets}} \geq 8 \%$$

It was a progress in comparison with the past situation, since banks have to increase their capital in order to develop their credit activities. Nevertheless, weaknesses appeared due to advent of financial innovations such as derivatives and securitizations, revealing the need of change in current regulation. In order to take into account this new market trend, the Basle Committee set up a new regulatory accord: **Basle II** effective by January 2007. New regulation introduces new types of risk- market risk and operational risk- and proposes new methods for credit risk appraisal. To a constrained and simple

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<sup>1</sup> Gordy,M.B: Credit risk Modelling: the cutting edge ;collection Risks books London,2003

regulation will be substituted an approach constituted by alternative set based on qualitative judgment of local regulation authorities. The new accord consists of three pillars: (1) minimum capital requirements, (2) supervisory review of capital adequacy, and (3) market discipline or public disclosure. Pillar contents basic elements for a relevant and accurate measurement of risks incurred by banking activities. They are developed in the first chapter of this document.

Henceforth, the RWA will be formed by Credit risk, market risk and operational risk. The most important reforms of Basle II are the inclusion of operational and market risks into the framework, and the more risk sensitive approaches to credit risk. Banks can choose among two different approaches to modeling credit risk : the standardized approach and the so-called IRB approaches.

The standardized approach is not very different from the 1988 accord still in force, but it brings in an element of risk sensitivity as it recognizes the classification of any defaultable asset by international credit rating agencies such as Standard& Poor's or Moody's. At least for assets that are officially rated, the bank underpins its book value with an amount of capital that depends on the rating classification.

Far more risk sensitive, however, are the IRB approaches. IRB stands for Internal Rating Based approach and means the use of the bank's own credit risk measuring systems for key drivers of credit risk as primary inputs to the capital calculation subject to meeting certain condition and explicit supervisory approval. The risk factors are: Probability of default (PD), Loss Given Default (LGD), Exposure At Risk (EAD) and Maturity (M). These risk measurements are converted into risk weights and regulatory requirements by means of the risk weight formulas specified by the Basle Committee or by another credit risk model approved by regulators. **IRB** approach is declined into two versions : **Foundation approach** and **Advanced approach**. In *foundation approach* banks only assess PD, while the other parameters are given by regulatory authorities. In *advanced approach*, banks measure their own parameters and determine their regulatory capital based on their own credit risk models. We focus our research on advanced approach in the current paper. Indeed, Banks manage their credit risk at both

transaction and customer level, and at a portfolio level. At the transaction level, one of the first steps that financial institutions would need to take in order to adhere to the Internal Rating Based (IRB) approach of Basel II is to implement a model for credit risk rating.

The purpose of credit risk rating, therefore, is to categorize customers into various classes. Each class should be homogenous in terms of probability of default (PD) which measures the average percentage of obligors that are unable to abide by their commitments in this rating grade in the course of one year. Then, in the event of default, a bank would have to initiate a recovery process. The estimate of the amount outstanding exposed (drawn amounts plus likely future drawdowns of yet undrawn lines) in case the borrower default is named "Exposure At Default" (EAD). And, The loss percentage a bank might face in that case is known as "loss given default" (LGD). The Expected Loss (EL) for the bank would be the product of PD, LGD and EAD. Since, EL is an estimate, it is best represented by a distribution at the portfolio level. The mean of the loss distribution is the expected loss and, serves, generally, as a basis for estimating the provisions that a bank needs to maintain. However, the provisions would only take care of the expected loss. One would expect some deviation from the mean, a variation beyond the estimated losses limits. Hence, banks would typically have to hold capital to take care of the deviation (based on a particular level of confidence). The deviation from the mean is referred to as unexpected loss (UL) that needs to be covered by the economic capital, which assessment is the purpose of credit risk models and the Risk Weighted Function proposed by the Committee in its July 2004 issuance. So the total loss can be materialized as follows:

$$\text{Total potential loss} = \text{Expected loss (EL)} + \text{Unexpected loss(UL)}$$

The new capital accord open a deep changes era in banking system in regards to risk appraisal. The changes might concern mainly the cost of credit. Therefore we work in this current paper under the basic hypothesis that IRB approach might increase the cost of credit within banks. We believe that this increased is subsequent to the raise of



capital required to cover credit risk and the huge investments made by bank to be compliant with Basle II new capital accord. These main hypothesis and sub –hypothesis will be verified through research in the paper.

The current regulation has to be applied worldwide, so Africa's banks are also concerned. It is obvious that banks play a vital function in African economies mainly in West Africa, due to the weakness or non- existence of financial markets. A steady development of African's economies is so much related to a sound and attractive banking system. The new regulation system offers incentives and opportunities to improve our banking system, provided that banks in this area deep reflections and take measure to better capture the effects of this regulation. Among the different credit risk approaches proposed by Basle II(Standardized approach and IRB approach), IRB approach seems to be more convenient. The reason is that almost west african's firms are not rated since there is no external rating agency. Moreover, most of West African banks have their own internal rating system, even though it does not properly fit to Basle II requirements. Somehow, through few improvements, they can easily assess risk parameters. Yet, West African regulatory authorities have not issued rules relative to Basle II Capital requirements which could allow implementation of the alternative solution which is *Foundation Approach*. Finally, *Advanced Approach* can be used to assess Capital Requirement. We can also refer to the Committee's aim in the formulation of its proposals:

*"...develop an approach to regulatory capital that more accurately reflects a bank's individual risk profile...The Committee envisions an expanded role for the IRB approach in the New Accord... The Committee expects internationally active banks involved in complex risk transfers and those with an above average risk profile to take steps to be in a position to use the IRB approach."*<sup>2</sup>

We work through this paper to verify the following hypothesis: The new capital accord increases RWA in comparison with Basle I. Therefore, cost of credit will go up.

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<sup>2</sup> BIS, consultative document on IRB approach, 2001

The second assumption is that RWA is heavily depends on PD. The higher is PD the higher is RWA. Consequently, since interests rates are linked to the amount of capital used (RWA) by banks to cover risks, interests rates will depend on PD.

The purpose of this paper is to help ECOBANK Ghana Limited, a subsidiary of Ecobank Group, one of West Africa and Central Africa leading bank, to implement Basle II new Capital Accord by setting up a right credit risk model suitable to its financial environment. During our staying within this bank, we notice that it has reliable rating system within the institutional department dealing with local large corporates and multinationals. The rating system is well maintained and updated, from which risk parameters may be extracted. Beyond Ecobank case, this research is a contribution to a successful implementation of Basle II recommendations in west African banks since research and steps related to these new rules are timid or not really yet undertaken by west African's banking regulations authorities.

The methodology used through this paper consists of documentation research based upon Basle II issued papers and other documents written on credit risk modeling. Afterwards, we made a diagnosis of Ecobank internal rating and collected data within the bank. Data concern Borrowers' ratings, losses data, over last three years (2003, 2004, and 2005). Finally, we try to assess credit risk factors and calculate the economical capital needed, in compliance with Basle II recommendations.

However, this work contains limits and assumptions either for simplicity or independent facts. First, data collected from the internal rating cover only three years while historical data over a minimum of five years are required to better assess risk factors. Second, we do not take into account collaterals, off balance sheet items when assessing credit risk, because we were not allowed to get them for confidential reasons.

The first Chapter gives an overview of Basle II. Chapter II discusses the major issues raised by IRB. These subjects are inherent to internal rating modeling, to definition of default, time horizon, rules of modeling..... Chapter III explains the minimum

requirements for the use of IRB advanced approach. Chapter IV deals with the methods of calculation of risk parameters and the determination of economical capital to cover the potential unexpected losses. Chapter V, is related to the practical stage e.g. implementation at Ecobank corporate portfolio. Chapter IV sums up the recommendations.

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# CHAPTER I: OVERVIEW OF BASLE II CAPITAL ACCORD

This chapter provides a summary of recommendations and rules set by Basle Committee in the framework of Basle II. It helps understanding the pillars, fundamental bases of the new regulations. There are three pillars within Basle II framework: **(1) minimum capital requirements, (2) supervisory review of capital adequacy, and (3) market discipline or public disclosure.**

*Pillar I* is the body of the new accord deals with the calculation of RWA and the different methods of credit risk, operational risk and market risk evaluation. Within pillar I the capital ratio and the definition of regulatory capital (tiers I and tiers II) remains unchanged, while RWA includes credit risk, market risk and operational risk. Our research focuses broadly on pillar and basically on credit risk.

*Pillar II* focuses on the rules over regulatory authorities' supervision of banks ways of risk assessment in compliance with new rules.

*Pillar III* states on information release from banks for a further reliance on banking system.

The new regulation keeps some rules from Basle I. Indeed, the ratio level minimum remains 8%, so is the definition of capital ration constituted by tiers I and tiers II.

## I. PILLAR I- CALCULATION OF MINIMUM CAPITAL REQUIREMENTS

Pillar I presents the calculation of the total minimum capital requirements for credit, market and operational risk. The capital ratio is calculated using the definition of

regulatory capital and risk-weighted assets. The total capital ratio must be no lower than 8%.

$$\text{Capital ratio} = \frac{\text{Regulatory capital}}{\sum \text{Risk weighted assets}} \geq 8 \%$$

Risk Weighted Assets include credit risk, market risk and operational risk.

### ***1.1- Credit risk***

Two methods are proposed to appraise credit risk or default : ***Standardized approach and Internal Ratings-Based Approach(IRB)***

#### **1.1.1 - Standardized approach**

It uses ratings agencies ratings on companies to derive risk weight through coefficients. The table provided below illustrates the risk weighting of rated corporate claims, including claims on insurance companies. The standard risk weight for unrated claims on corporates will be 100%.

Credit assessment	AAA to AA-	A+ to A-	BBB+ to BB-	Below BB-	Unrated
Risk weight	20%	50%	100%	150%	100%

#### **1.1.2 - The Internal Ratings-Based Approach**

Subject to certain minimum conditions and disclosure requirements, banks that have received supervisory approval to use the IRB approach may rely on their own internal estimates of risk components in determining the capital requirement for a given exposure. The risk components include measures of the probability of default (PD), loss given default (LGD), the exposure at default (EAD), and effective maturity (M). In some

cases, banks may be required to use a supervisory value as opposed to an internal estimate for one or more of the risk components.

IRB is declined into Foundation and advanced approach. In Foundation approach, only PD is determined, the other components are given by regulators. In Advanced approach bank determines all the components and evaluate the own risk weighted assets. We will work in the current paper through the advanced approached.

## ***1.2- Market risk***

Market risk is defined as the risk of losses in on and off-balance-sheet positions arising from movements in market prices. The risks subject to this requirement are:

- The risks pertaining to interest rate related instruments and equities in the trading book;
- Foreign exchange risk and commodities risk throughout the bank.
- There are two methods of measuring market risk: ***standardized and internal method***

### **1.2.1- Standardized method**

A set of weighting factors determined by regulatory authorities that are used according to the type of securities to assess market risk.

### **1.2.2 -Internal method**

Under supervisory approval, banks can set their own system to measure market risk.

## ***1.3- Operational risk***

Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal

Risk (Legal risk includes, but is not limited to, exposure to fines, penalties, or punitive damages resulting from supervisory actions, as well as private settlements) but excludes strategic and reputational risk.

Three methods for calculating operational risk capital charges in a continuum of increasing sophistication and risk sensitivity: (1) the Basic Indicator Approach; (2) the Standardised Approach; and (3) Advanced Measurement Approaches (AMA).

### 1.3.1- The Basic Indicator Approach

Banks using the Basic Indicator Approach must hold capital for operational risk equal to the average over the previous three years of a fixed percentage (denoted alpha) of positive annual gross income. Figures for any year in which annual gross income is negative or zero, should be excluded from both the numerator and denominator when calculating the average. The charge may be expressed as follows:

$$K_{BIA} = \left[ \sum (GI_{1..n} \times \alpha) \right] / n$$

KBIA = the capital charge under the Basic Indicator Approach

GI = annual gross income, where positive, over the previous three years

N = number of the previous three years for which gross income is positive

α = 15%, which is set by the Committee, relating the industry wide level of required capital to the industry wide level of the indicator.

### 1.3.2- Standardised Approach

In this approach bank's activities are divided into eight business lines: corporate finance, trading & sales, retail banking, commercial banking, payment & settlement, agency services, asset management, and retail brokerage. Within each business line, gross income is a broad indicator that serves as a proxy for the scale of business operations and thus the likely scale of operational risk exposure within each of these

business lines. The capital charge for each business line is calculated by multiplying gross income by a factor (denoted beta) assigned to that business line. Beta serves as a proxy for the industry-wide relationship between the operational risk loss experience for a given business line and the aggregate level of gross income for that business line. It should be noted that in the Standardised Approach gross income is measured for each business line, not the whole institution, i.e. in corporate finance, the indicator is the gross income generated in the corporate finance business line. The table below illustrates Beta for each business line :

<b>Business Lines</b>	<b>Beta Factors</b>
Corporate finance ( $\beta_1$ )	18%
Trading and sales ( $\beta_2$ )	18%
Retail banking ( $\beta_3$ )	12%
Commercial banking ( $\beta_4$ )	15%
Payment and settlement ( $\beta_5$ )	18%
Agency services ( $\beta_6$ )	15%
Asset management ( $\beta_7$ )	12%
Retail brokerage ( $\beta_8$ )	12%

### **I.3.3- Advanced Measurement Approaches (AMA)**

Under the AMA, the regulatory capital requirement will equal the risk measure generated by the bank internal operational risk measurement system using the quantitative and qualitative criteria for the AMA discussed below. Use of AMA is subject to supervisory approval.

## **II. PILLAR II : SUPERVISORY REVIEW OF CAPITAL ADEQUACY**

The supervisory review process of the Framework is intended not only to ensure that banks have adequate capital to support all the risks in their business, but also to



encourage banks to develop and use better risk management techniques in monitoring and managing their risks. Supervisors are expected to evaluate how well banks are assessing their capital needs relative to their risks and to intervene, when appropriate. This interaction is intended to foster an active dialogue between banks and supervisors such that when deficiencies are identified, prompt and decisive action can be taken to reduce risk or restore capital. Accordingly, supervisors may wish to adopt an approach to focus more intensely on those banks with risk profiles or operational experience that warrants such attention. The assessment of compliance with the minimum standards and disclosure requirements of the more advanced methods in Pillar 1, in particular the IRB framework for credit risk and the Advanced Measurement Approaches for operational risk. Supervisors must ensure that these requirements are being met, both as qualifying criteria and on a continuing basis.

In order to reach supervisory objectives relates above principles are set up.

***Principle 1: Banks should have a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital level.***

This principle implies that banks comply with the following items:

- Board and senior management oversight;
- Sound capital assessment;
- Comprehensive assessment of risks;
- Monitoring and reporting; and
- Internal control review.

***Principle 2: Supervisors should review and evaluate bank's internal capital adequacy assessments and strategies, as well as their ability to monitor and ensure their compliance with regulatory capital ratios. Supervisors should take***

appropriate supervisory action if they are not satisfied with the result of this process.

The periodic review can involve a combination of:

- On-site examinations or inspections
- Off-site review;
- Discussions with bank management;
- Review of work done by external auditors

***Principle 3: Supervisors should expect banks to operate above the minimum regulatory capital ratios and should have the ability to require banks to hold capital in excess of the minimum.***

Supervisors may in some cases impose a higher level of capital than appropriate following the ratio of 8%. In other words, some bank may use a ratio higher than 8% in order to get additional buffer to cover risk foreseen by regulators.

***Principle 4: Supervisors should seek to intervene at an early stage to prevent capital from falling below the minimum level required to support the risk characteristics of a particular bank and should require rapid remedial action if capital is not maintained or restored.***

Supervisors should consider a range of options if they become concerned that a bank is not meeting the requirements embodied in the supervisory principles outlined above. These actions may include intensifying the monitoring of the bank, restricting the payment of dividends, requiring the bank to prepare and implement a satisfactory capital adequacy restoration plan, and requiring the bank to raise additional capital immediately. Supervisors should have the discretion to use the tools best suited to the circumstances of the bank and its operating environment.

### **III. PILLAR III : MARKET DISCIPLINE**

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

Banks have to disclose in addition to classical accounting information other information such as methodologies used to measure different risk parameters. The disclosures set out in Pillar 3 should be made on a semi-annual basis.

## **CHAPTER II : LITERATURE REVIEW**

This Chapter discusses the major issues raised by IRB approach. IRB, mainly advanced one, is based on the use of internal model for credit risk assessment.

The default notion is tightly linked to credit risk; credit risk is also denominated default. So, we try to define primarily default following many authors. More other, a review of different methods proposed by several authors will be made to understand the importance of this subject.

Some persons are worried about the link between the need of capital under new regulation system and the economical situation. Discuss is raised on the tendency to worsen economical situation in the case of recession.

Probability of default is the key component IRB approach. It is determined through matrices of transition which allow assessing the changes in customer's ratings. The stability of these matrices is fundamental to a better determination of accurate capital for risk covering.

### **I. DEFINITION OF DEFAULT**

Default is the probability for an obligor to be unable to honor his commitments. In the current section we review several events qualified as "default". Default is the basic item of IRB approach since its events account for the assessment of Probability of Default (PD), Loss Given Default (LGD) and Exposure at Default (EAD). The understanding of this notion is fundamental for the comprehension of IRB approach. First, we analyze the views of some authors and agencies and finally, we give the definition proposed by the Bank for International Settlements (BIS).

There are several possible definitions of "default" following definitions proposes by authors: missing a payment obligation for a few days, missing a payment obligation for

more than 90 days, filing for bankruptcy, breaking a covenant triggering a cross default for all lenders to the same entity.

Joël Bessis<sup>3</sup> states that a payment delay of a few days for individuals or small businesses is closer to “delinquency” than default, since the likelihood of getting the payment remains high. Thus “payment default” commonly refers to a minimum period, such as 3 months after due date. Bankruptcy and restructuring are default events, given that they follow major failure of payment obligations. He distinguishes “*technical default*” and “*economical default*”.

“Economical default” occurs when the value of the assets of the borrowers dips below the value of the debt. It is the view of default under the Merton (1974) model, implemented in instrumental default models such as KMV Credit monitor.

As for “technical default”, it includes covenants triggering default. Many covenants trigger a technical default, requiring a waiver from lenders before continuing operations. Such events usually initiate negotiation, whatever the risk to the borrower’s survival. Some covenants trigger cross-default and cross-acceleration. Cross-default implies that a failure of payment with respect to any debt obligation of the lender triggers a default for all lenders. Cross-acceleration specifies that prompt repayments are due immediately, although this might only result in prompt renegotiation with all lenders. Still, without waivers granted by lenders, the borrower becomes bankrupt.

