LEADING INTERNAL AND EXTERNAL SOURCES OF CREDIT RISK IN THE TOP SOUTH AFRICAN BANKS

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Abstract

This paper aimed at identifying the leading credit risk indicators in the South African banking context as well as the development of an integrated leading credit risk indicator model. A content analysis was used as a data extraction methodology and structural equation modelling was used as a data analysis methodology. The results obtained indicated that utilising the structural equation modelling, gross savings, and prime overdraft rates, number of judgements, business insolvencies and unemployment rates were formulated as leading economic and market (external) indicators of credit risk in the South African banking context. Similarly, utilising the principal component analysis, bank asset quality, bank asset concentration as well as bank trading and hedging activities were formulated as leading bank specific (internal) indicators of credit risk in the South African banking context. The Integrated Leading Credit Risk Indicator Model (ICRIM) was formulated utilising the accepted leading credit risk indicators. The ICRIM parameters were benchmarked against the generally accepted fit indices such as the RMSEA, comparative fit (baseline comparison) as well as the Hoelter and its results output were found to be consistent with these generally accepted fit indices.

Keywords: Banking, Content Analysis, Credit Risk, Indicators, Economy, South African Banks and the Structural Equation Modelling

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1. Introduction

The idea behind investigating the leading external and internal indicators of credit risk is premised on the proposal that banks have an important role in the economy. The relationship between banks and the economy is driven by the role of banks which many researchers are in agreement that banks assume the financial intermediation role in the economy (Allen & Carletti, 2008; Boot & Marinc, 2008; Delibasic, 2008 and Wilson *et al.*, 2010).

For Delibasic (2008), banks become financial intermediaries when they finance different business activities in the economy. To be able to finance different activities as suggested by Delibasic (2008), Allen and Carletti (2008) state that banks collect demandable deposits to raise funds in the short term and invest these funds in long term assets (i.e. loans to different sectors of the economy). Allen and Carletti (2008) refer to the transformation of deposits into loans as a "maturity transformation role" of banks in the economy.

Based on this relationship, it is clear that any instability in the banking system would result in instability within other sectors of the economy, thus impacting the growth of the economy. Banque de France (2008) support this statement and state that banks assume an important role in the financing of economies and in their view, should banks be unable to perform their assumed position (financing function) the economic growth of a country will be compromised.

The recent vulnerabilities in the banking system which resulted in the global economic meltdown is another case in point of the relationship between banks and the economy. In the South African perspective, banks came under pressure from high bad debt levels (Financial Mail, 2011). For example the total impaired loans and advances recorded at the end of financial year 2008 was R70 723 (Rm). At the end of the 2009 financial year, banks had recorded a significant increase on total impaired loans to R109 704 (Rm) in 2009. During this period, the South African economy slipped into recession (i.e. GDP was at -2.7% at the end of 2009).

2. Objectives

In South Africa, the responsibility of ensuring that there is a sound and stable banking system is with the

South African Reserve Bank (SARB). On an annual basis, the banking supervision report is published. This publication tracks and reports the South African banking system vulnerabilities. The banking supervision report, however, solely focuses on conventional financial indicators such as current ratio, acid test ratio, capital adequacy ratios etc.

Several researchers (Becchetti & Sierra, 2003; Drehmann *et al*., 2006; Keasey & Watson, 1987 and Zavgren, 1985) agree that the inclusion of non-financial data rather than focus solely on conventional financial indicators provide better predictions for vulnerabilities. This study follows a comprehensive approach and its objective is to investigate whether there are economic, financial or market variables that could assume the role of the leading credit risk indicators in the South African banking context. Stated differently, the purposes of this study are twofold; namely:

- To utilise financial, market and economic measures to identify the leading credit risk indicators in the South African banking context. This purpose is important as it outlines internal circumstances which would point to the vulnerability of a bank as well as external circumstances under which counterparties or borrowers will be unable to meet their obligations in accordance with agreed terms.
- To integrate the leading credit risk indicators in the South African banking context and develop an integrated leading credit risk indicator model for the top South African banks. This purpose is important as it constructs an early warning model (signalling model) i.e. a model which signals when banks are likely to be vulnerable (i.e. what combination of financial, market and economic variables could act as a signal for bank exposure to credit risk). Further, the combination of leading financial, market and economic result in the integration of financial and non-financial variable i.e. a broader view which demonstrate that through a series of activities undertaken, banks become connected to the wide range of activities, thus increasing their vulnerability to activities beyond their control.

3. Hypotheses and research questions

Credit risk is defined as the potential that a bank borrower or counterparty could fail to meet its obligations in accordance with agreed terms leading to losses to banks (Bank of International Settlement, 2004). From this definition, there are two research questions that have been formulated and they are stated as follows:

R1 - What are the external circumstances under which the counterparty or borrower will be unable to meet their obligations in accordance with agreed terms and could these external circumstances be represented by economic and market variables that act as a warning sign thus assuming the role of the leading economic and market credit risk indicators in the South African banking context?

To answer this research question, the paper has made the following five (5) hypotheses, namely:

a. Leading indicators of credit risk in the top South African banks could be indicated by the unemployment rate i.e. an increase in the unemployment would mean that some of those in employment would have lost their jobs and if they had credit they are likely to have difficulties to keep up with the repayment terms thus exposing banks to credit risk.
b. Leading indicators of credit risk in the top South African banks could be indicated by savings patterns (gross savings) i.e. decreasing savings is an indicator that the disposable income has to some extent diminished and there could be a likelihood that borrowers or counterparties may have difficulties to keep up with the repayment terms thus exposing banks to credit risk.
c. Leading indicators of credit risk in the top South African banks could be indicated by interest rate (prime) changes i.e. an increase in interest rate would mean that circumstances of repayments changes and there is a likelihood that borrowers or counterparties may have difficulties to keep up with the repayment terms thus exposing banks to credit risk.
d. Leading indicators of credit risk in the top South African banks could be indicated by the pattern of business insolvencies i.e. when businesses become insolvent, they may lay down employees and the indicators of this are explained by the unemployment hypothesis (R1a). Additionally, businesses may not be able to repay what they would have borrowed.
e. Leading indicators of credit risk in the top South African banks could be indicated by the pattern of default judgements issued against defaulters i.e. increasing levels of default judgment could indicate distress and that the asset quality held by banks could have declined (i.e. non-performing).