Besides, BIS capital accord (2001) has issued a reference definition of default, which should be used in risk parameters and capital assessment.

A default is considered to have occurred with regard to a particular obligor when **one or more** of the following events have taken place :

- It is determined that the obligor is unlikely to pay its debt obligations (principal, interest, or fees) in full;

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<sup>3</sup> Risk management in banking, Edit John Wisley 2003

- A credit loss event associated with any obligation of the obligor, such as a charge-off, specific provision, or distressed restructuring involving the forgiveness or postponement of principal, interest, or fees;
- The obligor is past due more than 90 days on any credit obligation;
- The obligor has filed for bankruptcy or similar protection from creditors.”

## **II. LITERATURE REVIEW ON CREDIT RISK MODELS**

There is wide spectrum of credit risk models, addressing different issues with different techniques, making a review necessary. Some models serve for defining the credit risk drivers of individual transactions: exposures, recoveries and default plus migration probabilities. Other models use these as input for modeling the credit risk of portfolio of loans or bonds (CreditMetrics, CreditRisk+, KMV Portfolio Manager .....). In term of default view, models can be classified into “default models (DM)” and “marked to market models (MTM)”. Default mode (DM) models estimate credit losses resulting from default events only, whereas mark to market (MTM) models classify any change in credit quality as a credit event.

Credit risk models can be divided into two main categories :(1) traditional approaches and (2) modern models, initially used in financial markets including (i) “first generation” structural-form models, (ii) “second generation” structural-form models, (iii) reduced-form models, and (iv) VaR models of Credit Risk Measurement and (v) Mortality rates models.

### ***II.1. Traditional methods***

Traditional models use accounting and qualitative information. They focus on attributing and/or estimating the probability of default (PD), rather than on the magnitude of potential losses in the event of default (so-called LGD, loss given default, also known as LIED, loss in the event of default). Moreover, traditional models are default models (DM). They typically specify “failure” to be bankruptcy filing, default, or liquidation,

thereby ignoring consideration of the downgrades and upgrades in credit quality that are measured in mark to market models. We consider three broad categories of traditional models used to estimate PD: (1) expert systems, including artificial neural networks; (2) external rating system; and (3) credit scoring models. All these systems use qualitative and quantitative information to determine the quality of obligors by attributing grades to each one reflecting its risk profile, even though some utilize predominantly qualitative or quantitative items.

Historically, bankers have relied on the “5 C’s” of expert systems to assess credit quality. They are Character (reputation), Capital (leverage), Capacity (earnings volatility), Collateral, and Cycle (macroeconomic) conditions. Treacy and Carey (2000) found that qualitative factors played more of a role in determining the ratings of loans to small and medium-sized firms with the loan officer chiefly responsible for the ratings, in contrast with loans to large firms in which the credit staff primarily set the ratings using quantitative methods such as credit-scoring models. Evaluation of the 5 C’s is performed by human experts, who may be inconsistent and subjective in their assessments (Frachot and Georges (2001)). Moreover, traditional expert systems specify no weighting scheme that would order the 5 C’s in terms of their relative importance in forecasting PD. Thus, artificial neural networks (Wilson and Sharda, 1994) have been introduced to evaluate expert systems more objectively and consistently. The neural network is “trained” using historical repayment experience and default data. Structural matches are found that fit to defaulting firms and then used to determine a weighting scheme to forecast PD. Each time that the neural network evaluates the credit risk of a new loan opportunity, it updates its weighting scheme so that it continually “learns” from experience. Thus, neural networks are flexible, adaptable systems that can incorporate changing conditions into the decision making process.

As far as scoring models are concerned we have discriminant analysis and logistic regression models. The aim of these models is to attribute a score, based on qualitative and quantitative ratios, which will be converted into probabilities of default through

matrices of transition. The popular Z-score (Altman, 1968) is based on linear discriminant analysis - borrowers are classified between good and bad one - while Ohlson O-Score (Ohlson, 1980) is based on generalised linear models (GLM) with the logit link function- probability of default is constrained to be comprise between 0 and 1- . Altman and Narayanan (1997) show that that financial ratios measuring profitability, leverage, and liquidity had the most statistical power in differentiating defaulted from non-defaulted firms in the case of Z-score.

## ***II.2 Modern models***

Modern models belong to financial market and use sophisticated methodologies for financial securities and derivatives assessment .Their use requires markets data. It is why, they are used for large Corporate where these data are available. Based on theories of these models, financial industry have produced model such as CreditMetrics, CreditRisk+.....

The structural approach models the economic process of default, whereas reduced form models split up risky debt prices in order to estimate the random intensity process underlying default.

First generation structural-form models are the ones based on the original framework developed by Merton (1974), using the principles of option pricing. In such a framework, the default process of a company is driven by the value of the company's assets and the risk of a firm's default is explicitly linked to the variability in the firm's asset value. Loans are modeled in a standard way as a claim on the value of a firm. The value of the firm's assets is measured by the price the whole firm's assets can be purchased. Thus, the total value of the firm's assets is equal to the value of the stock plus the value of the debt. Loan default occurs if the market value of the firm's assets falls below the amount due to the loan.



**The first generation structural-form** models include Black and Cox (1976), Geske (1977), and Vasicek (1984). Each of these models tries to refine the original Merton framework by removing one or more of the unrealistic assumptions. Black and Cox (1976) introduce the possibility of more complex capital structures with subordinated debt; Geske (1977) introduces interest paying debt; Vasicek (1984) introduces the distinction between short and long term liabilities.

**Second-generation models** include Kim, Ramaswamy and Sundaresan (1993), Hull and White (1995), Nielsen, Saà-Requejo and Santa Clara (1993), Longstaff and Schwartz (1995), Finger (2002) and others. While the original Merton model assumes that default can occur only at maturity of the debt when the firm's assets are no longer sufficient to cover debt obligations, second generation structural form models assume that default may occur at any time between the issuance and maturity of the debt, when the value of the firm's assets reaches a lower threshold level. This approach simplifies the first class of models by both specifying the cash flows to risky debt in the event of bankruptcy and simplifying the bankruptcy process. This occurs when the value of the firm's underlying assets hits some exogenously specified boundary.

CreditMonitor and Portfolio Manager of KMV<sup>4</sup> are illustrations of structural models. CreditMonitor, geared to measure probability of default (PD) at single loan level. PD is determined through Expected default Frequency (EDF), the probability that market value of the firm's assets falls below the amount due to the loan. As for Portfolio Manager, it aims to assess credit risk within credit portfolio. In this approach, different items relative to each loan (risk, return and correlations) are used to appraise the risk marginal contribution of any new loan within a portfolio. So, it allows the measure of economic capital needed to cover the risk raised by additional loan granted to a borrower.

**Reduced-form models or intensity-based models** include Litterman and Iben (1991), Fons (1994), Madan and Unal (1995), Jarrow and Turnbull (1995), Das and

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<sup>4</sup> KMV is a company founded in 1989 by Stephen Kealhofer, John McQuown and Oldrich Vasicek

Tufano (1995), Jarrow, Lando and Turnbull (1997), Lando (1998), Duffie and Singleton (1999), and Duffie (1998). Reduced-form models do not condition default on the value of the firm, and parameters related to the firm's value need not be estimated to implement them. In contrast to structural models, intensity-based models do not specify the economic process leading to default. Default is modeled as a point process. Defaults occur randomly with a probability determined by the intensity or "hazard" function. Intensity-based models decompose observed credit spreads on defaultable debt to ascertain both the PD (conditional on there being no default prior to time  $t$ ) and the LGD (which is 1 minus the recovery rate). Das and Tufano (1996) obtain PD using a deterministic intensity function and assume that LGD is correlated with the default risk-free spot rate. Longstaff and Schwartz (1995) utilize a two factor model that specifies a negative relationship between the stochastic processes determining credit spreads and default-free interest rates. Jarrow and Turnbull (1995) assume that the recovery rate is a known fraction of the bond's face value at maturity date, whereas Duffie and Singleton (1998) assume that the recovery rate is a known fraction of the bond's value just prior to default. In Duffie and Singleton (1999), both PD and LGD are modeled as a function of economic state variables. Madan and Unal (1998) and Unal et. al. (2001) model the differential recovery rates on junior and senior debt.

Illustrations of reduced form models are Kamakura proprietary model based on Jarrow (2001), uses equity as well as debt prices in order to disentangle the PD from the LGD; and KPMG's Loan Analysis System.

Var models are based on the concept of Var (Value at risk) which is composed of Expected losses (EL) and Unexpected Losses (UL) on a loan at a given horizon with certain confidence level. Var can be derived from the probability distribution of the future value of a credit. Once the default probability for each asset is computed (using either the structural or intensity-based approach), each loan in the portfolio can be valued (using either analytical solutions or Monte Carlo simulation) so as to derive a probability distribution of portfolio values. A loss distribution can then be calculated permitting the

computation of Value at Risk (VaR) measures of unexpected losses by specifying the minimum losses that will be exceeded with a certain probability.

The theory of Var is the fundament of CreditMetrics of JP Morgan. Contrary to the other models, CreditMertics measures both individual risks and portfolio ones. CreditMetrics models default probabilities using the historical default experience of comparable borrowing firms. That is, the CreditMetrics model is built around a credit migration matrix that measures the probability that the credit rating of any given debt security will change over the course of the credit horizon (usually one year). The credit migration matrix considers the entire range of credit events, including upgrades and downgrades as well as actual default. Thus, CreditMetrics is a mark-to-market (MTM), rather than a default mode (DM) model. Moreover, CreditMetrics can estimate a VaR measure based on the actual distribution as well as on an approximation using a normal distribution of loan values.

Mortality rates models or actuarial models use historical default data to assess mortality rates of credits for all types of ratings. Thus, a marginal mortality rate of a listed security over a given year is determined by dividing on one hand, the defaulted securities within the same grade and during the same period with on the other hand securities presenting the same characteristics but still existing (not defaulted). These rates represent the probability of default (PD) of the credits belonging to the same rating or grade.

Credit Risk +, a proprietary model developed by Credit Suisse Financial Products, is derived from this model. Under Credit Risk +, each individual loan is regarded as having a small probability of default, and each loan's probability of default is independent of the default on other loans. Since Credit Risk + is a DM model, it does not consider non-default migrations in credit quality. Thus, the Credit Risk Plus credit risk measure is closer to a loss-of-earnings or book-value capital measure than a full market value of economic capital measure. The figure below gives a comparison of different major credit risk models invented by finance industry.

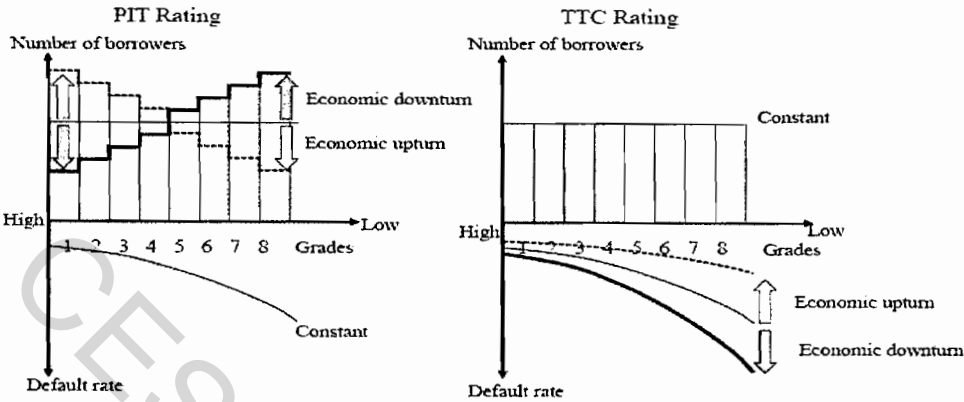
### Comparison of Different Credit Risk Measurement Models

	CreditMetrics	Credit Risk Plus	Merton OPM KMV/Moody's	Reduced Form KPMG/Kamkura
Definition of Risk	MTM	DM	MTM or DM	MTM
Risk Drivers	Asset Values	Expected Default Rates	Asset Values	Debt and Equity Prices
Data Requirements	Historical Transition Matrix, Credit Spreads & Yield Curves, LGD, Correlations, Exposures	Default Rates and Volatility, Macroeco Factors, LGD, Exposures	Equity Prices, Credit Spreads, Correlations, Exposures	Debt and Equity Prices, Historical Transition Matrix, Correlations, Exposures
Characterization of Credit Events	Credit Migration	Actuarial Random Default Rate	Distance to Default: Structural and Empirical	Default Intensity
Volatility of Credit Events	Constant or Variable	Variable	Variable	Variable
Correlation of Credit Events	Multivariate Normal Asset Returns	Independence assumption or correlation with expected default rate	Multivariate Normal Asset Returns	Poisson Intensity Processes with Joint Systemic Factors
Recovery Rates	Random (Beta distribution)	Constant Within Band	Constant or Random	Constant or Random
Numerical Approach	Simulation or Analytic	Analytic	Analytic and Econometric	Econometric
Interest Rates	Constant	Constant	Constant	Stochastic
Risk Classification	Ratings	Exposure Bands	Empirical EDF	Ratings or Credit Spreads

### III. RATING ASSIGNMENT HORIZON—RELATIONSHIP WITH THE BUSINESS CYCLE

The time horizon of assessing the creditworthiness of borrowers in assigning ratings is also important, as it has a great influence in the determination of risks parameters based on ratings. Two different approaches may be taken in considering the effect of the business cycle in assigning ratings. One is a point-in-time system (PIT rating). In PIT rating, risks are evaluated based on the current condition of a firm regardless of the phase of the business cycle at the time of evaluation, it is a short term rating (generally one year time) . The other is a through-the-cycle system (TTC rating). In TTC rating, risks are taken into account on the assumption that a firm is experiencing the bottom of the business cycle and is under stress.

Chart 5: Point-In-Time (PIT) and Through-The-Cycle (TTC) Ratings



*\*extract from "Advancing credit risk Management through Internal rating Systems" Bank of Japan*

Nov 2005

Chart 5 illustrates changes in grades based on PIT and TTC ratings in relation to the business cycle. In PIT rating, grades fluctuate reflecting the business cycle and thus ratings tend to be upgraded at economic upturns and downgraded at economic downturns. In addition, ex-post default rates per grade are stable regardless of the business cycle. On the other hand, in TTC rating, grades of firms remain the same through the business cycle, and ex-post default rates within the same grade fluctuate reflecting the business cycle. In this way, the difference between PIT and TTC ratings shows up in this behavior of rating changes and default rates per grade. Rating agencies usually assign grades from a long-term perspective, and their choices, therefore, are considered to approximate those based on TTC rating.

Meanwhile, few financial institutions seem to clearly make a choice between PIT and TTC ratings. They seem to evaluate the creditworthiness of borrowers over some period, for example, three to five years, indicating that their choice is somewhere between the above two types of ratings.

According to Kjersti Aas<sup>5</sup>(2005) the choice between PIT and TTC ratings or a mixture of the two depends on the length of time financial institutions are exposed to credit risk. If

<sup>5</sup> A survey on Basle II IRB approach for credit portfolio

the majority of a bank's loans have a long time before maturity, it is desirable to assign a grade considering creditworthiness over the whole period. He states that it is difficult in practice to assess the future change in a borrower's conditions over the long term including the business cycle as in the case of TTC rating. One alternative might be to adopt an approach in which ratings are based on recent conditions and assess the degree of credit risk under the economic downturn by use of a stress test. This approach is based on PIT rating but takes account of TTC components in application. Catarineu-Rabell et al. (2003) recommend that regulators encourage banks to adopt TTC systems in order to mitigate procyclicality. So long as the PDs assigned to each grade are estimated by taking long-run average default frequencies, stable rating assignments imply stable PD assignments, and so diminish capital volatility.

Carey and Hrycay (2001) find evidence in agency ratings that TTC systems assign rating based on the borrower's likelihood of survival in the event of a macroeconomic stress scenario. Because the stress scenario is fixed, the current state of the macroeconomy is irrelevant. Another view is that TTC ratings are simply long-term ratings. Altman and Rijken find that agency ratings and PIT models perform comparably in predicting default over a six years horizon.

But, as for Arnaud de Servigny PIT and TTC are not compatible. Volatility is higher in the former method than in the latter case. However, ratings instability and the differential between these two methodologies depend on the quality of rating: ratings of medium risky firms present divergent conclusion, while ratings of best and riskiest firms show convergent results.

Though we cannot judge a priori which rating method is better than the other for certain banks, it is still very important for financial institutions to understand whether their own internal rating systems are more PIT-oriented, TTC-oriented, or follow a mixed approach, in other words, how their systems are affected by the business cycle. Basle II Committee does not take any position relative to this issue, but only recommend that rating system be consistent and reflect the real risk exposure of each borrower.

## IV. STABILITY OF TRANSITION MATRICES

Probability of default in our work will be assessed through matrix of transition. So, it is important to have an understanding of its behaviour and the other issues raised by its construction.

We can define a transition matrix as a matrix which defines for a credit, class of credit or an entire portfolio the migrations i.e probabilities of change of class or probability to default. The time horizon is generally one year. This matrix is fundamental for assessment of probability of default which is a basic factor for internal credit risk model. Given that economic capital is very sensitive to probability of default we should pay close attention to this matrix.

When matrix is set, the issue is to know whether migrations probability determined upon historical data can be used to anticipate future migrations: is the character Markovian? Is it stable at any time and under any circumstances?

### **a) Is matrix stable at any time?**

Nickell, Perraudin, Varrotto(1998) carried out a survey on transition matrices, according to the type of obligor and the economical situation, based on a sample of 6534 obligors taken between December 1970 and 1997.

The first step of their study consisted of setting up an unconditional transition matrix over the whole period. The results show increasing migration volatility for low ratings: ratings volatility increases when the quality of credit declines. Whereas, another study led by Carty and Fons(1993) over a similar period(27 years) reveals another matrix different from the previous. This is an evidence that transition matrix is not stable over the time. In the other hand, they divided up the population into types of obligor and geographical area. The conclusions reveal identical matrices for similar types of economic sectors and the same matrices for identical geographical areas mainly for

borrowers with good rating. This analysis demonstrates that transition matrices are dependent to the type of area and types of obligor; so not always stable.

### **b) Is the character Markovian?**

The Markovian character means that parameters estimated through historical data can be used to anticipate future trends. The issue here is to find out whether a matrix based on historical data can be used to foresee future trends. Thus it possible to use the notion of "independency to economic situation" develop by MacKinsey- Wilson(1997) to solve this problem. The test made by Nickell, Perraudin, Varotto(1998) shows that for counterparts *investment grade* the volatility decreases during expansion period and increases during slow down period. It can be concluded that migrations do not have markovian character and so does the transition matrix.

Moreover, another survey carried out by Bangia, Diebold and Schuermann makes known that a long future time horizon has an impact on the stability of transition matrix. However, markovian character cannot be automatically rejected. Other further researches, reveal a *path dependency* i.e a downwards trend of rating in the past has an impact upon the downwards trend probability of future rating.

## **V. PROCYCLICALITY OF NEW CAPITAL REQUIREMENT**

The future rules of capital requirements modulate these requirements according to the quality of the borrowers, measured by a rating. Deterioration of the quality of a borrower should be translated by an increase in the required capital. Thus, the new ratio allows, in theory, to better adjust the lawful requirements with the effective risk of borrowers and it reacts more quickly to fluctuations of economic situation. However, the quality deterioration is more frequent in period of recession. Consequently, if the internal and external notations tend to follow the business cycle, with the new ratio, the lawful requirements will tend to be stronger during recession period and to become lighter in expansion period. They could then have a procyclical effect, i.e. tend to amplify the cycle, by slowing down the offer of credit in period of deceleration, and



accelerating it in phase of growth. Intrinsically, the new ratio discriminates according to cycle phase's, and this characteristic could amplify the cyclic fluctuations if it makes access to the credit more difficult in period of recession.

Several approaches of the potential procyclicality are possible. The first, of macroeconomic type, insists on the existence of a channel of the credit and a phenomenon of "financial accelerator": when the economic situation is bad, the asymmetry of information encourages banks to be more selective and to restrict credits. In this approach, the prudential rules are procyclical if they induce a change of the behaviours of applicant for credit. This effect can be measured by studying the incidence of the fluctuations of capital induced by the economic situation on flows, the financings of banks and the nonsubstitutable financings of market being supposed (Blum and Hellwig, 1995). Heid (2000) suggests that the reinforcement of the multiplier of the request is possible if measurements of the risks do not anticipate sufficiently the reversals of cycles. Another approach suggests that the procyclicality is financial and comes from an overreaction of financial agents to the evolution of the risks in time. The stress is laid here on the incidence of the changes of anticipations of the risks on the behaviours of financings supplies (Borio [2001]). Rules of capital indexed on the risk are likely to affect the choices of investment of the banks. The recombining of the banking portfolio towards less risky classes of credits in period of recession could contribute to amplify the selectivity and would have a procyclical effect. The empirical tests of the adjustments of portfolio under prudential constraints mainly related to the current rules of solvency and the conclusions are mitigated by it. Some survey, ,show the absence from effects (Shrieves and Dahl[1992 ], Aggarwal and Jacques[1997 ] and Rime[1998 ]), while Shepherd and Udell(1994), and Hancock and Wilcox(1994) obtain more distinct conclusions. New surveys start on the potential procyclicality of prudential constraints varying with the risk (Carpenter and al [2002]). Their interpretation of the procyclicality shows a high volatility from the requirements in capital correlated with the cycles. But the effects on volumes of credits (facilities) and the composition of the portfolio of the banking are not studied. However, one can show the existence of a procyclical effect only if the variations in capital result indeed in adjustments of the

portfolio. A more effective measure of the procyclical effects of the new ratio would thus consist in connecting the variations in capital to the readjustments of portfolio observed. But this further study requires the study of portfolio's composition in time. A recent study of the bank of France states similar views. (Bordos, Foulcher and Oung, 2002).

Resti(2002), states that there is a link between Recovery Rates (RRs) and default rates(DRs). The impact of such a mechanism was assessed, based on simulations over a 20-year period, using a standard portfolio of bank loans (the composition of which is adjusted through time according to S&P transition matrices). Two results of these simulations are worth mentioning. First, the procyclicality effect is driven more by up- and downgrades, than by default rates; in other words, adjustments in credit supply needed to comply with capital requirements respond mainly to changes in the structure of weighted assets, and only to a lesser extent to actual credit losses (except in extremely high default years). Second, when RRs are permitted to fluctuate with default rates, the procyclicality effect increases significantly. Moreover, bank spreads to become more volatile, since revisions in short-term RR estimates are factored into loan prices.

There are three methods by which the procyclical impact of the IRB approach could be dampened (Michael B. Gordy and Bradley Howells [2004])<sup>6</sup>. First, banks could adopt through-the-cycle rating methodologies which "filter out" the impact of the business cycle on borrower ratings. Assuming that the probability of default (PD) associated with each rating grade is calculated as a long-term historical average, through-the-cycle systems dampen the sensitivity of borrower PDs to macroeconomic conditions. By smoothing these critical inputs to the Basel capital function, smoothing of the output (i.e., the regulatory capital requirement) is obtained. Second, procyclicality can be reduced simply by flattening the IRB capital function in order to reduce the sensitivity of capital charges to changes in PD. Third, supervisors can apply a smoothing rule directly to the output of the IRB capital function.

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<sup>6</sup> Can we treat the disease without killing the patient ?

## CHAPTER III: MINIMUM REQUIREMENT FOR THE USE OF IRB ADVANCED APPROACH

This chapter provides an overview of the prerequisite for use of IRB approach. All banks will not be allowed to use this approach except those which are authorized by regulatory supervisors under compliance with the following requirements. Many of these requirements are in form of objectives that a qualifying bank's internal rating systems must fulfill as said in this section *"IRB minimum requirements described focus on those key elements of the bank's internal processes that promote meaningful identification and differentiation of estimated borrower risk across exposures, reliable and disciplined estimation of risk components, and clarity in the documentation of rating systems and decisions. When validating adherence to these minimum requirements, supervisors will need to make objective comparisons as well as subjective judgments. The minimum requirements thus include "objective" and measurable criteria as well as more "subjective", judgment-oriented criteria"*.<sup>7</sup>

This part of our paper is a review of requirements set by Basle II committee in its main consultative papers (2001, 2004), consistent with Committee's September 2000 paper entitled *Principles for the Management of credit risk*. The Committee does not intend to dictate the form of operational detail of bank's risk management policies and practices. It recognizes that supervisors may customize operational procedures to fit the requirements to bank's national realities.

Requirements concern principally internal rating system, the bedrock of IRB and estimation of risk components. The aim is to ensure integrity, reliability, consistence, and accuracy of both rating system and assessment of risk components.

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<sup>7</sup> BIS consultative paper : IRB approach, January 2001, page 41

# **I. ARCHITECTURE OF A RATING SYSTEM**

## ***1.1. Borrower and facility rating***

To be eligible to IRB approach, banks should have risk rating system that provides a separate assessment of borrower and transaction characteristics. Borrower ratings focus on the credit risk of borrowers, in other words, whether borrowers will default or not (the possibility of default). While facility ratings focus on risk exposures of each transaction. In assigning grades, facility ratings take into account the collateral or guarantee pledged to loans, and the maturity, in addition to the creditworthiness of borrowers. With this rating system, different grades can be assigned to loan contracts with one borrower depending on the degree of risk exposure for each transaction.

There are two types of facility ratings, which are more elaborate than borrower ratings, namely, one-dimensional and two-dimensional systems. An one-dimensional system bases facility ratings on borrower ratings and makes upward or downward adjustments to the grades as necessary to reflect the characteristics of the loan transaction concerned (such as the secured level of loans in terms of the ratio of collateral or guarantee pledged to loans). A two-dimensional system combines borrower ratings with evaluation of the features of individual loan transactions independent of borrowers (e.g., ratings based on LGD).

The Committee encourages banks to use, two-dimensional approach likely to provide supervisors with confidence that the assignment of borrower ratings is not tainted by consideration of the specific structure of the transaction.

## ***1.2. Scope of rating***

Each borrower and facility must be assigned a rating prior to the bank entering into a commitment to lend. The system should, therefore, be applied to all credit risk with consistency. This will in turn promote accuracy and efficiency in the ratings.

For inter-related borrowers, such as affiliates and subsidiaries, every separate legal entity to which the bank has exposure should be separately assessed and assigned to a borrower rating.

### **a) Rating grades**

A rating grade is defined as an assessment of borrower risk on the basis of specified and distinct set of rating criteria, from which estimates of PD are derived.

Having an appropriate number of grades and their definitions also affects the adequacy of credit risk management. The number of grades should ensure that borrowers and transactions with a similar level of risk are grouped together. It implies that definition of grade should be clear, and not broadly. Obviously, financial institutions dealing with many borrowers with varying degrees of creditworthiness should have a relatively large number of grades.

Too many grades for a small number of borrowers may also be inappropriate because accuracy of risk estimation may decline if the number of borrowers in each grade is too small.

Banks which adopt the internal ratings-based (IRB) approach in the Basel II Framework are required to have a minimum of 6 to 9 grades for performing borrowers and a minimum of 2 grades for non-performing borrowers.

### **b) Rating criteria**

The requirements address the range of possible rating systems a bank may have: those on the expert judgment of credit personnel, those which use statistical models, and those which rely on both techniques.

Rating criteria should cover all factors that are relevant to the analysis of borrower risk. These factors should demonstrate an ability to differentiate risk, have predictive and discriminative power, and be both plausible and intuitive in order to ensure that ratings are designed to distinguish risk rather than to minimize regulatory capital requirements.

### **c) Rating Assignment Horizon**

When assigning a borrower grade, the personnel responsible for assigning a grade must evaluate the rating criteria over the future horizon based on current information experience with the borrower, including its ability to meet contractual obligations and withstand normal business stresses. According to the nature of the obligor's activities bank may use at the point in time (PIT) or trough the cycle (TTC). The following example highlights this point. One borrower's financial conditions may be very stable with the strong likelihood of industry conditions also remaining stable over the next several years. Another borrower is in an industry characterized by rapid technological change, cyclical demand and competitors with significantly greater financial resources. It will be suitable to use TTC for the later borrower and PIT for the former in order to better capture the risks raised by these two obligors evolving in sector with opposite characteristics.

## **II. RATING PROCESS**

### ***II.1. Assigning and Reviewing Ratings***

Assignment and review of rating should respect the requirements of independency and integrity. To fulfill these requirements the person or the unit assigning and/or reviewing ratings must be independent, so does not stand to benefit from the grade assignment. More over, management should ensure that the party assigning and reviewing has access to all relevant information and has competency in evaluating firms in the subject industry as well as the material risks posed by the facilities.

Ratings should be at least reviewed annually and be re-rated when events require. Furthermore, new financial information should help to refresh rating within 90 days for non-problem borrowers and 30 days for borrowers with weakened financial condition.

## ***II.2. Quantitative and Qualitative Evaluations***

For borrower ratings, grades for each borrower are usually decided based on evaluation using quantitative information, such as financial indicators regarding the borrower, and qualitative information, such as industry trends, and extension of financial support from parent companies. A quantitative rating model is often used for quantitative evaluation of individual borrowers. Financial indicators that have a close statistical relationship with defaults are used in this model. Furthermore, in many cases, it is better to use substantive financial data reflecting borrowers' financial conditions that are not necessarily captured by accounting data, such as nonperforming assets and unrealized losses. If quantitative financial data are insufficient to accurately measure the creditworthiness of borrowers, qualitative analysis should be used to make necessary adjustments. Specifically, (1) qualitative factors may be expressed in terms of scores that are either added to or subtracted from scores reflecting quantitative evaluation, or (2) grades based on quantitative evaluation may be upgraded or downgraded to reflect qualitative factors.

Chart 2: Examples of Quantitative Factors Determining Borrower Ratings

<b>Risk factors</b>	<b>Examples</b>
<b>Size of operation</b>	Amount of capital and net assets
<b>Safety</b>	Current ratio, capital adequacy ratio, and current account balance ratio
<b>Profitability</b>	Return on assets, operating profits, years required to pay back interest-bearing liabilities, and interest coverage ratio
<b>Others</b>	Rate of growth in sales and profits

Chart 2: Examples of Qualitative factors determining Borrower ratings

Type of factor	Examples
<b>Industry</b>	Growth potential, size of market fluctuations, and entry Barriers
<b>Firm</b>	Ownership relations with parent companies or affiliate firms, the management's ability, and existence of an external audit system

### III. MINIMUM REQUIREMENT FOR ESTIMATION OF PD, LGD, EAD

#### III.1 Probability of default (PD)

Given that PD is a primary input for the IRB approach, a close attention should be paid to it.

The estimation of PD is first based on the definition of reference definition of default given by the Committee. Let's remind it briefly. *"A default is considered to have occurred with regard to a particular obligor when **one or more** of the following events have taken place.*

- (a) *It is determined that the obligor is unlikely to pay its debt obligations (principal, interest, or fees) in full;*
- (b) *A credit loss event associated with any obligation of the obligor, such as a charge-off, specific provision, or distressed restructuring involving the forgiveness or postponement of principal, interest, or fees;*
- (c) *The obligor is past due more than 90 days on any credit obligation; or*
- (d) *The obligor has filed for bankruptcy or similar protection from creditors.*<sup>8</sup>

<sup>8</sup> IRB approach , consultative paper, BIS, page 36



PD should be estimated for each grade. Its estimates should be grounded in historical experience, and must represent a conservative view of long-run average (at least five years) for the borrower grade in question. It implies that banks have to assess current PDs based on current data, and measure also long-run average based on its historical data. Adjustments are necessary to ensure that PD chosen as input reflects a consistent item corresponding to the likelihood of borrower to default. For example, if current realized PDs for a given grade is materially higher than the bank's long-run average experience, it would be inappropriate to utilize the long-run average. Likewise, if current realized PDs for a given grade are materially lower than the bank's long-run average experience, it would be prudent to utilize the long-run average. It is desirable for banks to estimate this long-run average over an entire economic cycle.

Three estimation techniques can be used: (1) internal default experience, (2) mapping to external data, and (3) statistical default models. Banks should consider all available information for estimating the average PD per grade. The first technique requires reliable and long historical data. The second one lays on the external data sources. In this case the bank should, either map its internal risk ratings to rating agency equivalents, or employ pooled data where the data was shared among a number of institutions to increase the width of data. In addition, for any techniques cited above, a clear understanding of the key model inputs and the model's methodology should be made. The aim is to avoid "black box" that is not well understood by bank staff.

### ***III.2. Loss Given Default (LGD)***

LGD refers to the ratio of expected loss relative to credit exposures at the time of default.

As in the case of PD, long-term historical data on defaulted assets is essential. Estimates of LGD must be based on a minimum data observation period that should ideally cover at least one complete economic cycle. Here the Committee has decided a period of seven years. The data should include peaks and troughs of the business

cycle in consideration of the fact that economic conditions may affect the amount of collection by changing the value of collateral and other factors. In building a reference database for estimation, other information potentially affecting LGD also needs to be gathered. This includes provision of collateral, collateral type, collateral coverage, and borrower characteristics<sup>9</sup>, such as industry, geography, and creditworthiness.

### ***III.3. Exposure at default (EAD)***

EAD is the amount outstanding of credit at the time of default. In advanced approach, banks must assign an estimate of EAD for each facility. It must be a long –run default average EAD for similar facilities and borrowers over a sufficiently long period of time (at least seven years), but with a margin of conservatism appropriate to the likely range of errors in the estimate.

As far as on-balance sheet is concern, banks have to estimate at no less than the current drawn amount. But in the case of off-balance sheet items, they should establish procedures in place for the estimation of EAD, and specify the estimates to be used for each facility.

More over, for exposures where EAD estimates are volatile over the economic cycle the bank must use EAD estimates that are appropriate for an economic downturn, if these are more conservative than the long-run average.

The criteria by which estimates are derived must be plausible and intuitive, and represent what the bank believes to be the material drivers of EAD. The choice must be supported by credible internal analysis by the bank.

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<sup>9</sup> Borrower information, such as industry, is basically linked to PD but may also affect LGD in some cases. For example, the amount of collection at the time of default tends to be relatively small for credit extended to borrowers belonging to an industry, which provides collateral with relatively low liquidity.

## **CHAPTER IV : ESTIMATE OF RISK COMPONENTS AND RISK WEIGHTED ASSETS (RWA)**

In this chapter we describe methodologies that will be used to assess, Probability of Default (PD), loss Given Default (LGD), exposure at default (EAD), Maturity (M) and the Capital requirement. Then, we will apply these methods later (next chapter) to implement IRB approach within Ecobank Ghana Ltd Corporate portfolio.

### **I. RISK PARAMETERS**

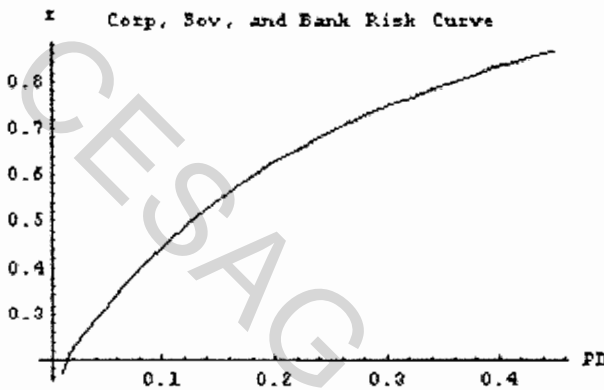
#### ***1.1. Probability of default (PD)***

##### **a) Definition**

The core of the IRB approach is the use of banks' own estimates of the probability of Default (PD) associated with an exposure. PD is a measure of probability that an obligor is not able to pay his debts within a certain time horizon. It has a major effect on Risk Weighted Assets, then on Capital requirement (figure 1). For banks and corporates exposure, it is assigned a minimum of 0.03% for obligors with the best credit quality. In the case of default the boundary condition is 100%. These floors imposed by the Basle Committee aim both to place a minimum bound on risk weights (and hence capital requirements) and also in recognition of the difficulty banks face in validating PD estimates of this magnitude. The Committee does not impose methods for quantifying PD, but recommends that an average of PDs be measured for each borrower grade. Hence all borrowers within that grade are treated as having the same PD. The time horizon for this estimation will be one year. It does not mean that banks should assess borrowers solely on the basis of their likely performance over the next 12 months, they should consider all relevant information in the rating (and lending decision), including information that is relevant to the credit capacity of the borrower beyond one year. The reason is that one year PDs are the typical inputs into internal capital allocation

systems, where one year coincides both with the usual financial reporting period and the typical minimum frequency with which ratings are reviewed internally.