R2 - What are the internal bank specific circumstances that could act as a warning sign that the bank is vulnerable thus assuming the role of the leading banking specific credit risk indicators in the South African banking context?

To answer this research question, the study has made the following three (3) hypotheses, namely:

a. Leading indicators of credit risk in the top South African banks could be indicated by movements in the asset quality (such as non-performing loan, provisions for loans losses, impairments growth in loan book) i.e. the decline in the

quality of asset as represented by growth in impairments, growth in non-performing loans indicates that borrowers have difficulties to keep up with the repayment terms thus exposing banks to credit risk.

b. Leading indicators of credit risk in the top South African banks could be indicated by concentration to a particular asset, counterparty, customer or service provider i.e. should loans be concentrated in a certain sector of the economy, disturbances in concentrated sectors could indicate a likelihood that borrowers may have difficulties to keep up with the repayment terms thus exposing banks to credit risk.

c. Leading indicators of credit risk in the top South African banks could be indicated by trading and hedging activities i.e. both trading and hedging activities exposes banks to the risk (market risk) of a change in the actual or effective market value, earnings or future cash flow of a portfolio of financial instruments. Adverse movements in market variables such as equity, bond and commodity prices, currency exchange, interest rates and credit spreads could indicate a likelihood that some of the counterparties may not be in a position to meet their obligations to banks.

4. Methodology

4.1 Identification of sources of data

A process was undertaken to identify reports that could contain potential indicators of credit risks. Potential sources of information were classified between internal sources (bank specific) as well as external sources (economic and market indicators). Through interactions with various professionals in banks, for internal sources of credit risk, it was established that this exists due to the difference in the nature of banks assets, risk appetites and different target markets or product portfolio. With regards to external sources of instabilities, they are generic and apply to all banks as they emanate from the interaction of banks with markets and the overall economy (external environment). Table 1 below demonstrates the sources of data and the type of indicator extracted from the source of information.

Table 1. Sources and Utilisation of Data

Source of data	Institution of Origin	Type of leading credit risk indicator extracted
Audited Annual Reports	Banks	Bank Specific Indicator/s
Risk and Capital Reports	Banks	Bank Specific Indicator/s
SARB Quarterly Bulletin	Supervisors	Economic Indicator/s
Banking Supervision Annual Report	Supervisors	Bank Specific Indicator/s
BA 900 Report	Supervisors	Bank Specific Indicator/s
Consumer Price Index Report	Monitors	Economic & Market Indicator/s
Labour Force Survey	Monitors	Economic Indicator/s
Liquidations & Insolvencies	Monitors	Market Indicator/s
Judgments against defaulters	Monitors	Market Indicator/s

4.2 Collection of data

Following the process of identifying data sources, data was collected from websites of the top South African banks through downloading risk and capital reports as well as the audited annual reports. In instances where the required information was not available on the specific bank's website, a written request was made to that bank. A similar exercise was undertaken for the economic and market related data.

With data sources identified and the actual data collected, to address the formulated research questions, the qualitative and quantitative research methodologies were applied. In this regard, the content analysis methodology was used to extract data from the source while the structural equation modelling was used to analyze data.

4.3 Method of data extraction: application of the content analysis methodology

In order to extract the relevance of information disclosed in each report, the empirical method known as content analysis was used as a coding method for the selected reports. Krippendorff (1980) outlined three (3) factors that support the suitability of content analysis that can be used for the purpose of coding information in reports namely; stability, reproducibility and accuracy.

- Stability refers to the ability of a researcher to code data the same way over time. Assessing stability of the content analysis methodology involves a test-retest procedure.
- Accuracy refers to the reliability of the coded information.
- Reproducibility refers to the extent to which coding produces the same results when the text is coded once more (for the second time) or by the other researchers.

The suitability of content analysis in coding reports is further highlighted by Hsieh and Shanon (2005) where they indicate that the content analysis methodology is not a single focused methodology as it has three dimensions namely, conventional, directed and summative. Recent literature still support the use of the content analysis methodology as an acceptable research method for analyzing reports, because the technique is particularly useful for extracting information that is not explicitly presented in a quantified and structured format, but is implicit in the text (Abeysekera, 2007; Boesso & Kumar, 2007; Brennan & Solomon, 2008; Barac & Moloi, 2010).

In applying the content analysis methodology as a data extraction tool, a five steps approach was followed and is described below:

Step one – During this step, a unit that will be analyzed will be selected, i.e. coding of the annual report to abstract relevant financial information or coding of the economic report to obtain relevant economic information.

Step two – This step opens the coding process by creating categories and abstraction. Categories and abstractions are created by making notes and headings in the text while reading it on the report. To ensure the quality control, the written material is revisited several times and as many headings as necessary are noted in to describe all aspects of the content.

Step three – In this step, relevant information coded from the process of making notes and headings in the text are recorded into the designed coding sheet. To ensure the quality control, coded material is revisited several times.

Step four – In this step, all coded variables are grouped and categorised. The main objective of grouping data is to ensure that the number of categories is reduced by collapsing categories which are similar into broader higher order categories. For this step to provide meaningful data, data is classified as fitting in to a certain group (i.e. data that is being collapsed should be explained by the similar categorised data).

Step five – This is a final step where relevant category is abstracted for the preparation of the application of the structural equation modelling (SEM) on the selected categories (Baptiste, 2001, Carspecken, 1996 & Moustakas, 1994).