Figure 1



The figures shows the increase of PDs when borrowers deteriorate. The better rating is, the less is probability of default

### b) Methods

Methods for estimation of PD in IRB approach should allow the use of internal data to associate a PD to each grade of borrower. There are three broad approaches:

- The use of data based on a bank's own default experience,
- Mapping to external data such as rating from rating agency,
- The use of statistical default models.

In our literature review, we saw the different statistical models such as accounting based and market based models. Given that in West Africa most of firms are not publicly traded, and are not rated, mapping methods and market based models can not be used. The only methods available are the use of bank's own default experience and accounting based methods. Since Ecobank Ghana uses Expert judgment models for borrowers' ratings we believe that the accurate method is the use of bank's own default

experience to measure Probability of Default (PD). In this purpose the main tool will be the matrix of transition based on internal data.

Credit migration or transition matrices characterize past changes in credit quality of obligors (typically firms) using ratings migration histories. Broadly there are two approaches, cohort and two variants of duration (or hazard) – parametric (imposing time homogeneity or invariance) and nonparametric (relaxing time homogeneity).

In simple terms, the cohort approach just takes the observed proportions from the beginning of the year to the end (for the case of annual migration matrices) as estimates of migration probabilities. Suppose there are  $N_i$  firms in rating category  $i$  at the beginning of the year, and  $N_{ij}$  migrated to grade  $j$  by year-end. **An estimate of the transition probability is :**

$$P_{ij} = \frac{N_{ij}}{N_i}$$

For example, if two firms out of 100 went from grade 'AA' to 'A', then  $P_{AA \rightarrow A} = 2\%$ . Any movements within the year are not accounted for. Typically firms whose ratings were withdrawn or migrated to Not Rated (NR) status are removed from the sample.

The *duration approach* counts all rating changes over the course of the year and divides by the time spent in the starting state or rating to obtain the migration intensity which is transformed into a migration probability. For example, if a firm begins the year in A, transitions mid-year to BBB, before ending the year in BB, both transitions (A  $\rightarrow$ BBB and BBB  $\rightarrow$ BB) as well as the portion of time spent in each of the three states would contribute to the estimated probabilities.

In this current work, we do not use duration approach, but *cohort approach* to build the matrix of transition. So borrowers will be classified into grade representing rating class. In the first column are ranged the different ratings at the beginning of the year and the first line contents the ratings at the end of the year. Each cell of the matrix shows the percentage of borrowers who migrated (change of class of rating). The last column gives the proportion of defaulted borrowers (in the sense of BIS definition of default) in each grade. As we use default model, only the last column relates the estimate of PD.

The process will be repeated each year. The final probability of default is the average of PD of each grade. After that the Basel committee recommends in its Consultative Paper (2004) *“Banks must regularly compare realized default rates with estimated PDs for each grade and be able to demonstrate that the realized default rates are within the expected range for that grade”*.

## **1.2. Loss Given Default (LGD)**

Besides the Probability of Default PD, the Loss Given Default LGD is the most important credit risk parameter within the Basel framework.

### **a) Definition of LGD**

The Basel II Consultative Document gives a definition of LGD as follows: Loss Given Default means economic loss from a defaulted transaction (including discount effects, funding costs and other direct and indirect costs), expressed as a percentage of the exposure at the time of default (EAD). LGD describes the part of a credit that is not recovered in the case of default. It reflects the fact that after the occurrence of a default, not all of the outstanding amount “Exposure at default” EAD needs necessarily be written off. Mostly of collateralizing, but also because of legal actions, agreements between bank and defaulted borrower, and so on, the creditor recovers a certain percentage of the outstanding amount. This fraction is called recovery rate. While the PD associated with a given borrower does not depend on the features of the specific transaction, LGD is facility-specific because such losses are generally understood to be influenced by key transaction characteristics such as the presence of collateral and the degree of subordination.

### **b) Method of estimation of LGD**

In the Foundation approach the value LGD is fixed and based on supervisory values: for instance, 45% for senior unsecured claims and 75% for subordinated claims.

In the case of advanced approach, banks have to estimate this parameter based on the loss experience.

It can be considerably reduced if eligible financial collaterals are recognized in the IRB sense. In this case, the effective LGD is calculated from the exposure values after risk mitigation<sup>10</sup>.

The loss given default is expressed as a percentage of exposure at default (EAD).

The formula is:

**LGD= 1- Recovery rate**

Recovery rate is defined as the present discounted value at the default date of recoveries received net of material direct and indirect costs associated with collecting on the exposure divided by the amount of the exposure at default.<sup>11</sup> Bank should assess recovery rate for each kind of facility, based on its recovery rate.

### ***1.3. Exposure at Default (EAD)***

As with LGD, EAD is also facility specific. In most cases EAD will equal the nominal amount of the facility, but for certain facilities (e.g. those with undrawn commitments) it will include an estimate of future lending prior to default. For a term loan, *EAD* is rarely ambiguous. This is not the case, however, for facilities such as lines of credit where a borrower is theoretically able to draw down at will up to the committed line of the facility. Moreover, as financial distress worsens, a borrower will typically draw down as much as possible on existing unutilized facilities in order to avoid default. Again as with LGD, under the foundation methodology EAD is estimated through the use of standard supervisory rules.

In the advanced methodology, the bank itself determines the appropriate EAD to be applied to each exposure, on the basis of robust data and analysis which is capable of being validated both internally and by supervisors. Thus a bank using internal EAD estimates for capital purposes might be able to differentiate EAD values on the basis of

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<sup>10</sup> The treatment of collaterals is described in detail in the Basel Capital Accord (Paragraph 259-274)

<sup>11</sup> Guidance on Paragraph 468 (LGD) of the Framework Document July 2005

a wider set of transaction characteristics (e.g. product type) as well as borrower characteristics.

### ***1.4. Maturity***

Credit portfolios consist of instruments with different maturities. The issue here is to find out the accurate maturity that should be used to assess the required capital. Empirical evidence indicates that long-term credits are riskier than short-term credits.

Under Foundation approach the effective maturity ( $M$ ) will be 2, 5 years for all grades. The same maturity may be used (authorization of National supervisors is required) by banks using advanced approach, only for domestic corporate borrowers with turnover less than € 500 million( this limit is the one set by Basle committee but when time will come to implement IRB, national regulations authorities will adapt this limit to local characteristics).

As far as advanced approach is concerned, the Committee required that banks measure the effective maturity for each facility. For this purpose many methods can be proposed depending on the features of the facility.

- For an instrument subject to a determined cash flow schedule, effective maturity ( $M$ ) is defined as:

$$\text{Effective Maturity (M)} = \frac{\sum_{t=0}^M t \cdot CF_t}{\sum_{t=0}^M CF_t}$$

Where,  $CF_t$  denotes the cash flows (principal, interest payments and fees) contractually payable by the borrower in period  $t$ .

- If a bank is not in a position to calculate the effective maturity of the contracted payments as noted above,  $M$  will be equal to the maximum remaining time ( in years) that the borrower is permitted to fully discharge its contractual obligation



( principal, interest and fees) under the terms of loan agreement. Normally, this will correspond to the nominal maturity of the instrument.

In any case,  $M$  will be no greater than 5 years.

Moreover, the Committee has proposed a maturity adjustment  $mi$  in the case of large corporate. The maturity adjustment for client  $i$  is given by (Basel Committee on Banking Supervision, 2004a) as follows :

$$\text{Maturity adjustment (M): } (0.11852 - 0.05478 \times \ln(pi))^2$$

$M = 2, 5$  years for all grades (for banks which are unable to determine maturity)

## II. CAPITAL REQUIREMENTS

In the credit business, losses of interest and principal occur all the time - there are always some borrowers that default on their obligations.

Figure 1 illustrates how variation in realized losses over time leads to a distribution of losses for a bank:

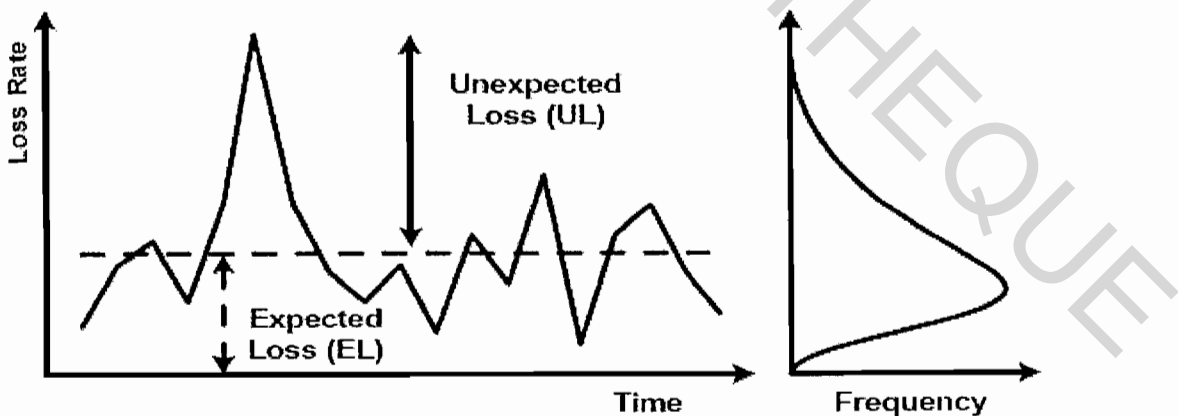


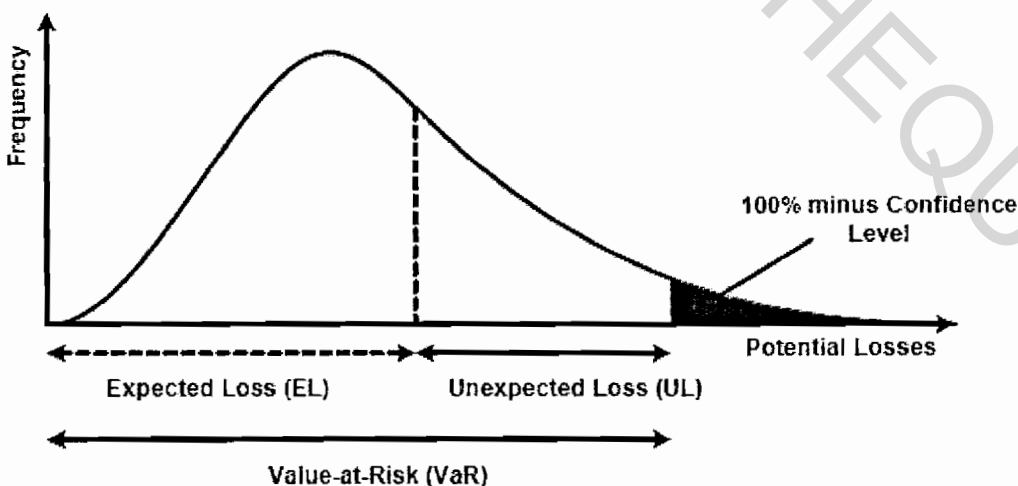
Figure 1

While it is never possible to know in advance the losses a bank will suffer in a particular year, a bank can forecast the **average** level of credit losses it can reasonably expect to experience. These losses are referred to as **Expected Losses (EL)** shown in the part below the dashed line in Figure 1. Financial institutions view Expected Losses as a cost component of doing business, and manage them by a number of ways, including pricing of credit exposures and provisioning (allowance).

One of the functions of bank's capital is to provide a buffer to protect bank against peak losses that exceed expected levels. Such peaks are illustrated by the spikes above the dashed line in Figure 1. Peak losses do not occur every year, but when they occur, they can potentially be very large. Losses above expected levels are usually referred to as **Unexpected Losses (UL)**.

Given that provision and pricing system can allow the coverage of Expected losses, the concern now is to find a model to determine the amount of loss which will exceed the expected level with a small predefined probability. This probability can be considered as the probability of bank insolvency. Capital is set to ensure that unexpected losses will exceed this level of capital with only this very low, fixed probability. This approach to setting capital is illustrated in Figure 2.

Figure 2



The curve in Figure 2 describes the likelihood of losses of a certain magnitude. The area under the entire curve is equal to 100% (i.e. it is the graph of a probability density). The curve shows that small losses around or slightly below the Expected Loss occur more frequently than large losses. The likelihood that losses will exceed the sum of Expected Loss (EL) and Unexpected Loss (UL) - i.e. the likelihood that a bank will not be able to meet its own credit obligations by its profits and capital - equals the hatched area under the right hand side of the curve. 100% minus this likelihood is called the **confidence level** and the corresponding threshold is called **Value-at-Risk (VaR)** at this confidence level. If capital is set according to the gap between EL and VaR and if EL is covered by provisions or revenues, then the likelihood that the bank will remain solvent over a one-year horizon is equal to the confidence level. Under Basel II, capital is set to maintain a supervisory fixed confidence level.

Knowing the risk parameters (PD, EAD, LGD) the Expected losses (EL) can be expressed as followed (in currency amounts):

$$EL = PD * EAD * LGD$$

Or, if LGD is expressed as a percentage of EAD, as

$$EL = PD * LGD$$

As far as unexpected losses are concerned, under Basel II IRB approach, banks are allowed, under certain requirements (chapter II) to use portfolio models to determine the capital needed to cover these losses. Portfolio models include traditional models such as..... and modern ones commonly used in finance such as CreditMetrics, Var,..... All these models have been reviewed previously in our literature review section. In its contribution to a better implementation of IRB approach, the Committee has proposed a risk weight function permitting the assessment of credit risk within a given portfolio<sup>12</sup>.

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<sup>12</sup> Consultative document 2004

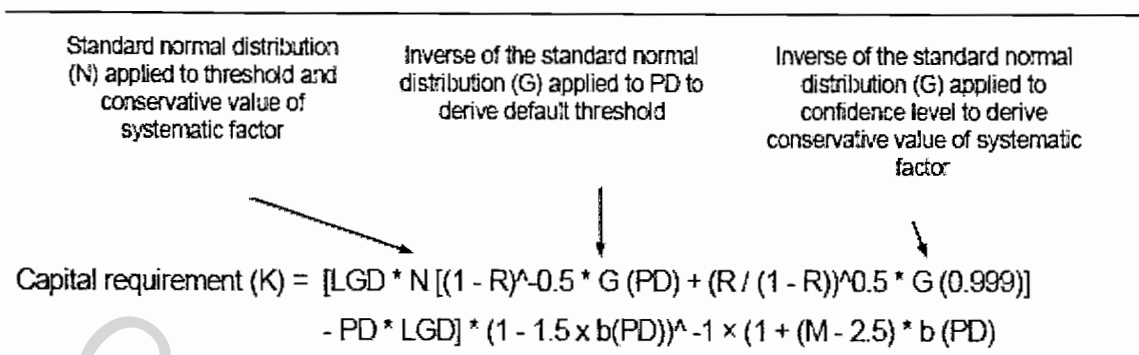
Bank may use this formula or decide to set up their own formula under the supervision of National Supervisors.

The risk weight function is quite simple after determination of the risk parameters. In our present work we will use this function to assess the capital needed within Ecobank corporate portfolio (in next chapter). In expectation of this implementation, we expose the function in this part and the different assumptions behind it.

### ***II.1. Capital formula***

The capital requirements of assets are derived from risk weight formulas, which were developed considering a special credit portfolio model, the so-called Asymptotic Risk Factor (ASRF) model. It is derived from an adaptation of the single asset model of Merton (1974), where loans are modeled in a standard way as a claim. In 1997 Vasicek showed that under certain conditions, Merton's single asset model can be extended to a model for the whole portfolio. The portfolio model used in the advanced IRB approach (Gordy, 2003; Pykhtin and Dev, 2002) is very similar to Vasicek's model. In this model, credit risk in a portfolio is divided into two categories, systematic and idiosyncratic risk. Systematic risk represents the effect of unexpected changes in macroeconomic and financial market conditions on the performance of borrowers. Idiosyncratic risk, on the other hand, represents the effects of risk connected to individual firms. The idea behind the ASRF model is that as the portfolio becomes more and more fine-grained, in the sense that the largest individual exposures account for a smaller and smaller share of total portfolio exposure, idiosyncratic risk is diversified away on the portfolio level.

In Basel II, the confidence level ( $R$ ) is set to 99.9%, i.e. an institution is expected to suffer losses that exceed its economic capital once in a thousand years on average.



In this function, in addition to LGD ( in percentage), PD( in percentage) , we have assets correlation( R), N(standard normal distribution), G(Inverse of the standard normal distribution), and b( maturity adjustment )

$$\text{Correlation (R)} = \frac{0.12 \times (1 - \text{EXP}(-50 \times \text{PD}))}{0.24 \times [1 - (1 - \text{EXP}(-50 \times \text{PD})) / (1 - \text{EXP}(-50))]} + \frac{0.24 \times [1 - (1 - \text{EXP}(-50 \times \text{PD})) / (1 - \text{EXP}(-50))]}{0.24 \times [1 - (1 - \text{EXP}(-50 \times \text{PD})) / (1 - \text{EXP}(-50))]}$$

$$\text{Maturity adjustment (b)} = (0.11852 - 0.05478 \times \ln(\text{PD}))^2$$

The capital requirement (K) as laid out in this framework is expressed as a percentage of the exposure. In order to derive risk weighted assets, it must be multiplied by EAD and the reciprocal of the minimum capital ratio 8%, i.e. by a factor of 12.5.

$$\text{Risk-weighted assets (RWA)} = K \times 12.5 \times \text{EAD}$$

### Correlation(R)

The asset correlations needed as input in the ASRF model, determine in short, how the asset values of the borrowers depend on each other. It should be noted that asset correlations and default correlations are not the same (see in Appendix B how they are related to each other). The input correlations also specify how the asset values of the borrowers depend on the general state of the economy, represented by the systematic risk factor, Y .In the IRB approach, the asset correlations are not to be estimated by the banks. Instead they should be determined by formulas given by the Basel Committee.

These formulas are based on two empirical observations (Lopez, 2004);asset correlations decrease with increasing probability of default and asset correlations increase with firm size

## ***II.2. Assumptions behind the capital formula***

These requirements impose strict assumptions on the diversification achieved within a bank portfolio :

- It must be assumed that the bank's credit portfolio is **infinitely fine-grained**, in the sense that any single obligor represents a negligible share of the portfolio's total exposure.
- It is assumed that a **single, common systematic risk factor** drives all dependence across credit losses in the portfolio, i.e. the bank must be well diversified across all geographic and industrial sectors in a large economy.

# CHAPTER V : IMPLEMENTATION OF IRB WITHIN ECOBANK GHANA LIMITED CORPORATE PORTFOLIO

This chapter is intended to use Basle II recommendations to measure the risk components and assess the Economic Capital needed recommendations within ECOBANK Ghana. A comparison will be made with Basle I Economic capital to find out the effects of new regulations on bank capital. This is an attempt to implement the new measures in a bank located in an area characterized by the lack of substantial historical data and where banks do not have sufficient means to comply with the multitude requirements of Basle II.

First, we describe ECOBANK Ghana rating system and find out the level of compliance with Basle II recommendations. Second, we estimate Probability of Default (PD), Exposure at Default (EAD) and Loss Given Default (LGD), and then measure the Capital needed to cover credit risks. Finally, we compare This Economic Capital with the one from Basle I(1988) still in force till 2007.

Since the work is very large in regard of the data, information from the bank, and the insufficiency of means to set up real system to measure accurately all these elements, we will make some assumptions in order to simplify the work.

## I. ECOBANK RATING SYSTEM

### *1.1. Description*

Ecobank Ghana Limited rates Obligors and Facilities through a methodology based on Experts judgment. So the system relies on credits officers' views of the risk that a facility may raise, even if there are quantitative and qualitative criteria set by the bank and intended to guide bank's Experts on their decisions. The rating system issues Obligor Risk Rating (ORR) and Facility Risk Rating (FRR). The current methodology is in use until a PC-based Debt Rating Model takes place .The methodology will also be used

whenever, in the opinion of credit officers, it is felt that the specified situation (e.g. financials not considered reliable, currently available information of adverse nature. . .) warrants a more conservative risk rating.

### **I.1.1. Obligor risk ratings (ORR)**

#### ***a) ORR Assignment***

ORR is assigned and approved when a credit is first extended. It is reviewed and revalidated at the time of each annual review. It can also be reviewed immediately and adjusted, if necessary, whenever there is a material event such as an adverse classification. The Country Risk Manager is Responsible for assigning risk ratings.

#### ***b) ORR Methodology***

The judgmental methodology discussed below will be followed. This methodology is based on qualitative and quantitative criteria related below.

#### ***c) ORR Range***

Barring a few exceptions (where unsecured obligors may qualify for a rating of 3 or 4), the majority of the Target Market names are likely to fall into the non-investment grade 5, 6, or 7 categories. As a matter of policy, the bank does not seek to develop business with any name that has an ORR worse than 6 unless the facilities are fully secured by cash.

#### ***d) Qualitative Criteria***

In determining obligor risk ratings Ecobank uses, among other things, financial data, industry and competitive information, their assessment of management quality and access to financing. With regard to financial data the bank uses standard thresholds built around sales, earnings, capitalization and liquidity. Generally the following qualitative starting by "03" characteristics determine the appropriate risk rating :



- **ORR 3 Obligors**

Obligors risk rated "3" are the best credits. The few obligors who may fall into this category will typically have the following characteristics :

- the best local credits
- large corporation (with annual sales in excess of \$250 millions)
- clear market leaders in their industry
- strong financial condition
- good access to the debt market
- strong parent support
- experienced parent support

- **ORR 4 Obligors**

Obligors risk rated "4" are strong local credits that will typically have the following qualities :

- large corporations ( with annual sales in excess of \$1.5 million)
- number 1 or 2 in their industry
- operate in an industry that has stable fundamentals
- strong financials position, with no obvious weakness or dependency. good access to the debt
- market and/or parent support
- sound, experienced management in key positions

#### - **ORR 5 Obligors**

These obligors are good local credits in our markets. Typically they will have the following qualities :

- Large corporation(with sales in excess of \$ 1000000)
- Well established companies, in the top three in their industry
- Operate in an industry with some cyclicity, but have the ability to cope with downturns
- Financially sound, leverage liquidity and other, financial ratios are normal for their industry
- Sound management in most positions
- Banks are and will continue to be their main source of financing.

#### - **ORR 6 Obligors**

Obligor's in this risk category are acceptable credits that are less stable than ORR 5 credits. Typically they will have the following qualities :

- medium size companies (with annual sales in excess of \$500000) operate in an industry that is considered volatile, but the company will have a secure niche position
- acceptable financial ratios, including leverage and liquidity, but there may be a record of some inconsistency
- reasonable management but without much depth
- banks are their primary source of financing
- obligor has incremental debt capacity, but banks strategy will tend towards structured facilities, managing and reducing the risk

- **ORR 7 Obligors**

These obligors will usually be those where any one of the following conditions exists :

- There has been some deterioration in performance. (e.g. caused by economic or political events or by management change)
- capacity to pay principal and interest in a timely manner is dependent on business conditions
- earnings are under pressure
- Weakening of competitive position
- Inadequate or weak management

- **ORR 8 Obligors**

Obligors risk rated "8" will evidence weakness and/or show that adverse changes have taken place. Outstanding will be as more likely to be loss and the following conditions will exist :

- adverse trends in sales and earnings
- profit margin in erosion
- interim losses
- fixed price contracts in volatile environment
- Increase in leverage relative to past, plan, industry norm
- no seasonal line clean up
- products subject to intense competition

This is considered as default class.

### **e) Quantitative Criteria**

Guideline parameters for key financial items are below. They must, however, remain non-determining criteria at this stage, because there is a need to develop more experience to refine the bank's view of local risk.

	Sales	PET/Sales	TNW	Leverage	Current Ratio	Cash Interest Coverage
Obligors	\$'0000	%	\$'0000			Times
ORR3	>250	>10	>100	<2.0	>1.5	>3.0
ORR4	>150	>5	>50	<2.5	>1.2	>2.0
ORR5	>100	>3	>25	<3.0	>1.0	>1.5
ORR6	>50	>0	>10	<3.5	>1.0	>1.0

Given that the data used belong to the prior year, there will always be the risk that the ORR derived will lack accuracy. Consequently, whenever necessary, the Country Risk Manager will override the derived rating and assign a more negative rating if a material event takes place. On the other hand, a more positive rating will be supported by current financials statements.

### **f) Judgmental Upgrades & Downgrades**

All rating upgrades require the approval of the Group Risk Manager. Rating downgrades can be approved by the Country Risk Manager or Country Head.

## **1.2. Facility Risk Ratings (FRE)**

The facility risk rating will normally be the same as the obligor risk rating. However, a different risk rating will be assigned by adjusting the obligor rating to take into account important factors that could affect the loss norm of the facility, such as nature of security, product risk and cross border risks.

Security may take the form of cash collateral, collateral against shares or marketable securities including government bonds and Treasury bills, guarantees, or letters of credit. The documentation on hand must be enforceable and the legal environment such that one can readily monetize such support and apply it to extinguish the credit exposure.

#### **a) Fully Cash-Collateralized Facilities**

Cash-collateralized facilities will be rated 1 if both the facility and collateral are in the same currency and in the country where the obligations arise.

They will be rated 2 if there is a currency mismatch and the documentation calls for a safety margin for currency fluctuation.

If the collateral is held in a country other than where the obligations arise, the FRR will reflect the Sovereign Risk Rating of that country provided that there is no currency mismatch.

#### **b) Collateralized by Government Securities**

Will be rated as per Facilities to Government (i.e. 1)

#### **c) Collateralized by Investment Grade, Marketable Securities**

Will be rated the worse of the rating of the securities or the Sovereign Risk Rating of the country in which the issuer is located.

#### **d) Collateralized by Other Assets**

The FRR will be equal to the ORR

### **e) Guaranteed Facilities**

The FRR should be based on the rating of the strongest entity among the obligor and the guarantor(s).

### **f) Term Facilities**

Unsecured term facilities will have the same FRR as the ORR

For secured facilities, the FRR will depend on the nature of collateral.

### **g) Classified Facilities**

Facilities which have been partially written off or reserved will carry a risk rating for the unreserved portion as for ORR for Obligor with Classified Facilities.

### **h) Facilities to Governments (Local Currency)**

Government facilities including facilities to government-owned entities will be rated as follows :

Facility Type	FRR
Cash deposits with the Central Banks	1
Treasury Bills with tenors up to 6 months	1
Treasury Bills with tenors over 6 months	2
Government Bonds with tenors up to 1 year	2
Government Bonds with tenors over 1 year	2
Other facilities with tenors up to 1 year	3
Other facilities with tenors of 1 to 3 years	3
Other facilities with tenors over 3 years	4

In most cases, facilities to local entities within a particular country should not have a better rating than similar facilities to the Central Bank or Treasury of that Bank.

### ***1.3. Compliance with Basle II requirements***

Ecobank Ghana has a rating system which provides separate assessment of borrowers and transactions characteristics. Furthermore, the different grades are fully specified and clearly defined by well defined qualitative and quantitative criteria; so that a borrower can be easily classify in a given class. The 6 grades minimum recommended is fully respected by the bank. The grades are reviewed annually by the risk manager. Up to this point the bank's rating system, is consistent with Basle II recommendations. But, in term of grades numbers and risk assignment and review process, the compliance is not full yet.

In fact, even though Ecobank rating system has 6 grades for performing borrowers ( minimum required for performing borrowers by Basle II), it does not have grades for non performing borrowers, as recommended by Basle Committee(at least 2 grades).

As far as rating review is concerned, Ecobank abides by the independency and integrity since grades are attributed by a unit at risk department whose staff has no contact with customers likely to distort their decision. These rating are, also reviewed by Country risk manager. The only weakness which is not conform to Basle II recommendations, is the time to react to new information on customer likely to change borrower's rating. The reaction time proposed by Basle II is 90 days for non-problem borrowers and 30 days for borrowers with weakened financial condition. The compliance of this time requires diligence and vigilance from the rating unit.

Ecobank rating system does not issue elements allowing the measurement of LGD, EAD or PD. The rating system should not be limited to assignment of ratings to borrower and facilities, but should enable bank management to get any items likely to allow assessment of the different risk factors within IRB approach.

## II. ASSESSMENT OF RISK COMPONENTS AND RISK WEIGHTED ASSETS

In this part we use the data collected on *large local Corporate* of Ecobank Ghana Limited. The first factor is the probability of default (PD), the second one is the Loss given default (LGD), the third one is Exposure at Default (EAD) and finally the Risk weighted Assets (RWA).

### Probability of default

Probability of default is the first and most important risk factor in IRB approach. Its assessment requires historical data. In our case the lack of data over a long period, and the small size of the sample are likely to bias our estimation of this risk component. However, in our context the methodology of estimation is more important than the accuracy of results.

The method consists of a classification of borrowers in their respective rating classes. These classes will be viewed as classes of risk. For each year (at the time of review) we assess the probability of a borrower to migrate to another class of risk. This migration gives the probability of transition. Since we use default model, the most important migration will be the probability of a borrower to migrate to the class of default, which is the "Class 8". For each year all the results of these calculations are gathered in a matrix of transition. And when we move from a year to another one an average of results of each class is made to find final matrix. An average of this final matrix and the new matrix of the year under review will constitute the new final matrix.

(For data see appendix)

### 2003

Here is the summary of population of borrowers in each class at the first year (2003), the starting year.



Classes(rating)	3	4	5	6	7	Total
Population	0	2	6	9	7	24

## 2004

### Migrations in term of population

Rating at the end of the year.	3	4	5	6	7	8(class of default)
Rating at the beginning of the year						
3						
4		1		1		
5			1	2	2	1
6				7	1	1
7					3	4

### Migrations in term of probability

Rating at the end of the year.	3	4	5	6	7	8(class of default)
Rating at the beginning of the year						
3	0	0	0	0	0	0,00
4	0	0,50	0	0,50	0	0,00
5	0	0	0,17	0,33	0,33	0,17
6	0	0	0	0,77	0,11	0,11
7	0	0	0	0	0,43	0,57

2005

**Migrations in term of population (from 2004 to 2005)**

Rating at the end of the year.	3	4	5	6	7	8(class of default)
Rating at the beginning of the year						
3						
4		0	1	0	0	0
5			1	3	0	1
6				5	2	3
7					3	5

**Migrations in term of probability**

Rating at the end of the year.	3	4	5	6	7	8(class of default)
Rating at the beginning of the year						
3						
4		0	1,00	0	0	0,00
5			0,20	0,60	0	0,20
6				0,50	0,25	0,25
7					0,37	0,62

**In 2005 the final matrix of transition (average of the different matrices)**

Rating at the end of the year. Rating at the beginning of the year	3	4	5	6	7	8(class of default)
3						
4		0	0,75	0	0,25	0,00
5			0,18	0,49	0,16	0,16
6				0,63	0,18	0,18
7					0,40	0,59

The probability of default is given by the last column, that is to say the probability to migrate towards the default class. Where probability is 0. 00%, the PD to be used will be the minimum PD= 0. 03% set by the Basle committee for best borrower. PD for class 8 will be 0.9, since 100% for limit boundary, does not allow capital assessment. In fact G (100%) one of component in the formula is not possible to evaluate.

**II.1. Exposure At Default (EAD)**

The exposure at default is the amount of Outstanding at the time of default. In our case, it is the outstanding at the time of migration towards the default class 8.

**II.2. Loss given Default (LGD)**

**LGD: 1- Recovery rate.**

The recovery rates have been given to us by the bank, based on their experience in recovery. It is noticed that most of the time, the level of recovery depends on the grade of the borrower and the grade of facility. But the obligor rate seems to be a key element

in the determination of the recovery rate. The bank continues to gather data in order to refine its conclusions.

- **For borrowers rated 5 and 6 the recovery rate is around 90%, so LGD will be 10%. The reason is that obligors in these grades generally have financial capacities to secure their facilities with strong collaterals (mortgage, support from parent company, securities) making the recovery rate high in case of default.**
- **For Borrowers rated 7 the recovery rate is 80%, so LGD is 20%**
- **For Borrowers rated 8 the rate is 25%, so LGD is 75%, since they are in bad financial position characterized by so many weaknesses that compromise generally the recovery. For these firms, in case of default, collaterals lose sometimes their original values.**

In our current study we will use recovery rates given by bank's management.

### ***II.3. Maturity***

The maturity will be 2.5 years, because this information was not available, 2.5 years is the one set by the committee for banks which are not able to assess their maturity.

An adjustment will be applied to this maturity. The adjustment formula :

$$b(\pi) = (0, 11852 - 0,05478 * \text{Log}(\pi))^{2}$$

### ***II.4. Correlation***

We use corporate correlation formula issued by Basle II, in the 2004 (a) consultative paper.

$$\text{Correlation}(R) = 0.12 * (1 - \text{Exp}(-50 * P_d)) / (1 - \text{Exp}(-50)) + 0.24 * [1 - (1 - \text{Exp}(-50 * P_d)) / (1 - \text{Exp}(-50))]^2$$

## II.5. Capital requirement

The first step consists of using Basle II Capital formula to assess Capital required, the second step consists of the use of the present method used by the bank (derived from Basle I capital requirement) to determine the Capital needed to cover credit risk and the last step is a comparison to find out the change in capital generated by the change of methodology. Note that we do not take into consideration operational risk which is the second component for a full assessment of total capital.

### a) Capital and Risk Weight Assets through Basle II RWA function

The Capital formula proposed by Basle committee is as follow :

Standard normal distribution (N) applied to threshold and conservative value of systematic factor	inverse of the standard normal distribution (G) applied to PD to derive default threshold	Inverse of the standard normal distribution (G) applied to confidence level to derive conservative value of systematic factor
↙	↓	↘
$\text{Capital requirement (K)} = [\text{LGD} * \text{N} [(1 - \text{R})^{-0.5} * \text{G} (\text{PD}) + (\text{R} / (1 - \text{R}))^{0.5} * \text{G} (0.999)] - \text{PD} * \text{LGD}] * (1 - 1.5 * \text{b}(\text{PD}))^{-1} * (1 + (\text{M} - 2.5) * \text{b}(\text{PD}))$		

*\*extracted from BIS, consultative paper "Explanatory note on IRB weight function" July 2005*

The following table gives the Capital required and the Risk Weight Assets (RWA) for Ecobank Ghana Large Corporate portfolio given that  $\text{RWA} = 12.5 \times \text{EAD} \times \text{K}$

Borrowers	Rating	Outstandings	Ln(PD)	PD	G	EAD	LGD	Maturity	B(pi)	Correlation	***	N(***)	K	RWA	RWA/Outsta
ACCRA BREWERY LI 6+		1324	-1,714798428	0,18	-0,9153651	1324	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	684,689101	51,71%
ASHANTI FOAM FAC	7	1324	-0,527632742	0,59	0,227545	1324	20%	2,5	0,0217338	12,0000%	1,38370767	0,916776007	6,7558%	1118,07865	84,45%
BEVERAGE INVESTM	8	107	-0,105360516	0,9	1,2815516	107	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	96,4452061	90,14%
CITI SAVINGS AND L	7	0	-0,527632742	0,59	0,227545	0	20%	2,5	0,0217338	12,0000%	1,38370767	0,916776007	6,7558%	0	0,00%
DOMOD ALUMINIUM	6	632	-1,714798428	0,18	-0,9153651	632	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	326,830447	51,71%
Dupaul Wood treatment	8	500	-0,105360516	0,9	1,2815516	500	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	450,678533	90,14%
DURAPLAST LIMITEI	7	982	-0,527632742	0,59	0,227545	982	10%	2,5	0,0217338	12,0000%	1,38370767	0,916776007	3,3779%	414,634909	42,22%
GEN.LEASING AND F	6	2289	-1,714798428	0,18	-0,9153651	2289	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	1183,7261	51,71%
GHANA LEASING CO	6	956	-1,714798428	0,18	-0,9153651	956	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	494,382765	51,71%
INTERPLAST LIMITEI	6	2838	-1,714798428	0,18	-0,9153651	2838	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	1467,63419	51,71%
KGM INDUSTRIES LT	8	658	-0,105360516	0,9	1,2815516	658	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	593,09295	90,14%
Oak Financial Services	8	0	-0,105360516	0,9	1,2815516	0	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	0	0,00%
LEASAFRIC		737	-1,714798428	0,18	-0,9153651	737	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	381,129809	51,71%
P.Z.CUSSONS INDUS'	8	633	-0,105360516	0,9	1,2815516	633	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	570,559023	90,14%
PERGAH TRANSPOR'	8	230	-0,105360516	0,9	1,2815516	230	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	207,312125	90,14%
PHYTO RIKER-GIHO	8	113	-0,105360516	0,9	1,2815516	113	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	101,853349	90,14%
QUALIPLAST LIMITE	8	1088	-0,105360516	0,9	1,2815516	1088	75%	2,5	0,0154484	12,0000%	2,50728247	0,993916828	7,2109%	980,676488	90,14%
REGIMANUEL GRAY	6	3582	-1,714798428	0,18	-0,9153651	3582	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	1852,38396	51,71%
SOMOTEX GH LTD	6	1681	-1,714798428	0,18	-0,9153651	1681	10%	2,5	0,0451378	12,0015%	0,16543325	0,565698507	4,1371%	869,306932	51,71%
TRACTOR AND EQUI	5	981	-1,832581464	0,16	-0,9944579	981	10%	2,5	0,0479211	12,0040%	0,08124149	0,532375047	4,0122%	491,989926	50,15%
		<b>18007</b>				<b>18007</b>								<b>12285,404</b>	<b>68,23%</b>