4.4 Method of Data Analysis: the Structural Equation Modelling (SEM)

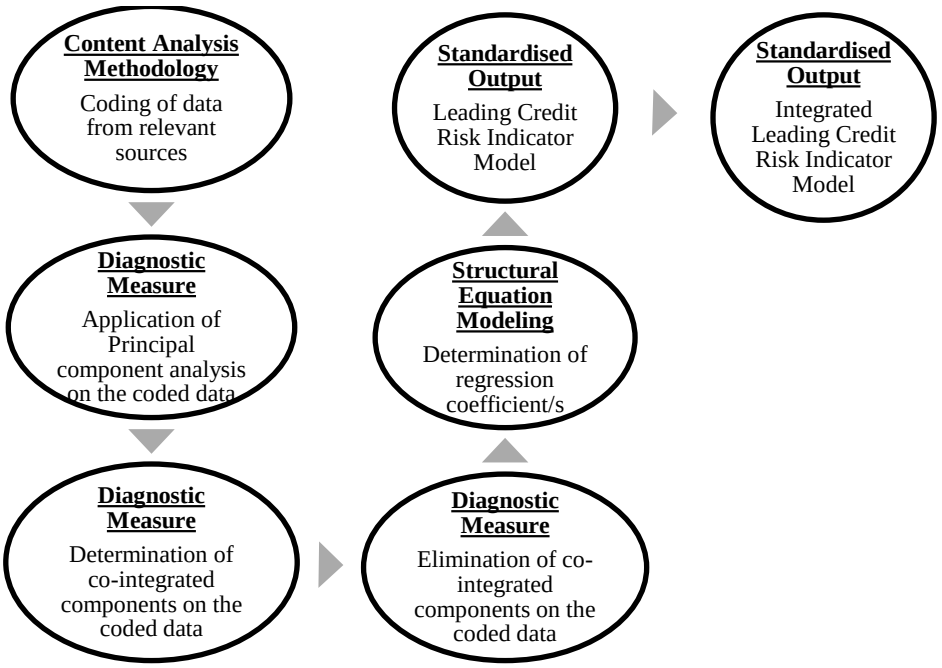
Since this paper seeks to identify internal and external circumstances (or leading indicators) where South African banks are likely to be exposed to credit risk, a methodology which allows that the observed variable is not directly measured was important. The structural equation modelling is an important instrument to utilise when the latent variables have not been directly measured. As per the requirement of the structural equation modelling, credit risk will not be directly observed; it will be treated as a latent variable.

Following the coding of potential indicators of credit risk from the specific report, the structural equation modelling (conducting principal component analysis test) was applied to the data to determine relations in the variables (co-integration test). As soon as the co-integration test was finalised, all co-integrated elements were eliminated to avoid duplication (i.e. the inclusion of variables that are already explained by other variables) in the model. This process is referred to as the dimension reduction exercise. Consequent to the elimination of the co-integrated elements, regression coefficients were determined, the output was standardised and compared with the fit indices. Figure 1 below demonstrates the sources of data and the type of indicator extracted from the source of information.

5. Limitations of the Study

The South African banking industry is dominated by the four banks, namely the Standard Bank of South Africa Limited, ABSA Bank Limited, First-Rand Bank Limited and Nedbank Limited. In 2010, these four banks contributed 84,6 per cent to the balance-sheet size of the total banking sector which was a level similar to that recorded in 2009 (SARB, 2010). Latest statistics shows the top four South African banks contributed 88 per cent (2011: 89 per cent) to the balance-sheet size of the total banking sector in South Africa (SARB, 2012).

Figure 1. Application of the structural equation modelling (SEM)



Following the dominance of the top four (4) banks, the limitations inherent to this paper are that foreign controlled banks and other small South African banks were excluded in this study due to the fact that both these elements represent a very small percentage size of the total banking sector. Further, this study relies on external sources of data such as the data extracted from the South African Reserve Banks Quarterly Bulletin, Statistics South Africa's labour force survey, the risk and capital reports as well as the audited financial statements from the top four South African banks. The accuracy of the source data used cannot be guaranteed.

6. Review of Related Literature

6.1 Review of literature on external sources and credit risk

Lindhe (2000) studied the relationship between the market, economic environment as well as banks and the study found that negative changes or movements in economic and market activities presented early warning signs for potential defaults which could destabilize banks. Lindhe's (2000) study outlined six (6) changes or movement in economic and market activities which could act as leading sources of instability in banks:

- Economic activity (Gross Domestic Product) – accordingly, as a general rule, lessening of demand results in difficulty for businesses (borrowers) to find a market for their products, which could result in payment difficulties by borrowers and trigger defaults.
- Business failures – there is an inverse relationship between the economic activity and the business failure. During the boom (high economic growth periods), there is generally a large number of business start-ups, on the same note many businesses closes when the economy enters recession. As an indicator of credit risk, more failures and so higher credit losses could be expected during a period of recession as opposed to a period of economic growth.
- Interest rate – accordingly, interest rates have a huge impact in the borrower's ability to service their loans. In general, bank lending is at variable interest rates. As results, any change in interest rates will have a rapid impact on the borrower's cost of capital. As an indicator of credit risk, more failures and so higher credit losses for banks could be expected during a period of high interest rates.
- Inflation – accordingly, higher inflation is a sign of macro-economic imbalances. A rapid increase in inflation has an impact on borrower's ability to repay their debt as they keep on going higher and higher. As an indicator of credit risk, more failures and so higher credit losses for banks could be expected during a period of high inflation.
- Exchange rate – this is an alternative to the terms of trade. Any increase (appreciation) in the exchange rate (South African Rand) against other currencies result in South African goods

and services being more expensive as compared to other nation's goods and services. Exporters find it difficult to find a market for their goods and services, which could result in their failure and thus defaults could be expected if they have taken any loan.

The identified circumstances under which banks are likely to be destabilized (Lindhe, 2000) have been accepted by other researchers and some of them subsequently classified as market risk, for example, the changes in exchange rates and interest rates, stock and commodities prices and use of financial instruments by Dryberg (2001).

The IMF (2003) introduced the movement in the household debt to gross domestic product and the real estate prices as additional economic and market indicators of credit risk in banks. Further support of market and economic movement as a source of external instabilities in banks are demonstrated by the assertion that credit risk often did not occur in isolation but is triggered by certain circumstances (The Monetary Authority of Singapore, 2006).

In their study of the relationships between economic growth and credit growth, Cottarelli, del'Ariccia and Vladkoca-Holla (2008) observed that before the 2008 financial crisis, many countries in Middle and Eastern Europe had witnessed credit growth booms which coincided with the improved prospects of economic growth and the reduction of interest rates. The relationship between credit risk and the economic growth was observed at the time when the interest rate increased, credit growth declined, the Middle and Eastern Europe economies entered into recession period and borrowers began to default on their obligations. The result of this study confirms economic growth and the interest rates as an indicator of credit risk (Cottarelli, del'Ariccia & Vladkoca-Holla, 2008).

The recent literature on the economic and market indicators of credit risk in banks are still in support of the view that market and economic climate have a role in identifying credit risk in banks. In this instance, for example, Lakstutiene, Breiteryte and Rumsaite (2009) are of the view that the quality of bank loan portfolios and the incurred credit risk loss are determined by the developments of the economy in country. Accordingly, any negative market and economic movement will have an implication on the financial state of bank borrowers, thus resulting in credit risk for banks.

6.2 Review of literature on internal sources and credit risk

6.2.1 Bank Asset Quality and Credit Risk

According to the Federal Deposit Insurance Corporation (2012) the single greatest risk in banking is the risk of loan losses stemming from the quality of banking assets. For the Federal Deposit Insurance Corporation (2012), loans losses are the greatest risk due to the fact that loans typically comprise a majority of the assets in most banks. Loans that result in losses from the provider are referred to as non-performing loans. The quality of bank asset is measured by the loan performance. Hou (2007) defines a non-performing loan as a loan that is not earning income and: (1) full payment of principal and interest is no longer anticipated, (2) principal or interest is 90 days or more delinquent, or (3) the maturity date has passed and payment in full has not been made.

As for the relationship between the asset quality and credit risk, several researches on the field of bank asset quality have found that many causes of bank failures are as a result of poor asset quality i.e. the asset quality is a statistically significant predictor of insolvency. In this regards, Dermirgue-Kunt (1989), Barr and Siems (1994) found that failing banking institutions always have high level of non-performing loans prior to their failures.

For those bank that are fortunate and do not fail, Kwan and Eisenbeis (1994), Hughes and Moon (1995) as well as Resti (1995) demonstrated that high non-performing loans result in inefficiencies i.e. there is a negative relationship between the non-performing loans and performance). Berger and Humphrey (1992), Barr and Siems (1994), De Young and Whalen (1994), Wheelock and Wilson (1994) all confirm the inefficiency observation in their studies where they demonstrate that failing banks tend to be located far from the most-efficient frontier.

6.2.2 Bank Asset Concentration and Credit Risk

Asset concentration risk is viewed as a risk that the bank is exposed to financial loss which if incurred would be significant due to the aggregate (concentration) exposure the bank has to a particular asset, counterparty, customer or service provider (Liberty, 2010). Similarly, the Bank of International Settlement (2006) views the concentration of exposures in credit portfolios as an important aspect of credit risk.

On the relationship between credit risk and asset concentration, the Bank of International Settlement (2006) indicated that historical experience in the studies of banks distress had demonstrated that concentration of credit risk in certain asset portfolios has been one of the major causes of bank distress. In the Comptroller's handbook, concentration of credit, the Comptroller of the Currency and Administrators of National Banks (2011) agrees with the Bank of International Settlement (2006) that concentration of credit risk in certain asset portfolios has been one of the major causes of bank distress. The Comptroller of

the Currency and Administrators of National Banks (2011) cite the recent financial crisis and point out that this crisis was a result of excessive concentrations of credit on certain asset portfolios.

Concentration of credit risk in certain portfolios become detrimental if the common characteristic becomes a common source of weakness in the loan portfolio i.e. detrimental common characteristic on business failures and unemployment rate will be the worsening economic environment as a common source. Business failures will result in business defaulting on their loans while continual increase in unemployment will also result in individuals defaulting on their loans. These types of loan pool could pose considerable risk to banks earnings and capital.

6.2.3 Bank Trading and Hedging Activities and Credit Risk

Allen and Santomero (2001) suggested that banks have moved away from their traditional role of taking deposits and making loans to innovative fee-producing activities such as investing or trading in derivatives thus exposing banks to the market related movement risk. Saunders, Cornett and McGraw (2006) agree with the notion that there has been a move from traditional role of banks by indicating that banks participate in two major trading activities that are generally associated with a financial institution's position in the foreign exchange trading account namely:

- Banks may act as agents to purchase and sell foreign currencies on behalf of their customers. As agents, banks earn fee income for matching buyers and sellers but they do not assume the foreign exchange risk themselves.
- Banks may trade foreign currencies for speculative purposes. They forecast future movements in relevant foreign exchange rates and then they take position to benefit from the forecasted movements. Speculative positions can be instituted through trading the spot currency instruments or by taking a position in the foreign exchange derivatives. (Saunders *et al*., 2006.)

To confirm the notion that there has been a move from traditional role of banks, Mollenkamp, Beckett and Miller (2000) studied the banks trading reports and found that in the first quarter of 2000, trading-account profits at Bank of America were $724 million, an increase of 45% as compared to a year earlier. Mollenkamp *et al.* (2000) attributes the increase to a flurry of trading in equity derivatives and interest rate swap orders to hedge the markets. For Fan *et al*. (2009), trading activities in commercial banks consist mostly of interest rate and foreign currency derivatives as well as cash securities, equities, bonds, and other assets. With regards to the hedging activities, Saunders, Cornett and McGraw (2006) indicate that banks mainly hedge against the foreign exchange exposures. Such hedging is designed to reduce foreign exchange risk caused by the fluctuations in the value of a financial institution's assets and liabilities denominated in foreign currencies due to variations in the exchange rate.

Other researchers such as Brewer, Minton and Moser (2000) disagree with the notion that banks mainly hedge against the foreign exchange exposures alone. They introduce the hedge against the interest rate movement. In contention to the notion that banks mainly hedge against the foreign exchange exposures alone Brewer, Minton and Moser (2000) argue that commercial banks had become active end-users or intermediaries in the interest rate derivatives markets since mid-1980s. Host of other researchers have studied the interest rate derivative and this include researchers such as Koppenhaver (1990), Shanker (1996), Ahmed, Beatty and Takeda (1997), Brewer, Jackson and Moser (2001), Zhao and Moser (2006), and Purnanandam (2007).