**Note:**

\*Excel spreadsheet

- \*\*\* : $((1-R)^{-0.55 \cdot G} (Pd) + (R / (1-R))^{0.5 \cdot G} (0.999))$
- Outstanding is expressed in \$ 000
- K is expressed as percentage of EAD
- Outstanding and RWA are in thousands of Dollars

On excel we can determine G (inverse of the standard normal distribution; NORMSINV) and N (standard normal distribution; NORMSDIST).

$$G(0.999) = 3.090232306 \quad G(0.9) = 3.0767854 \quad G(0.59) = 0.227544977 \quad G(0.16) = -0.994457883$$

$$G(0.18) = -0.915365088$$

## b) Capital and Risk Weight Assets assessed through Basle I Capital requirement

Under Basle I the Capital formula is:

$$\frac{\text{Capital}}{\text{Credit Risk weighted Assets}} \geq 8\%$$

We emphasize here on the risk weighted assets. **Basle I** is similar to Basle II Standardized approach where coefficients are set for each kind of assets according to its riskiness in order to determine the risk weighted. The following coefficients will be used according to the feature of the facility :

- **0%**
  - ✓ for facilities to government and affiliate companies;
  - ✓ for facilities to central bank
  - ✓ claims fully secured by cash collateral held within the bank
  
- **20%**
  - ✓ claims secured by Government or Central Bank;
  - ✓ Facilities guaranteed by cash collateral held within another bank
  
- **50%**
  - ✓ Facilities secured by a mortgage
  - ✓ Claims backed up by a guarantor
  
- **100%:** for other types of facilities

Based on these coefficients we assess the RWA. We have been helped by the bank risk management Department to determine RWA, given that outstanding, for each Obligor

under our work, is complex and composed by many facilities with different characteristics. We aggregate outstanding with similar feature in the purpose of the calculation of RWA. Then we will get the total amount of RWA for the entire portfolio.

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Borrower	Ratings	PD	Outstandings(\$)	0%	20%	50%	100%	RWA I	RWA II
ACCRA BREWERY LIMITED	6+	0,18	1324	0	517	497	310	661,9	684,69
ASHANTI FOAM FACTORY LTD	7	0,59	1324	0	298	230	796	970,6	1118,08
BEVERAGE INVESTMENTS GH.L	8	0,9	107	0	0	51	56	81,5	96,45
CITI SAVINGS AND LOANS CO	7	0,59	0	0	0	0	0	0	0
DOMOD ALUMINIUM LTD	6	0,18	632	211	164	54	203	262,8	326,83
Dupaul Wood treatment Ltd	8	0,9	500	0	0	209	291	395,5	450,68
DURAPLAST LIMITED	7	0,59	982	89	108	401	384	606,1	414,63
GEN.LEASING AND FINANCE C	6	0,18	2289	765	233	967	324	854,1	1183,73
GHANA LEASING COMPANY LTD	6	0,18	956	0	198	370	388	612,6	494,38
INTERPLAST LIMITED	6	0,18	2838	260	543	806	1229	1740,6	1467,63
KGM INDUSTRIES LTD.	8	0,9	658	0	0	305	353	505,5	593,09
Oak Financial Services	8	0,9	0	0	0	0	0	0	0
LEASAFRIC	6	0,18	737	0	176	313	248	439,7	381,13
P.Z.CUSSONS INDUSTIRES GHANA	8	0,9	633	0	0	176	457	545	570,56
PERGAH TRANSPORT LTD	8	0,9	230	0	18	67	145	182,1	207,31
PHYTO RIKER-GIHOC PHARML	8	0,9	113	0	0	98	15	64	101,85
QUALIPLAST LIMITED	8	0,9	1088	0	187	203	698	836,9	980,68
REGIMANUEL GRAY LIMITED	6	0,18	3582	780	861	782	1159	1722,2	1852,38
SOMOTEX GH LTD	6	0,18	1681	478	872	131	200	439,9	869,31
TRACTOR AND EQUIPMENT GH	5	0,16	981	105	102	202	572	693,4	491,99
								<b>11614,4</b>	<b>12285,4</b>

\*Excel spread

### Comments

- 1- In comparison with the current methodology (Basle I), Basle II IRB approach is a risk sensitive approach. IRB approach is highly dependent on PD and LGD. The higher PD, the higher RWA. The lower LGD, the lower RWA.
- 2- Given that sensitivity of RWA to LGD and PD is very high; bank should pay close attention to the determination of these components.
- 3- RWA, and so Capital required through Basle II are higher than those estimated through current methodology (Basle I).

## c) Verification of assumptions

### 1) First assumption: New capital accord increases the need of regulatory capital to cover risks.

As seen above in the RWA, using Basel II capital formula is \$12, 285, 000 within the corporate portfolio. It shows an increase in comparison with Basle I formula which provides an amount of \$11,614,000. So we can conclude that Basle II will increase the capital needed to cover risk since the RWA used to calculate the new ratio increases.

### 2) RWA is heavily dependent on PD

To corroborate this hypothesis, we reduce PD of 0.05 and see of the effect of such change on the RWA.

Borrowers	Rating	Outstandings	Ln(PD)	PD	G	EAD	LGD	Maturity	B(pi)	Correlation	***	N(***)	K	RWA	RWA/Outsta
ACCRA BREWERY LI6+		1324	-2,120263536	0,12	-1,1749868	1324	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	606,518478	45,81%
ASHANTI FOAM FAC	7	1324	-0,634878272	0,53	0,0752699	1324	20%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	7,4430%	1231,80899	93,04%
BEVERAGE INVESTM	8	107	-0,174353387	0,84	0,9944579	107	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	150,294906	140,46%
CITI SAVINGS AND L	7	0	-0,634878272	0,53	0,0752699	0	20%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	7,4430%	0	0,00%
DOMOD ALUMINIUM	6	632	-2,120263536	0,12	-1,1749868	632	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	289,516373	45,81%
Dupaul Wood treatment	8	500	-0,174353387	0,84	0,9944579	500	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	702,312644	140,46%
DURAPLAST LIMITEI	7	982	-0,634878272	0,53	0,0752699	982	10%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	3,7215%	456,811341	46,52%
GEN.LEASING AND F	6	2289	-2,120263536	0,12	-1,1749868	2289	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1048,58066	45,81%
GHANA LEASING CO	6	956	-2,120263536	0,12	-1,1749868	956	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	437,939324	45,81%
INTERPLAST LIMITEI	6	2838	-2,120263536	0,12	-1,1749868	2838	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1300,07511	45,81%
KGM INDUSTRIES LT	8	658	-0,174353387	0,84	0,9944579	658	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	924,243439	140,46%
Oak Financial Services	8	0	-0,174353387	0,84	0,9944579	0	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	0	0,00%
LEASAFRIC		737	-2,120263536	0,12	-1,1749868	737	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	337,616404	45,81%
P.Z.CUSSONS INDUS'	8	633	-0,174353387	0,84	0,9944579	633	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	889,127807	140,46%
PERGAH TRANSPOR'	8	230	-0,174353387	0,84	0,9944579	230	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	323,063816	140,46%
PHYTO RIKER-GIHOC	8	113	-0,174353387	0,84	0,9944579	113	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	158,722657	140,46%
QUALIPLAST LIMITE	8	1088	-0,174353387	0,84	0,9944579	1088	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	1528,23231	140,46%
REGIMANUEL GRAY	6	3582	-2,120263536	0,12	-1,1749868	3582	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1640,89818	45,81%
SOMOTEX GH LTD	6	1681	-2,120263536	0,12	-1,1749868	1681	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	770,058581	45,81%
TRACTOR AND EQUI	5	981	-2,302585093	0,1	-1,2815516	981	10%	2,5	0,0598564	12,0809%	-0,221258	0,412445661	3,4327%	420,929454	42,91%
		<b>18007</b>				<b>18007</b>								<b>13216,75</b>	<b>73,40%</b>

When PD is raised by 0.05(5%), the RWA increases in 0.076 so 7.6% following this calculation  $[(13,216.75-12,285.4)/12,216.75]$ . So we can conclude that rise in RWA is always higher than rise in PD, the key factors in risk assessment.

### III. RECOMMENDATIONS

Recommendations address mainly rating system, the bedrock of Internal Rating Based approach.

a) As far as Ecobank is concerned a two dimensional rating system will be more appropriated than one dimensional system. A two-dimensional system combines borrower ratings with evaluation of the features of individual loan transactions independent of borrowers (e.g., ratings based on LGD). This is also the recommendation of Basle Committee which encourages banks to adopt this kind of system to provide a reliable and sound risk profile of obligors. This system also allows getting both borrower's ratings and Loss Given Default (Lgd) at the same time. The rating on facilities will be based on the features of the facility and the loss experience on the borrower to whom the facility is granted.

The following is an example of a two dimensional:

**Facility ratings (A to J) (Two-dimensional system)**

Ratings based on LGD

		Ratings based on LGD					
Grade		1	2	3	...	7	8
Borrower ratings	1	A					
	2	B					
	3	C				I	
	...	D					
	...					...	
	9	I				J	
	10						

*\*extract from "Advancing credit risk Management through Internal rating Systems" Bank of Japan Nov 2005*

b) Ecobank should introduce at least two non performing grades to comply with Basle II. The existing rating system has only a non performing grade which doesn't allow classifying obligor with slight risk of repayment and an obligor with high risk to meet commitments. The recommendation of Basle II tends to design with accuracy obligors' features mainly those who are not performing perfectly.

c) Increase the staff in charge of rating system and invest enough to acquire devices for data and to have an accurate assessment of risks factors.

The staff of risk department within the bank is not consistent to deal with new requirements raised by new accord. Credit analysis should be sharpened to assess risk perfectly. In addition, data collection demands well trained and in sufficient number to perform this task.

Obviously, the implementation of the new accord requires a lot of investment to employ additional staff and mainly new devices to abide data collection and assessment of risks through determination of risk parameters.

d) Regional regulators should start thinking on Basle II issues in order to provide guidelines to existing banks in their area. They have prominent role to play in Basle II implementation in term of supervision and risk factors determination.

In the first chapter we relate the different principles laid by Basle Committee for a better supervision. Moreover, national bank regulators should determine the different risk factors within standardized approach.

All these facts required that local regulators start issuing papers, rules and training people involved in the process. So far, we have noticed such work in West Africa.

## CONCLUSION

We try through this work to expose the way that Basle II intends to appraise credit risk through IRB approach. The exercise was not easy as the regional regulations authorities have not issued rules yet, for practical implementation of Committee's recommendations to the features of banking activities in West Africa. Therefore our work is solely based on original references issued by Basle II Committee, which do not always fit to our realities. Somehow, we did our best to apply IRB approach, with a lot of assumptions in simplification purpose, and due to the fact that the bank's management did not want to release all information needed on borrowers, knowing that some information is actual and covered by confidential rules. The database of twenty four (24) borrowers was not sufficient to find out the real impact of IRB within Ecobank. Nevertheless, the work is undertaken to explain the methodology and the probable effects of IRB, rather than getting real results that can be used by the bank.

Even if IRB approach seems to be very complex, and requires huge financial charges for implementation, West African banks will benefit from implementation of IRB approach.

The capital required to cover risks depends on borrower's profile, and the risk assessment methodology used. The current challenge faces by banks is the determination of risk factors: Probability of Default (PD) and Loss given Default (LGD). The capital requirement heavily depends upon the assessment of PD and LGD, which require historical default data, generally unavailable since banks do not have an appropriate rating system providing essential elements for this purpose. So banks should manage to get a strong, reliable and well managed rating system. The capital assessed through Basle II Capital formula increases in comparison with the current Capital methodology. The effects on the economy will be huge. It will leads bank to increase their equity if they want to maintain their current fundings to national economies. Otherwise they will be constraint to

reduce their contribution to local economy, and jeopardize the development trend. Fortunately the high sensitive nature of IRB approach gives the chance to increase facilities by keeping the current capital level, provided that, banks set up sound and reliable risk assessment system likely to give a clear view of borrowers risk profile, and deal with borrowers having good rating or having solid collaterals. Anyway the negative impact of the coming capital rules is certain, because banks will require collaterals while most of African companies cannot get enough collaterals to cover all their financial needs.

Another issue is to know whether the investment involved by the implementation of Basle II IRB approach will be compensated by the benefits generated from the use of the new rules.

Finally the solution may be the issuance by regional banking regulators of rules based on Basle II recommendations and adapted to local realities and in consideration of the high needs of funding of Companies for development in West Africa.

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## **Résumé en Français**

# Thème : L'évaluation du Risque de Crédit par l'approche avancée des notations internes (Bâle II-IRB) :

## *Application au portefeuille des grandes entreprises nationales de Ecobank Ghana Limited.*

Le risque de crédit est l'une des premières préoccupations des banques, des organes de régulations et autres institutions financières en ce sens que son évaluation et sa maîtrise conditionnent leur survie et leur développement. Le présent mémoire est rédigé dans le but d'aider les banques et les organes de régulations à mieux comprendre l'approche IRB (Internal Rating Based approach) en français « **approche basée sur la notation interne** » conçue par le Comité de Bâle II dans le cadre des recommandations édictées, et devant entrer en vigueur le 1<sup>er</sup> Janvier 2006.

Dans les années 80, les banques s'adonnaient à la course à l'accroissement du volume de leur bilan, sans se soucier des risques que de telles pratiques pouvaient engendrer dans leur portefeuille. Cela explique entre autre, la faillite de grandes banques telles que la *Texan Bank* en 1984 et la *Banque Illinoise* en 1985. Pour y remédier le Comité de Bâle, organe de Contrôle international de l'activité bancaire, a institué en 1988 les Accords de Bâle I. Bâle I a introduit entre autre le système de coefficients à appliquer aux différents actifs figurant dans les bilans des banques pour mesurer le risque que comporte ces actifs pour la banque. En plus, les banques doivent désormais détenir des fonds propres représentant au moins 8% des risques, pour la couverture de ceux-ci. Cette réglementation permettait une maîtrise des risques par l'accroissement des fonds propres des banques. Mais, l'évolution des techniques et des instruments de la Finance, telle que la titrisation ont entraîné l'introduction d'actifs de plus en plus risqués qui n'avaient pas été prévus par Bâle I. Aussi,



Bâle I manquait de flexibilité en raison du caractère figé des coefficients, ce qui limitait les banques dans leur activité d'octroi de crédit. C'est pour remédier à cet état de fait et s'adapter aux récentes évolutions de la finance internationale que nouvelles règles sont éditées, connues sous le nom de Bâle II devant entrer en vigueur le 1<sup>er</sup> janvier 2007.

Bâle II, en plus du risque de crédit a introduit le risque opérationnel dans la détermination des fonds propres pour la couverture des risques, et a maintenu le niveau des fonds propres à 8%. Nous ne traitons ici que du risque de crédit. Deux principales méthodes ont été proposées pour la détermination du risque de crédit et du montant du capital économique nécessaire à sa couverture. Ce sont la **méthode standardisée**, et les **méthodes IRB** qui se déclinent en approche « **Foundation** » et en approche « **Advanced** » (**approche Avancée**). La première méthode est similaire à celle proposée par Bâle I, en ce sens qu'elle attribue des coefficients de pondération aux différents emprunteurs selon la notation attribuée par les agences de notation. Quant aux méthodes IRB, elles se fondent sur les notations internes attribuées par les banques à leurs clients, grâce à leur système de notation. Les éléments clés de cette approche sont, la **Probabilité de défaut (PD)**, la **Perte en cas de Défaut(PCD)** , **l'exposition en cas de défaut(ECD)** et parfois **l'Echéance Effective(EE)**. L'exigence en fonds propres pour la couverture du risque de crédit, assimilé ici à la survenance de défaut, est déterminé à l'aide d'un modèle interne de risque de crédit établi par la banque et validé par les instances de régulations ou par l'utilisation de la Fonction de Pondération des Risques (Risk Weight function- **RWA**) proposée en 2004 par le Comité.

La probabilité en cas de défaut (PD) mesure pour chaque type d'emprunteurs noté, la probabilité qu'il fasse défaut. La perte en cas de défaut (LGD) évalue la perte que la banque aura à subir en cas de survenance d'un défaut. L'exposition en cas de défaut(ECD), estime le montant des sommes exposées au risque, qui généralement est constitué des montants restants dus moins les garanties consenties par le client au moment de l'octroi du prêt

Dans le cas de l'approche « Foundation » les banques estiment seulement la PD, les autres facteurs étant fournis par les organes de régulations en fonction de certains critères retenus. Pour l'approche Avancée, Les banques calculent tous les facteurs avec leurs propres méthodes, validées par les instances de régulations.

Le présent travail s'intéresse à l'application pratique de l'approche Avancée de l'approche IRB au portefeuille des grandes entreprises nationales ghanéennes clientes de Ecobank Ghana limited. Ce mémoire est constitué d'un *Chapitre I* qui passe en revue la littérature relative à l'évaluation du risque de crédit par les notations internes, d'un *Chapitre II* qui traite des exigences minimum requises pour l'application de l'approche IBR avancée, d'un *Chapitre III* indiquant les méthodes de calcul des différentes composantes du risques, ainsi que des exigences en fonds propres, et un *Chapitre IV*, qui est une mise en œuvre des différentes méthodes au sein du portefeuille des grandes entreprises locales de Ecobank Ghana .