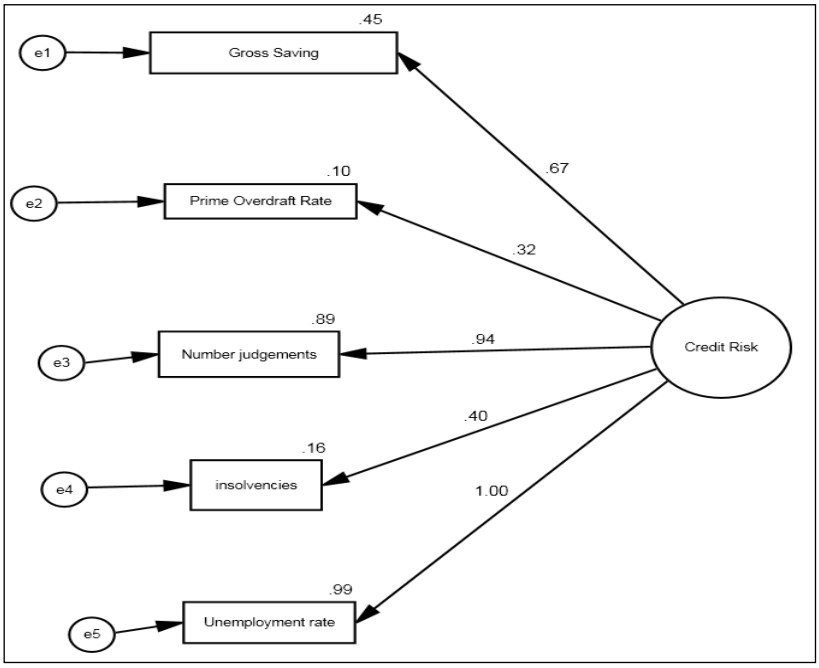
On the relationship between hedging and trading activities, Demsetz and Strahan (1997) as well as Hirtle (2009) suggest that there exist a positive relationship between banks hedging and trading activities. Hedging operations decrease the risk of the bank and thereby allow it to pursue additional risky activities, such as derivatives trading. For the purpose of robustness, Fan *et al*. (2009) also examined the relationship between trading and hedging accounts using regression analysis. Fan *et al.* (2009) regression included the trading account as a dependent variable while the total assets variable and the size of the hedging account were treated as independent variables. The results confirmed that the trading activities were positively related with the hedging activities.

Both trading and hedging activities exposes banks to the risk (market risk) of a change in the actual or effective market value, earnings or future cash flow of a portfolio of financial instruments. These changes are normally caused by adverse movements in market variables such as equity, bond and commodity prices, currency exchange and interest rates, credit spreads, recovery rates, correlations and implied volatilities. Changes in the market conditions could result in losses in the trading book, interest rate risk in the banking book, equity investments and foreign currency translation risk.

7. Presentation of Findings

7.1 Formulated Leading Economic and Market (External) Indicators of Credit Risk

Figure 2. Formulated Leading Economic and Market Indicators of Credit Risk



As can be noted in figure 2 above, analyzed results using the principal analysis revealed that of gross savings, prime overdraft rates, number of judgments, business insolvencies and unemployment rates represented the leading economic and market indicators of credit risk. Detailed discussion of how each indicator impact on credit risk follows below.

7.1.1 Unemployment Rate as an External Indicator of Credit Risk in the top South African Banks

During the analysis of economic data using the structural equation modelling to determine the leading indicators of credit risk, it was found that the unemployment rate was highly correlated (at 0.99) to the unobserved credit risk. Further analysis of the unemployment rate as a leading indicator of credit risk suggests that any changes in the unemployment rate would have a significant signs for the purpose of credit risk as it has been established through the structural equation modelling that the significant relationship exist between the two variables.

With regards to the relationship between unemployment rate and other formulated leading credit risk indicators, it was found that the unemployment rate was 0.657 correlated to gross savings which is a significant correlation at the level of 0.01 (2-tailed), -0.395 correlated to prime overdraft rate which is a significant correlation at the level of 0.05 (2-tailed), 0.388 correlated to business failures/ insolvencies which is a significant correlation at the level of 0.05 (2-tailed) and 0.860 correlated to default judgments which is a significant correlation at the level of 0.01 (2-tailed).

Result findings which suggest that there is high correlations between unemployment as a leading indicator of credit risk is found to be consistent with the view that as unemployment increases (i.e. adverse changes in macro-economy), more defaults could be expected as those who would have borrowed find themselves unemployed and thus defaulting from their commitments.

7.1.2 Default Judgments as an External Indicator of Credit Risk in the Top South African Banks

Critical data analysis of selected economic information using the structural equation modelling to determine the leading indicators of credit risk revealed that default judgments by corporate and households were correlated (at 0.89) to the unobserved credit risk. An in-depth analysis of default judgments by corporate and households as a leading indicator of credit risk suggests that any changes in default judgments by corporate and households factor would also reveal itself as a significant signal of changes in credit risk even

though this would be slightly lower that the unemployment rate signal.

With regards to the relationship between default judgments and other formulated leading credit risk indicators, it was found that the default judgments were 0.860 correlated to unemployment rate which is a significant correlation at the level of 0.01 (2-tailed), -0.331 correlated to gross savings which is a significant correlation at the level of 0.05 (2-tailed), -0.397 correlated to prime overdraft rate which is a significant correlation at the level of 0.05 (2-tailed) and -0.10 correlated to insolvencies which is a significant correlation at the level of 0.05 (2-tailed).

Result findings suggesting that default judgments by corporate and households factor as one of leading indicators of credit risk was found to be consistent with the view that the economic agent's inability to repay their debts leading to credit provider taking them to court to obtain judgment compelling defaulters to either repay their debt or have their assets attached and auctioned indicate that the income made by economic agent is either consumed in its entirety or economic agents utilises the disposable income for the purpose of debt repayment leaving them with no buffer and any adverse change in macro-economic conditions significantly affect economic agents cash flow, compelling them to default from their commitments.

7.1.3 Aggregate Gross Savings as an External Indicator of Credit Risk in the Top South African Banks

Analysis of selected economic data using the structural equation modelling to determine the leading indicators of credit risk revealed that gross savings were correlated (at 0.45) to the unobserved credit risk. An in-depth analysis of gross savings as a leading indicator of credit risk suggests that any changes in the gross savings patterns by economic agents could signal the changing credit risk patterns. It is however, noted that the gross savings signal of credit risk is slightly lower as compared to the changes signalled by the unemployment rate and the default judgment variables.

With regards to the relationship between gross savings and other formulated leading credit risk indicators, it was found that the gross savings were 0.657 correlated to unemployment rate which is a significant correlation at the level of 0.01 (2-tailed), 0.240 correlated to prime overdraft rate which is a significant correlation at the level of 0.05 (2-tailed), 0.261 correlated to business failures/ insolvencies which is a significant correlation at the level of 0.05 (2-tailed) and 0.331 correlated to default judgments which is a significant correlation at the level of 0.05 (2-tailed).

Result findings suggesting that gross savings factor is one of leading indicator of credit risk was found to be consistent with the view that economic agent's inability to save indicate that most income made by economic agent is either consumed in its entirety or economic agents utilises the disposable income for the purpose of debt repayment leaving them with no buffer and any adverse change in macro-economic conditions significantly affect economic agents cash flow, compelling them to default from their commitments.

7.1.4 Business Failures/Insolvencies as an External Indicator of Credit Risk in the Top South African Banks

Critical analysis of economic data using the structural equation modelling to determine the leading indicators of credit risk revealed that business failures/insolvencies were correlated (at 0.16) to the unobserved credit risk. Further analysis of business failures/insolvencies as a leading indicator of credit risk suggests that changes in the business failures/insolvencies signals changes in the credit risk patterns as demonstrated by the relationship between these two variables. It however noted that the business failure/insolvencies signal of credit risk is lower correlation that the unemployment rate, the default judgment as well as the gross savings variables.

With regards to the relationship between business failures/insolvencies and other formulated leading credit risk indicators, it was found that business failures/insolvencies were 0.388 correlated to unemployment rate which is a significant correlation at the level of 0.05 (2-tailed), 0.049 correlated to prime overdraft rate which is a significant correlation at the level of 0.05 (2-tailed), 0.261 correlated to gross savings which is a significant correlation at the level of 0.05 (2-tailed) and -0.010 correlated to default judgments which is a significant correlation at the level of 0.05 (2-tailed).

Result findings which suggest that business failures/insolvencies is a leading indicator of credit risk was found to be consistent with the view that adverse macro-economic conditions significantly affect firm's profitability and gearing, compelling financially fragile firms to fail and default from their commitments.

7.1.5 Prime Interest Rate as an External Indicator of Credit Risk in the Top South African Banks

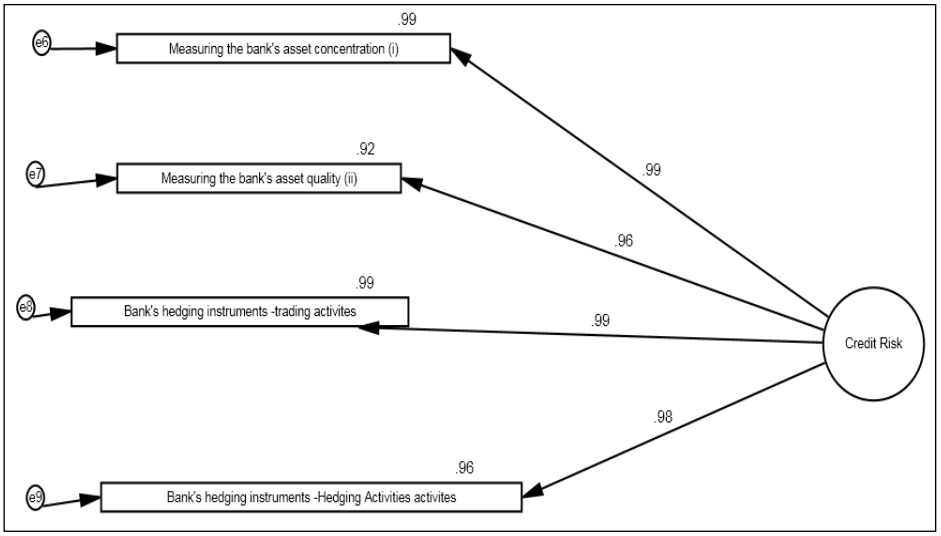
Analysis of economic and market data using the structural equation modelling to determine the leading indicators of credit risk found that the movements in interest rate was correlated (at 0.10) to the unobserved credit risk. Analysed data further

revealed that changes in the interest rate variable as a leading indicator of credit risk would also signal changes in credit risk. It is noted that the prime interest rate as a signal of credit risk changes is slightly lower as compared to the changes signalled by the unemployment rate, the default judgment, gross savings and business failures/insolvencies variables.

With regards to the relationship between the prime interest rate and other formulated leading credit risk indicators, it was found that interest rates were -0.395 correlated to unemployment rate which is a significant correlation at the level of 0.05 (2-tailed), 0.240 correlated to gross savings rate which is a significant correlation at the level of 0.05 (2-tailed), 0.049 correlated to insolvencies which is a significant correlation at the level of 0.05 (2-tailed) and -0.397 correlated to default judgments which is a significant correlation at the level of 0.05 (2-tailed). Result findings which suggest that movement in the interest rates was one of the leading indicators of credit risk were found to be consistent with idea that movement in interest rates is an indicator of the movements in credit risk.

7.2 Formulated Leading Bank Specific (Internal) Indicators of Credit Risk

Figure 3. Formulated Leading Bank Specific Indicators of Credit Risk



Analyzed results using the principal analysis revealed that of bank asset quality, bank asset concentration as well as bank trading hedging activities represented the leading financial indicators of credit risk. Detailed discussion of how each indicator impact on credit risk is discussed below.