Les thèmes suivants ont été passés en revue dans le *Chapitre I* :

✓ ***la définition de la notion fondamentale de défaut ;***

Certains auteurs comme Joël Bessis distinguent le défaut « technique » et le défaut « Economique ». Le défaut économique correspond à la situation dans laquelle l'emprunteur accuse un retard d'au moins 90 jours, un retard de quelques jours pouvant être interprété comme une simple difficulté passagère. Le défaut économique, répond à la définition de défaut donnée par Merton, c'est-à-dire la situation dans laquelle les actifs d'un emprunteur deviennent inférieurs à la valeur de ces obligations vis-à-vis de la banque. Mais la BRI (Banque des Règlements Internationaux) a décidé d'une définition standard du défaut qui est la suivante : (a) Un emprunteur qui est peu susceptible d'honorer ses engagements de dette (principal, intérêt, plus les frais); (b) tout événement de perte de crédit associé à n'importe quel engagement telle que la constitution de provision, engagement d'une restructuration impliquant la rémission ou l'ajournement du principal, de l'intérêt, ou des frais; (c) L'emprunteur a des

arriérés d'au moins 90 jours sur n'importe quel engagement de crédit; (d) l'emprunteur est déclaré en faillite ou sous une protection semblable contre des créanciers.

✓ ***les théories sur les modèles de risque de crédit***

Les théories existantes sur les modèles de risque se classent en modèles traditionnels et en modèles modernes. Les modèles traditionnels se réfèrent aux méthodes quantitatives basées sur la comptabilité et aux méthodes qualitatives. Au titre de ces méthodes on peut citer la méthode de Scoring et la méthode basée sur le jugement des Experts. Les modèles modernes étaient à l'origine utilisés par les marchés financiers. Ils sont construits autour de la théorie de Merton (1974) selon laquelle, le défaut survient lorsque la valeur des actifs d'un emprunteur devient inférieure à la valeur de ces engagements. La formule de calcul des fonds proposée par le Comité de Bâle II est dérivée d'une variante de ce dernier modèle conçue par Vasicek en 1984.

✓ ***l'horizon d'attribution des ratings et relation avec le cycle d'activité***

L'horizon d'attribution du rating est généralement d'un an, mais dépend de la méthode de notation retenue. On distingue deux méthodes : la méthode « Point In Time-PIT » c'est-à-dire la méthode de notation à l'horizon d'un an, et la méthode « Through The Cycle-TTC ». La première méthode ne tient compte que des éléments qualitatifs et quantitatifs dans un horizon d'un an et pouvant avoir des effets sur le profil de risque d'un emprunteur. Tandis que la deuxième méthode tient compte des éléments sur un cycle complet (généralement 5 ans), pour la détermination de la note. Bâle II recommande l'utilisation de la deuxième méthode qui est susceptible d'aboutir à l'attribution d'une note consistante et crédible.

✓ ***la procyclicalité des exigences en fonds propres***

Une des questions soulevées par la nouvelle formule est celle de savoir si elle n'est pas procyclique, c'est-à-dire qu'elle implique une forte exigence de fonds en

période de récession, et une faible exigence en période d'expansion. La conséquence d'un tel comportement sera que les banques en cas de récession ne pourront pas être en mesure d'offrir les financements adéquats à l'économie en raison de la dégradation des notes qui entraînera une croissance des exigences de fonds propres. La question est toujours à l'étude.

✓ ***la question de la stabilité des matrices de transitions.***

Les PDs sont déterminées à l'aide des matrices de transition. Les matrices de transitions sont des tableaux qui enregistrent les probabilités qu'un emprunteur migre d'une classe à une autre et surtout, la probabilité de migrer vers la classe de défaut. Il est recommandé une série longue (7 ans minimum) pour la détermination des PDs. Pour que les PDs issues des matrices reflètent les risques de défaut d'un emprunteur, il faudra que les matrices suivent une série Markovienne, c'est-à-dire que la logique de la série à un temps  $n$  peut être utilisée pour estimer la logique au temps  $n+1$ . Les études se contredisent et les débats se poursuivent.

Le deuxième aspect de notre travail a consisté en une revue des conditions édictées par le Comité pour une application de l'approche IRB. La principale recommandation est la mise en place d'un système de notation susceptible de fournir les facteurs de risques nécessaires à la détermination des fonds propres. Ainsi, il a été recommandé que le système de notation comporte au moins 6 classes de notes pour les emprunteurs sains, et au moins 2 catégories de notes pour les emprunteurs en difficulté. La définition des caractéristiques des notes doit être explicite et susceptible d'éviter que des individus aux profils de risques différents ne soient rangés dans la même classe. Les notes doivent être revues annuellement, et les corrections nécessaires apportées pour que les notes reflètent à tout instant le risque que comporte le client. Enfin, quelque soit le modèle de détermination des fonds propres, la banque doit le soumettre à l'approbation des organes de régulations bancaires.

Nous avons exposé dans le Chapitre III, les différentes méthodes de détermination des facteurs de risques, et expliqué la fonction de pondération proposée par Bale II que nous utiliserons dans le cas de Ecobank Ghana.

Le premier facteur à déterminer est la Probabilité de défaut. Elle se s'évalue par l'intermédiaire des matrices de transition, qui est un tableau à double entrée alignant d'un coté les notations en début d'année et de l'autre les notations en fin d'année. La probabilité de migration pour une classe donnée est le rapport entre le nombre de clients ayant migré et le nombre initial de clients dans la classe. L'information la plus importante est la migration des clients vers la classe de défaut. Pour chaque année une matrice de transition est établie, et une moyenne des probabilités est ainsi déterminée. La probabilité minimale est fixée à 0,03% pour les meilleures notes et 100% pour les plus mauvaises notes.

Le deuxième facteur à déterminer est la Perte en Cas de Défaut (PCD). La formule utilisée est : **1- le taux de recouvrement**. Le problème revient ici en la détermination des taux de recouvrement selon le profil de risque et le type de concours accordés.

Le troisième facteur est l'Exposition en Cas de Défaut (ECD) qui correspond aux montants restants à payer.

Quant à l'échéance, elle doit être de 2,5 années pour les banques qui n'arrive pas à déterminer l'échéance effective des différents concours. Un ajustement peut être effectué ensuite.

Pour la mise en œuvre de l'approche IRB, nous avons disposé des données sur trois ans concernant les portefeuilles des grandes entreprises de Ecobank Ghana. Ces données portent sur les notations attribuées par la banque aux grandes entreprises locales et aux types de concours accordés. Elles portent également sur les montants des concours et les restes à payer. Les données n'étaient pas suffisantes pour donner une fiabilité à nos calculs, de mêmes que certaines informations couvertes par le secret bancaire ne nous étaient pas disponibles. Ainsi nous n'avons pas pu disposer des données sur toutes les garanties sécurisant les prêts accordés. Mais le but visé, était plus la maîtrise de

méthodologie que l'exactitude des résultats, vu que les données ne sont pas suffisantes.

L'application de l'approche IRB à Ecobank, nous a permis de constater que cette approche entraîne l'accroissement des fonds propres par rapport à la méthodologie issue de Bâle I. La raison est que l'approche IRB, est très sensible à l'évolution des facteurs de risques que sont la PD, PCD et l'ECD. En effet plus la PD est élevée, plus l'exigence en fonds propres est grande, de même, plus la PCD est élevée plus les fonds propres requis sont élevés. En revanche, elle permet d'économiser en fonds dans le cas de portefeuilles composé de clients aux bonnes notes. En fait, la philosophie de la nouvelle approche est la récompense des bons clients et la sanction des mauvais clients qui se verront appliquer des tarifications très élevées pouvant compenser leur consommation en capital.

L'application de l'approche IBR, nécessitera d'énorme investissement en ressources humaines et technologie. Reste à savoir si les bénéfices de la mise en œuvre de cette nouvelle méthodologie suffiront à compenser les charges occasionnées par celle-ci.

## **APPENDICES**

**Appendix I:** July 2003 Portfolio

**Appendix II:** July 2004 Portfolio

**Appendix III :** July 2005 portfolio

## Appendix I

Borrowers Name	ORR	FRR	Total facilities	Outstanding
Accra Brewery Ltd	6	6	341	207
Accra Brewery Ltd	6	6	226	62
Ashanti Foam Factory Ltd	6	6	341	-
Ashanti Foam Factory Ltd	6	6	170	19
Ashanti Foam Factory Ltd	6	6		568
Ashanti Foam Factory Ltd	6	6		135
Ashanti Foam Factory Ltd	6	6	40	40
Beverage Investments GH	8	8	308	120
Beverage Investments GH	8	8	170	98
Cadbury Gh Ltd.	8	8	91	103
Cadbury Gh Ltd.	8	8	72	5
Cadbury Gh Ltd.	8	8		43
Cadbury Gh Ltd.	8	6+	27	15
Cadbury Gh Ltd.	8	6+	76	9
Citi Savings and Loans	6	1	454	-
Domod	5	5	227	-
Domod	5	5	53	53
Dupaul Wood Treatment	7	6	198	198
Duraplast Ltd	7	7	483	85
Duraplast Ltd	7	7		127
Duraplast Ltd	7	1		154
Duraplast Ltd	7	6	183	60
Duraplast Ltd	7	6		143
General Leasing & Finance	6	6	24	24
General Leasing & Finance	6	6	23	23
General Leasing & Finance	6	6	3	3
General Leasing & Finance	6	6	40	40
General Leasing & Finance	6	6	1 171	424
General Leasing & Finance	6	6	329	329
Ghana Leasing Co. Ltd	6	6	11	11
Ghana Leasing Co. Ltd	6	6	2 000	1 357
Ghana Leasing Co. Ltd	6	6	6	6
Ghana Leasing Co. Ltd	6	6	7	7
Ghana Leasing Co. Ltd	6	6	2	2
Ghana Leasing Co. Ltd	6	6	48	48
Interplast Limited	6	2-	227	47
Interplast Limited	6	2-	114	-
KGM Limited	6	6	170	158
KGM Limited	6	6	43	43
KGM Limited	6	6	289	189
KGM Limited	6	6	97	64
KGM Limited	6	6	345	120
Leasafric Ghana Limited	6	6	1 580	541
Leasafric Ghana Limited	6	6	415	145
Leasafric Ghana Limited	6	6		584
Leasafric Ghana Limited	6	1		193
Limex Construction Limited	7	6	206	196
Oak Financial Services Ltd	6	1	148	21
Phyto Riker-Gihoc Pharma	7	8	267	267



Phyto Riker-Gihoc Pharm	7	8		13
Phyto Riker-Gihoc Pharm	7	8		50
Phyto Riker-Gihoc Pharm	7	8		50
Phyto Riker-Gihoc Pharm	7	8		190
Phyto Riker-Gihoc Pharm	7	8		68
Phyto Riker-Gihoc Pharm	7	8		61
Phyto Riker-Gihoc Pharm	7	8	86	86
Phyto Riker-Gihoc Pharm	7	8	129	129
Phyto Riker-Gihoc Pharm	7	8		36
Phyto Riker-Gihoc Pharm	7	8	51	51
Phyto Riker-Gihoc Pharm	7	8	26	26
Phyto Riker-Gihoc Pharm	7	8	22	22
Phyto Riker-Gihoc Pharm	7	8	75	75
Qualicap Ltd	8	8	153	220
Qualicap Ltd	8	8	129	64
Qualicap Ltd	8	8	98	98
Qualiplast Limited	6	6+	227	201
Qualiplast Limited	6	6+	150	86
Qualiplast Limited	6	6+	9	9
Regimanuel Gray Limited	6	6+	2206	1 687
Regimanuel Gray Limited	6	6+	1000	300
Somotex Ghana ltd	6	6	170	89
Somotex Ghana ltd	6	6	300	200
Somotex Ghana ltd	6	6		511

BIBLIOTHEQUE

## Appendix II

Borrowers Names	ORR	FRR	Total facilities	Outstanding
ACCRA BREWERY LIMITED	6	6	1111	569
ACCRA BREWERY LIMITED	6	6		-
ACCRA BREWERY LIMITED	6	6	5	5
ACCRA BREWERY LIMITED	6	6	5	9
ACCRA BREWERY LIMITED	6	6	24	24
ACCRA BREWERY LIMITED	6	6	8	-
ASHANTI FOAM FACTORY LTD	7	7	167	126
ASHANTI FOAM FACTORY LTD	7	7	333	80
ASHANTI FOAM FACTORY LTD	7	7	600	405
ASHANTI FOAM FACTORY LTD	7	7	41	41
ASHANTI FOAM FACTORY LTD	7	7	53	53
BEVERAGE INVESTMENTS GH.L	8	8	222	181
BEVERAGE INVESTMENTS GH.L	8	8	78	40
CADBURY GHANA LIMITED	8	8	89	41
CADBURY GHANA LIMITED	8	8	6	6
CADBURY GHANA LIMITED	8	8	3	2
CADBURY GHANA LIMITED	8	8	4	3
CADBURY GHANA LIMITED	8	8	4	3
CADBURY GHANA LIMITED	8	8	5	4
CADBURY GHANA LIMITED	8	8	10	8
CADBURY GHANA LIMITED	8	8	51	25
CADBURY GHANA LIMITED	8	8	1	1
CADBURY GHANA LIMITED	8	8	1	1
CADBURY GHANA LIMITED	8	8	9	9
Citi Savings and Loans	6	1	444	-
CITI SAVINGS AND LOANS CO	6	1		2
DOMOD ALUMINIUM LTD	5	5	209	209
DOMOD ALUMINIUM LTD	5	5		-
DUPAUL WOOD TREATMENT GH	7	8	155	143
DURAPLAST LIMITED	7	7	278	214
DURAPLAST LIMITED	7	1		47
DURAPLAST LIMITED	7	1		89
DURAPLAST LIMITED	7	1		25
DURAPLAST LIMITED	7	1		100
DURAPLAST LIMITED	7	7	37	33
DURAPLAST LIMITED	7	7	6	5
DURAPLAST LIMITED	7	7	44	40
DURAPLAST LIMITED	7	7	96	85
DURAPLAST LIMITED	7	7	193	91
DURAPLAST LIMITED	7	7	5	4
DURAPLAST LIMITED	7	7	5	4
DURAPLAST LIMITED	7	7	8	7
DURAPLAST LIMITED	7	7	8	7
DURAPLAST LIMITED	7	7	13	12
DURAPLAST LIMITED	7	7	14	13
DURAPLAST LIMITED	7	7	15	14
DURAPLAST LIMITED	7	7	27	24
DURAPLAST LIMITED	7	7	38	27

GEN.LEASING AND FINANCE C	6	1		15
GEN.LEASING AND FINANCE C	6	6	6	6
GEN.LEASING AND FINANCE C	6	6	8	8
GEN.LEASING AND FINANCE C	6	6	21	21
GEN.LEASING AND FINANCE C	6	6	108	108
GEN.LEASING AND FINANCE C	6	6	108	108
GEN.LEASING AND FINANCE C	6	6	27	27
GEN.LEASING AND FINANCE C	6	6	172	172
GEN.LEASING AND FINANCE C	6	6	31	31
GEN.LEASING AND FINANCE C	6	6	105	105
GEN.LEASING AND FINANCE C	6	6	79	79
GEN.LEASING AND FINANCE C	6	6	23	23
GEN.LEASING AND FINANCE C	6	6	84	84
GEN.LEASING AND FINANCE C	6	6	24	24
GEN.LEASING AND FINANCE C	6	6	133	133
GEN.LEASING AND FINANCE C	6	6	35	35
GEN.LEASING AND FINANCE C	6	6	499	61
GEN.LEASING AND FINANCE C	6	6	37	37
GHANA LEASING COMPANY LTD	6	6	3	3
GHANA LEASING COMPANY LTD	6	6	42	42
GHANA LEASING COMPANY LTD	6	6	23	23
GHANA LEASING COMPANY LTD	6	6	108	108
GHANA LEASING COMPANY LTD	6	6	5	5
GHANA LEASING COMPANY LTD	6	6	53	53
GHANA LEASING COMPANY LTD	6	6	61	61
GHANA LEASING COMPANY LTD	6	6	89	89
GHANA LEASING COMPANY LTD	6	6	65	65
GHANA LEASING COMPANY LTD	6	6	30	30
GHANA LEASING COMPANY LTD	6	6	175	175
GHANA LEASING COMPANY LTD	6	6	84	84
GHANA LEASING COMPANY LTD	6	6	18	18
GHANA LEASING COMPANY LTD	6	6	39	39
GHANA LEASING COMPANY LTD	6	6	15	15
GHANA LEASING COMPANY LTD	6	6	33	33
GHANA LEASING COMPANY LTD	6	6	1103	204
GHANA LEASING COMPANY LTD	6	6	54	54
INTERPLAST LTD	6	2-	222	-
INTERPLAST LTD	6	2-	500	-
KGM INDUSTRIES LTD.	6	6	167	105
KGM INDUSTRIES LTD.	6	6	26	26
KGM INDUSTRIES LTD.	6	6	21	21
KGM INDUSTRIES LTD.	6	6	100	100
KGM INDUSTRIES LTD.	6	6	271	87
KGM INDUSTRIES LTD.	6	6	43	43
LEASAFRIC	6	6		37
LEASAFRIC	6	6	14	14
LEASAFRIC	6	6	38	38
LEASAFRIC	6	6	7	7
LEASAFRIC	6	6	82	82
LEASAFRIC	6	6	83	83
LEASAFRIC	6	6	16	16
LEASAFRIC	6	6	457	457