7.2.1 Bank Asset Quality as an internal Indicator of Credit Risk in the Top South African Banks

Critical analysis of economic data using the structural equation modelling to determine the leading indicators of credit risk revealed that the bank asset quality was correlated (at 0.92) to the unobserved credit risk. Further analysis of bank asset quality as a leading indicator of the unobserved credit risk suggests that changes in the bank asset quality would signal the changes in the credit risk pattern of the bank under observation.

With regards to the relationship between the bank asset quality and other formulated bank specific leading credit risk indicators, it was found that the bank asset quality was 0.946 correlated to asset concentration which is a significant correlation at the level of 0.01 (2-tailed), 0.965 correlated to the trading activities which is a significant correlation at the level of 0.01 (2-tailed) and 0.914 correlated to the hedging activities which is a significant correlation at the level of 0.01 (2-tailed).

Result findings which suggest that bank asset quality is a leading indicator of credit risk was found to be consistent with the idea that many causes of bank failures are as a result of poor asset quality and even if the bank is fortunate not to fail, the said bank will be inefficient.

7.2.2 Bank Asset Concentration as an internal Indicator of Credit Risk in the Top South African Banks

Critical analysis of bank specific data using the structural equation modelling to determine the leading indicators of credit risk revealed that bank asset concentration was correlated (at 0.99) to the unobserved credit risk. Further analysis of bank asset concentration as a leading indicator of the unobserved

credit risk suggests that changes in the bank asset concentration would signal the changes in the credit risk pattern of the bank under observation. It is noted that the bank asset concentration as a signal of changes in credit risk is slightly higher than the signal provided by the bank asset quality.

With regards to the relationship between the bank asset concentration and other formulated bank specific leading credit risk indicators, it was found that the bank asset concentration was 0.946 correlated to asset quality which is a significant correlation at the level of 0.01 (2-tailed), 0.987 correlated to the trading activities which is a significant correlation at the level of 0.01 (2-tailed) and 0.978 correlated to the hedging activities which is a significant correlation at the level of 0.01 (2-tailed).

Result findings which suggest that bank asset concentration is a leading indicator of credit risk was found to be consistent with the view that many bank failures or inefficiencies were as a result of poor asset diversification, particularly in loans advanced to correlated sectors.

7.2.3 Bank Trading and Hedging Activities as an internal Indicator of Credit Risk in the Top South African Banks

Critical analysis of economic data using the structural equation modelling to determine the leading indicators credit risk revealed that bank trading and hedging activities were correlated (at 0.99 for trading activities and 0.96 for hedging activities) to the unobserved credit risk. Further analysis of bank trading and hedging activities as a leading indicator of the unobserved credit risk suggests that changes in these activities would signal the changes in the credit risk pattern of the bank under observation. It is noted that both the asset concentration and the bank trading activities highly signify the relationship with credit risk while hedging activities and the asset quality are slightly lower signals of credit risk.

With regards to the relationship between the trading activities and other formulated bank specific leading credit risk indicators, it was found that the bank trading activities were 0.987 correlated to asset concentration which is a significant correlation at the level of 0.01 (2-tailed), 0.966 correlated to the hedging activities which is a significant correlation at the level of 0.01 (2-tailed) and 0.965 correlated to the asset quality which is a significant correlation at the level of 0.01 (2-tailed).

On the other hand, it was found that the hedging activities were 0.978 correlated to asset concentration which is a significant correlation at the level of 0.01 (2-tailed), 0.914 correlated to asset quality which is a significant correlation at the level of 0.01 (2-tailed), and 0.966 correlated to the trading activities which is a significant correlation at the level of 0.01 (2-tailed).

Result findings which suggest that bank trading and hedging activities are part of the leading indicators of credit risk were found to be consistent with the view that adverse movements in market variables such as equity, bond and commodity prices, currency exchange and interest rates, credit spreads, recovery rates etc. could result in losses in the trading book, interest rate risk in the banking book, equity investments as well as foreign currency translation risk.

8. Formulated Integrated Leading Credit Risk Indicator Model for South African Banks (ICRIM)

Results presented above highlighted the formulated leading credit risk indicator indicators for South African banks. The formulated leading credit risk indicators for South African banks included both the bank specific as well as the economic and market indicators of credit risk. Utilising the structural equation modelling, gross savings, prime overdraft rates, number of judgments, business insolvencies and unemployment rates were formulated as leading economic and market indicators of credit risk. Similarly, utilising the structural equation modelling bank asset quality, bank asset concentration as well as bank trading and hedging activities represented the leading bank specific indicators of credit risk.

Based on the formulated bank specific as well as the economic and market indicators of credit risk for South African banks, the Integrated Leading Credit Risk Indicator Model (ICRIM) can be stated as follows:

$$ICRIM = \alpha_o + \alpha_1 U + \alpha_2 NJ + \alpha_3 GS + \alpha_4 I + \alpha_5 IR + \alpha_6 AC + \alpha_7 HI + \alpha_8 AQ + \varepsilon_i$$

Table 2. Detailed Description of ICRIM Parameters

Economic and Market (External) indicators of credit risk		**Bank specific (internal) indicators of credit risk**	
Symbol	Full Description	**Symbol**	Full Description
U	Unemployment	***AC***	Asset Concentration
NJ	Number of Judgments	***HI***	Trading & Hedging Instruments
GS	Gross Savings	***AQ***	Asset Quality
I	Insolvencies		
IR	Interest Rate		

As can be noted above, the formulated Integrated Leading Credit Risk Indicator Model has utilised a comprehensive approach in determining indicators of credit risk for South African banks i.e. both financial and non-financial data was utilised in the determination of indicators of credit risk as opposed to the emphasis on credit risk of an individual assets as well as the solely reliance on financial statement information.

Formulated Integrated Leading Credit Risk Indicator Model for South African banks indicate circumstances under which the counterparty or borrower will be unable to meet their obligations in accordance with agreed terms (which also extend, not only to loans provided but also to other securities and bonds). The Integrated Leading Credit Risk Indicator Model can simply be stated as a signalling model as to when banks are likely to be exposed (i.e. what combination of variables will act as a signal for banks' exposure to credit risk).