LEASAFRIC	6	6	45	45
LEASAFRIC	6	6	22	22
LEASAFRIC	6	6	107	107
LEASAFRIC	6	6	12	12
LEASAFRIC	6	6	250	250
LEASAFRIC	6	6	59	59
LEASAFRIC	6	6	794	27
LEASAFRIC	6	6	14	14
LIMEX CONSTRUCTION LTD	8	8	119	110
OAK FINANCIAL SERVICES LT	6	1	144	133
PHYTO RIKER-GIHOC PHARM.L	7	4+	81	81
PHYTO RIKER-GIHOC PHARM.L	7	8	21	21
PHYTO RIKER-GIHOC PHARM.L	7	8	23	23
PHYTO RIKER-GIHOC PHARM.L	7	8	12	12
PHYTO RIKER-GIHOC PHARM.L	7	8	20	20
PHYTO RIKER-GIHOC PHARM.L	7	8	9	9
PHYTO RIKER-GIHOC PHARM.L	7	8		6
PHYTO RIKER-GIHOC PHARM.L	7	8	48	48
PHYTO RIKER-GIHOC PHARM.L	7	8	80	80
PHYTO RIKER-GIHOC PHARM.L	7	8	45	45
PHYTO RIKER-GIHOC PHARM.L	7	8	8	8
PHYTO RIKER-GIHOC PHARM.L	7	8	53	53
PHYTO RIKER-GIHOC PHARM.L	7	8	25	25
PHYTO RIKER-GIHOC PHARM.L	7	8	52	52
PHYTO RIKER-GIHOC PHARM.L	7	8	50	50
PHYTO RIKER-GIHOC PHARM.L	7	8	7	7
PHYTO RIKER-GIHOC PHARM.L	7	8	54	54
PHYTO RIKER-GIHOC PHARM.L	7	8	61	61
PHYTO RIKER-GIHOC PHARM.L	7	8	65	65
PHYTO RIKER-GIHOC PHARM.L	7	8	147	147
PHYTO RIKER-GIHOC PHARM.L	7	8	13	13
PHYTO RIKER-GIHOC PHARM.L	7	8	14	14
PHYTO RIKER-GIHOC PHARM.L	7	8	31	31
PHYTO RIKER-GIHOC PHARM.L	7	8	528	474
PHYTO-RIKER(GIHOC)PHARM L	7	8	175	175
PHYTO-RIKER(GIHOC)PHARM L	7	8	21	21
PHYTO-RIKER(GIHOC)PHARM L	7	8	32	32
QUALICAP LTD	8	8	150	218
QUALICAP LTD	8	8	37	17
QUALICAP LTD	8	8	23	21
QUALICAP LTD	8	8	26	23
QUALICAP LTD	8	8	41	37
QUALICAP LTD	8	8	95	85
QUALIPLAST LIMITED	7	7	222	162
QUALIPLAST LIMITED	7	7	31	28
QUALIPLAST LIMITED	7	7	8	7
QUALIPLAST LIMITED	7	7	26	23
QUALIPLAST LIMITED	7	7	35	15
QUALIPLAST LIMITED	7	7	16	14
REGIMANUEL GRAY LIMITED	6	5	6	6
REGIMANUEL GRAY LIMITED	6	5	6	6
REGIMANUEL GRAY LIMITED	6	5	6	6

REGIMANUEL GRAY LIMITED	6	5	10	10
REGIMANUEL GRAY LIMITED	6	5	10	10
REGIMANUEL GRAY LIMITED	6	5	17	17
REGIMANUEL GRAY LIMITED	6	5	17	17
REGIMANUEL GRAY LIMITED	6	5	17	17
REGIMANUEL GRAY LIMITED	6	5	17	17
REGIMANUEL GRAY LIMITED	6	5	22	22
REGIMANUEL GRAY LIMITED	6	5	22	22
REGIMANUEL GRAY LIMITED	6	5	22	22
REGIMANUEL GRAY LIMITED	6	5	28	28
REGIMANUEL GRAY LIMITED	6	5	39	39
REGIMANUEL GRAY LIMITED	6	5	842	39
REGIMANUEL GRAY LIMITED	6	5	1 078	281
REGIMANUEL GRAY LIMITED	6	5	300	300
REGIMANUEL GRAY LIMITED	6	5	300	300
REGIMANUEL GRAY LIMITED	6	5	400	400
SOMOTEX GH LTD	6	6	333	201
SOMOTEX GH LTD	6	6		1
SOMOTEX GH LTD	6	6		389
SOMOTEX GH LTD	6	6		111
SOMOTEX GH LTD	6	6	69	69
SOMOTEX GH LTD	6	6	25	25
SOMOTEX GH LTD	6	6	406	200
SOMOTEX GH LTD	6	6	87	87

## Appendix III

Borrowers name	ORR	FRR	Facilities total amounts	Outstanding
ACCRA BREWERY LIMITED	6	6+	1325	1324
ASHANTI FOAM FACTORY LTD	7	7	662	555
ASHANTI FOAM FACTORY LTD	7	7	89	89
ASHANTI FOAM FACTORY LTD	7	7	92	92
ASHANTI FOAM FACTORY LTD	7	7	185	185
ASHANTI FOAM FACTORY LTD	7	7	260	260
ASHANTI FOAM FACTORY LTD	7	7	600	300
ASHANTI FOAM FACTORY LTD	7	7	66	22
ASHANTI FOAM FACTORY LTD	7	7	54	36
ASHANTI FOAM FACTORY LTD	7	7	19	19
ASHANTI FOAM FACTORY LTD	7	7	214	71
ASHANTI FOAM FACTORY LTD	7	7	192	192
ASHANTI FOAM FACTORY LTD	7	7	238	238
ASHANTI FOAM FACTORY LTD	7	7	300	300
ASHANTI FOAM FACTORY LTD	7	7	386	386
ASHANTI GOLDFIELDS COMPAN	4	4	331	0
BEVERAGE INVESTMENTS GH.L	8	8	221	107
CITI SAVINGS AND LOANS CO	7	1	442	0
DOMOD ALUMINIUM LTD	6	6	78	78
DOMOD ALUMINIUM LTD	6	6	182	182
DOMOD ALUMINIUM LTD	6	6	331	116
DOMOD ALUMINIUM LTD	6	6	256	256
DURAPLAST LIMITED	7	7	242	242
DURAPLAST LIMITED	7	7	276	159
DURAPLAST LIMITED	7	7	100	100
DURAPLAST LIMITED	7	7	3	3
DURAPLAST LIMITED	7	7	37	9
DURAPLAST LIMITED	7	7	131	121
DURAPLAST LIMITED	7	7	158	158
DURAPLAST LIMITED	7	7	190	190
DURAPLAST LIMITED	7	7	81	0
DURAPLAST LIMITED	7	7	120	0
DURAPLAST LIMITED	7	7	174	0
GEN.LEASING AND FINANCE C	6	6	39	7
GEN.LEASING AND FINANCE C	6	6	105	39
GEN.LEASING AND FINANCE C	6	6	76	32
GEN.LEASING AND FINANCE C	6	6	35	12
GEN.LEASING AND FINANCE C	6	6	35	14
GEN.LEASING AND FINANCE C	6	6	23	18
GEN.LEASING AND FINANCE C	6	6	35	18
GEN.LEASING AND FINANCE C	6	6	39	21
GEN.LEASING AND FINANCE C	6	6	30	22
GEN.LEASING AND FINANCE C	6	6	39	29
GEN.LEASING AND FINANCE C	6	6	44	33
GEN.LEASING AND FINANCE C	6	6	61	38
GEN.LEASING AND FINANCE C	6	6	47	42
GEN.LEASING AND FINANCE C	6	6	50	44
GEN.LEASING AND FINANCE C	6	6	51	45
GEN.LEASING AND FINANCE C	6	6	61	46

GEN.LEASING AND FINANCE C	6	6	83	48
GEN.LEASING AND FINANCE C	6	6	143	56
GEN.LEASING AND FINANCE C	6	6	67	62
GEN.LEASING AND FINANCE C	6	6	110	64
GEN.LEASING AND FINANCE C	6	6	93	75
GEN.LEASING AND FINANCE C	6	6	160	76
GEN.LEASING AND FINANCE C	6	6	93	77
GEN.LEASING AND FINANCE C	6	6	219	82
GEN.LEASING AND FINANCE C	6	6	96	88
GEN.LEASING AND FINANCE C	6	6	135	101
GEN.LEASING AND FINANCE C	6	6	126	108
GEN.LEASING AND FINANCE C	6	6	151	130
GEN.LEASING AND FINANCE C	6	6	142	138
GEN.LEASING AND FINANCE C	6	6	331	276
GEN.LEASING AND FINANCE C	6	6	460	358
GEN.LEASING AND FINANCE C	6	6	56	56
GEN.LEASING AND FINANCE C	6	6	34	34
GHANA LEASING COMPANY LTD	6	6	146	8
GHANA LEASING COMPANY LTD	6	6	11	1
GHANA LEASING COMPANY LTD	6	6	200	17
GHANA LEASING COMPANY LTD	6	6	109	18
GHANA LEASING COMPANY LTD	6	6	50	8
GHANA LEASING COMPANY LTD	6	6	291	48
GHANA LEASING COMPANY LTD	6	6	160	27
GHANA LEASING COMPANY LTD	6	6	27	3
GHANA LEASING COMPANY LTD	6	6	23	3
GHANA LEASING COMPANY LTD	6	6	50	6
GHANA LEASING COMPANY LTD	6	6	67	17
GHANA LEASING COMPANY LTD	6	6	50	21
GHANA LEASING COMPANY LTD	6	6	55	32
GHANA LEASING COMPANY LTD	6	6	77	68
GHANA LEASING COMPANY LTD	6	6	121	101
GHANA LEASING COMPANY LTD	6	6	254	113
GHANA LEASING COMPANY LTD	6	6	540	405
GHANA LEASING COMPANY LTD	6	6	13	13
GHANA LEASING COMPANY LTD	6	6	47	47
INTERPLAST LIMITED	6	6	11	0
INTERPLAST LIMITED	6	4+	72	72
INTERPLAST LIMITED	6	6	93	93
INTERPLAST LIMITED	6	6	140	140
INTERPLAST LIMITED	6	6	20	20
INTERPLAST LIMITED	6	6	11	11
INTERPLAST LIMITED	6	6	823	823
INTERPLAST LIMITED	6	6	499	499
INTERPLAST LIMITED	6	6	177	177
INTERPLAST LIMITED	6	6	1000	1000
INTERPLAST LIMITED	6	6	3	3
KGM INDUSTRIES LTD.	8	8	110	99
KGM INDUSTRIES LTD.	8	8	113	82
KGM INDUSTRIES LTD.	8	8	250	178
KGM INDUSTRIES LTD.	8	8	350	286
KGM INDUSTRIES LTD.	8	8	14	13
LEASAFRIC	6	6	74	19
LEASAFRIC	6	6	32	11

LEASAFRIC	6	6	662	208
LEASAFRIC	6	6	20	1
LEASAFRIC	6	6	240	20
LEASAFRIC	6	6	27	17
LEASAFRIC	6	6	59	38
LEASAFRIC	6	6	93	53
LEASAFRIC	6	6	148	67
LEASAFRIC	6	6	184	143
LEASAFRIC	6	6	250	160
LEASAFRIC	6	6	1238	0
PHYTO RIKER-GIHOC PHARM.L	8	6+	50	50
PHYTO RIKER-GIHOC PHARM.L	8	6+	0	0
PHYTO RIKER-GIHOC PHARM.L	8	6+	52	52
PHYTO RIKER-GIHOC PHARM.L	8	6+	10	10
PHYTO RIKER-GIHOC PHARM.L	8	6+	46	0
PHYTO RIKER-GIHOC PHARM.L	8	6+	52	0
PHYTO RIKER-GIHOC PHARM.L	8	6+	1	1
QUALIPLAST LIMITED	8	8	442	361
QUALIPLAST LIMITED	8	8	69	69
QUALIPLAST LIMITED	8	8	72	65
QUALIPLAST LIMITED	8	8	60	55
QUALIPLAST LIMITED	8	8	128	117
QUALIPLAST LIMITED	8	8	276	251
QUALIPLAST LIMITED	8	8	20	16
QUALIPLAST LIMITED	8	8	52	44
QUALIPLAST LIMITED	8	8	122	102
QUALIPLAST LIMITED	8	8	9	8
REGIMANUEL GRAY LIMITED	6	6	72	72
REGIMANUEL GRAY LIMITED	6	6	300	75
REGIMANUEL GRAY LIMITED	6	6	300	75
REGIMANUEL GRAY LIMITED	6	6	400	100
REGIMANUEL GRAY LIMITED	6	6	250	250
REGIMANUEL GRAY LIMITED	6	6	350	350
REGIMANUEL GRAY LIMITED	6	6	350	350
REGIMANUEL GRAY LIMITED	6	6	350	350
REGIMANUEL GRAY LIMITED	6	6	350	350
REGIMANUEL GRAY LIMITED	6	6	350	350
REGIMANUEL GRAY LIMITED	6	6	500	500
REGIMANUEL GRAY LIMITED	6	6	500	500
REGIMANUEL GRAY LIMITED	6	6	260	260
SOMOTEX GH LTD	6	6	552	310
SOMOTEX GH LTD	6	6	110	110
SOMOTEX GH LTD	6	6	386	386
SOMOTEX GH LTD	6	6	40	20
SOMOTEX GH LTD	6	6	479	479
SOMOTEX GH LTD	6	6	330	330
SOMOTEX GH LTD	6	6	43	43
SOMOTEX GH LTD	6	6	3	3



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Borrower	Ratings	PD	Outstandings(\$)	0%	20%	50%	100%	RWA I	RWA II
ACCRA BREWERY LIMITED	6+	0,18	1324	0	517	497	310	661,9	684,69
ASHANTI FOAM FACTORY LTD	7	0,59	1324	0	298	230	796	970,6	1118,08
BEVERAGE INVESTMENTS GH.L	8	0,9	107	0	0	51	56	81,5	96,45
CITI SAVINGS AND LOANS CO	7	0,59	0	0	0	0	0	0	0
DOMOD ALUMINIUM LTD	6	0,18	632	211	164	54	203	262,8	326,83
Dupaul Wood treatment Ltd	8	0,9	500	0	0	209	291	395,5	450,68
DURAPLAST LIMITED	7	0,59	982	89	108	401	384	606,1	414,63
GEN.LEASING AND FINANCE C	6	0,18	2289	765	233	967	324	854,1	1183,73
GHANA LEASING COMPANY LTD	6	0,18	956	0	198	370	388	612,6	494,38
INTERPLAST LIMITED	6	0,18	2838	260	543	806	1229	1740,6	1467,63
KGM INDUSTRIES LTD.	8	0,9	658	0	0	305	353	505,5	593,09
Oak Financial Services	8	0,9	0	0	0	0	0	0	0
LEASAFRIC	6	0,18	737	0	176	313	248	439,7	381,13
P.Z.CUSSONS INDUSTIRES GHANA	8	0,9	633	0	0	176	457	545	570,56
PERGAH TRANSPORT LTD	8	0,9	230	0	18	67	145	182,1	207,31
PHYTO RIKER-GIHOC PHARM.L	8	0,9	113	0	0	98	15	64	101,85
QUALIPLAST LIMITED	8	0,9	1088	0	187	203	698	836,9	980,68
REGIMANUEL GRAY LIMITED	6	0,18	3582	780	861	782	1159	1722,2	1852,38
SOMOTEX GH LTD	6	0,18	1681	478	872	131	200	439,9	869,31
TRACTOR AND EQUIPMENT GH	5	0,16	981	105	102	202	572	693,4	491,99
								<b>11614,4</b>	<b>12285,4</b>

\*Excel spread

### Comments

- 1- In comparison with the current methodology (Basle I), Basle II IRB approach is a risk sensitive approach. IRB approach is highly dependent on PD and LGD. The higher PD, the higher RWA. The lower LGD, the lower RWA.
- 2- Given that sensitivity of RWA to LGD and PD is very high; bank should pay close attention to the determination of these components.
- 3- RWA, and so Capital required through Basle II are higher than those estimated through current methodology (Basle I).

## c) Verification of assumptions

### 1) First assumption: New capital accord increases the need of regulatory capital to cover risks.

As seen above in the RWA, using Basel II capital formula is \$12, 285, 000 within the corporate portfolio. It shows an increase in comparison with Basle I formula which provides an amount of \$11,614,000. So we can conclude that Basle II will increase the capital needed to cover risk since the RWA used to calculate the new ratio increases.

### 2) RWA is heavily dependent on PD

To corroborate this hypothesis, we reduce PD of 0.05 and see of the effect of such change on the RWA.

Borrowers	Rating	Outstandings	Ln(PD)	PD	G	EAD	LGD	Maturity	B(pi)	Correlation	***	N(***)	K	RWA	RWA/Outsta
ACCRA BREWERY LI6+		1324	-2,120263536	0,12	-1,1749868	1324	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	606,518478	45,81%
ASHANTI FOAM FAC	7	1324	-0,634878272	0,53	0,0752699	1324	20%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	7,4430%	1231,80899	93,04%
BEVERAGE INVESTM	8	107	-0,174353387	0,84	0,9944579	107	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	150,294906	140,46%
CITI SAVINGS AND L	7	0	-0,634878272	0,53	0,0752699	0	20%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	7,4430%	0	0,00%
DOMOD ALUMINIUM	6	632	-2,120263536	0,12	-1,1749868	632	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	289,516373	45,81%
Dupaul Wood treatment	8	500	-0,174353387	0,84	0,9944579	500	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	702,312644	140,46%
DURAPLAST LIMITEI	7	982	-0,634878272	0,53	0,0752699	982	10%	2,5	0,0235005	12,0000%	1,2213818	0,889029262	3,7215%	456,811341	46,52%
GEN LEASING AND F	6	2289	-2,120263536	0,12	-1,1749868	2289	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1048,58066	45,81%
GHANA LEASING CO	6	956	-2,120263536	0,12	-1,1749868	956	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	437,939324	45,81%
INTERPLAST LIMITEI	6	2838	-2,120263536	0,12	-1,1749868	2838	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1300,07511	45,81%
KGM INDUSTRIES LI	8	658	-0,174353387	0,84	0,9944579	658	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	924,243439	140,46%
Oak Financial Services	8	0	-0,174353387	0,84	0,9944579	0	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	0	0,00%
LEASAFRIC		737	-2,120263536	0,12	-1,1749868	737	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	337,616404	45,81%
P Z CUSSONS INDUS	8	633	-0,174353387	0,84	0,9944579	633	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	889,127807	140,46%
PERGAH TRANSPOR	8	230	-0,174353387	0,84	0,9944579	230	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	323,063816	140,46%
PHYTO RIKER-GIHOC	8	113	-0,174353387	0,84	0,9944579	113	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	158,722657	140,46%
QUALIPLAST LIMITE	8	1088	-0,174353387	0,84	0,9944579	1088	75%	2,5	0,0164022	12,0000%	2,2012396	0,986140466	11,2370%	1528,23231	140,46%
REGIMANUEL GRAY	6	3582	-2,120263536	0,12	-1,1749868	3582	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	1640,89818	45,81%
SOMOTEX GH LTD	6	1681	-2,120263536	0,12	-1,1749868	1681	10%	2,5	0,0550691	12,0297%	-0,110001	0,456204139	3,6648%	770,058581	45,81%
TRACTOR AND EQUI	5	981	-2,302585093	0,1	-1,2815516	981	10%	2,5	0,0598564	12,0809%	-0,221258	0,412445661	3,4327%	420,929454	42,91%
		18007				18007								13216,75	73,40%