The model is deemed integrated as it encompasses financial, market and economic changes. The model further confirms that through a series of activities undertaken, banks become connected to the wide range of activities, thus increasing their exposure to activities beyond their control. As such, negative movements to activities in the market and economy could negatively impact on banks. It is stated that the formulated Integrated Leading Credit Risk Indicator Model will be useful to banking supervisors, bank depositors as well as bank investors in their effort to understand the indicators of credit exposures in the bank of their interest.

9. Testing Performance of Leading Credit Risk Indicators vs Model FIT Indices

9.1 Benchmarking the ICRIM against the Baseline Comparison

According to the generally accepted fit indices (see Shreiber *et al.,* 2006), for the model to meet the goodness of fit requirements, baseline comparison for Normed Fit Index (NFI) should be greater than 0.95 for acceptance, Incremental Fit Index (IFI) should be greater than 0.95 for acceptance, Tucker-Lewis (TLI) can be greater than zero (0) and the Comparative Fit Index (CFI) should be greater than 0.95 for acceptance.

Table 3. Benchmarking the ICRIM against the Baseline Comparison

Index	**Requirements**	**ICRIM (Economic and Market)**	**ICRIM (Bank Specific)**	**Comment**
Normed Fit Index (NFI)	≥ 0.95	0.953	0.955	Requirement satisfied
Incremental Fit Index (IFI)	≥ 0.95	1.044	0.958	Requirement satisfied
Tucker-Lewis Index (TLI)	≥ 0	1.162	0.874	Requirement satisfied
Comparative Fit Index (CFI)	≥ 0.95	1.00	0.968	Requirement satisfied

It is apparent in Table 3 above, the formulated Integrated Leading Credit Risk Indicator Model was found to be consistent with the generally accepted fit indices known as the comparative fit (baseline comparison).

9.2 Benchmarking the ICRIM against the Hoelter .05 and the Hoelter .01

As for the comparison of the ICRIM with the Hoelter, generally accepted fit indices (see Shreiber *et al.,* 2006) do not prescribe the requirements for the model

to meet the goodness of fit with the exception that the Hoelter .01, suggest that N should be equals to 200 and also that for the Hoelter .05, the sample should be large. It is however not stated how large the sample should be.

Table 4. Benchmarking the ICRIM against the Hoelter .05 and the Hoelter .01

Index	Requirements	ICRIM (Economic and Market)	ICRIM (Bank Specific)	Comment
Hoelter .01	N/A	457	22	N/A
Hoelter .05	N/A	336	14	N/A

Table 4 above demonstrates the performance of the ICRIM against the Hoelter 0.1 and Hoelter .05. As indicated, both the Hoelter .01 and Hoelter .05 have no requirements with the exception of the suggestion that the sample size should be large for the Hoelter .05 (no specific guidance as to how large the sample should be) and the Hoelter .01 where it is suggested that N should be equals to 200.

9.3 Benchmarking the ICRIM against the Root Mean Square Error of Approximation (RMSEA)

With regards to the Root Mean Square Error of Approximation (RMSEA), generally accepted fit indices (see Shreiber et al., 2006) prescribe that the root mean square error of approximation is less than the ranges 0.6-0.8.

Table 5. Benchmarking the ICRIM against the Root Mean Square Error of Approximation (RMSEA)

Index	Requirements	ICRIM (Economic and Market)	ICRIM (Bank Specific)	Comment
RMSEA	< 0.6-0.8 with confidence interval	0.000	0.446	Requirements satisfied

Table 5 above demonstrates the performance of the ICRIM against the Root Mean Square Error of Approximation (RMSEA) which prescribe that the root mean square error of approximation is less than the ranges 0.6-0.8. Accordingly, the formulated Integrated Leading Credit Risk Indicator Model was found to be consistent with the requirements of the RMSEA as generally accepted fit index.

10. Conclusions and Recommendations

The banking field is extremely dynamic and as such, consistent study of banking literature, trends, new developments and research should always be undertaken to contribute to the body of knowledge and provide new insight into this dynamic field. Owing to the dynamism, the role and importance of banks in the economy, this study investigated ways to make contribution to the banking body of knowledge.

Having identified the leading credit risk indicators in the South African banking context and developed the Integrated Leading Credit Risk Indicator Model (ICRIM) to measure the exposure of South African banks to credit risk, the main recommendation stemming from this research are as follows:

- When determining the sources of instability into the banking system, a comprehensive approach should be sought i.e. for the purpose of determining indicators of credit risk for South African banks both financial and non-financial data (comprehensive approach) was utilised in the determination of indicators of credit risk as opposed to the emphasis on credit risk as related to an individual variable, individual bank assets as well as the solely reliance on financial statement information.
- The South African Reserve Bank (SARB) has a responsibility of ensuring that South Africa has a sound and a stable banking system. On an annual basis, SARB publishes its banking supervision report to the South African government. This report is tabled in the South African national assembly (parliament) for deliberations. The banking supervision report put more emphasis on the financial ratios such as profitability, current ratio, acid test ratio etc. This report should be enhanced to include, analyse and report on the broader key credit risk indicators identified by this study. The broader emphasis will permit earlier identification of all threats in the banking system. Authorities could then move and contain identified threats to

avoid instability in the South African banking system. This study integrated several economic, market and bank specific variable to form an Integrated Leading Credit Risk Indicator Model for South African banks. In performing its duty of ensuring stable banking system in South Africa, SARB should consider adopting the Integrated Leading Credit Risk Indicator Model which provides a far much broader assessment of vulnerabilities in the South African banking system than focusing on financial ratios alone.

Finally, this paper provides a structured approach of identifying leading indicators and it further provides "a tool" that integrates all leading credit risk indicators. This tool is better suited because it is an objective tool, and secondly, because it encompasses a variety of indicators both internal (those that the bank can control) and external indicators (outside the control) that can be used to assess the threats into the South Africa's banking system thus contributing to the main aim which is promoting the soundness of the South Africa's banking system and to contribute to its financial stability.

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