Financial Institutions and Services

# Credit Risk and Securitisation in the South African Banking Sector

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**Abstract:** This paper investigates the relationship between credit risk and securitisation in the South African banking sector. Panel data analysis was used to analyse the annual observations from four major South African banks for a sample period from 2005 to 2014. Results indicate that the basis for securitisation variation in South African banks stems from capital, bank size and the economic growth of the country. A positive impact of securitisation on credit risk was discovered. The paper revealed that, contrary to previous findings, the global financial crisis of 2007–2009 had no effect on the securitisation in the South African banking sector. This paper also found that size has a significant influence on capitalisation. Compared to small banks, large banks tend to securitise more and take on further credit risk. Therefore, banks should increase or maintain an acceptable capital amount to hedge against any unexpected risks. Proper systems should be established and adopted to encourage repayment of loans by borrowers.

**Keywords:** Bank stability; solvency risk; cointegration, bank performance; South Africa

**JEL Classification:** G21; G32

## 1. Introduction

Banks are at the heart of every economy. Healthy and successful banks are vital for economic development, especially in a country such as South Africa. Nevertheless, there are a number of risks faced by banks, including credit risk (risk of repayment), market risk, operational risk, trade union risk, liquidity risk, interest risk, portfolio risk and legal risk. The most important of these risks is credit risk. Credit risk is one of the most significant risks for every bank. Credit risk is the inability of the borrower to repay the loan, combined with the bank's poor

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supervision over the credit granted. Credit risk is one of the causes of the 2007–2009 global financial crisis and consequent economic meltdown (Charles & Kenneth, 2013). Moreover, Chijoriga (1997) contends that the influence of credit risk is far greater, and capable of collapsing a whole bank, compared to the other risks faced by banks. As an attempt to hedge against credit risk and the future financial instability, most banks have increased their securitisation activities. Securitisation is the process that starts when an individual or a company approaches a bank for a loan, and the bank approves the loan, but incurs the cost and risk of non-payment by the borrower (Shenker & Colletta, 1991). In mitigation, banks group a number of loans together according to their different characteristics, and then pool these loans into different securities that can be sold on the open market (Shenker & Colletta, 1991). This securitisation is implemented to transfer the risk associated with these loans, and to protect the bank liquidity and profitability (Shenker & Colletta, 1991).

The engagement of banks in the securitisation process lies in the three benefits associated with this process. The first benefit is the efficient source of funding by removing certain stocks (loans) from the bank's books and thereby realising more capital, reducing financing costs and improving capital requirements (Griffin,1997). The second one is the improved banks' Statement of Financial Position, in which risky assets, including loans are removed from the banks' statement of financial position (Liaw & Eastwood, 2000). This process tends to improve the financial, economic, and capital measures of the bank (Liaw & Eastwood, 2000). The third benefit of securitisation is related to the use of securitisation as a risk management tool (Davis, 2000). Among the risks faced by banks, credit risk is one of the risks directly related to the banks' performance and profitability, and for this reason, banks take advantage of securitisation to provide the additional funding required to cover credit risk.

The South African securitisation market has increased substantially since its first transaction in 1989. Due to misunderstanding of this new concept and lack of appreciation by banks, for a period of 12 years (1989–2001), certain restrictions were imposed by regulatory bodies to slow down the rapid development of securitisation in South Africa (Moyo & Firrer, 2008). Following the newly amended securitisation regulation in 2001, the securitisation market in South Africa started to grow significantly again. However, there is limited research on securitisation and credit risk in South Africa. This paper aims to contribute to the existing literature and empirical analysis by evaluating the relationship between securitisation and credit risk in the South African context. This paper follows the measures of credit risk used by Salah and Fedhila (2012), but utilises the relevant risk proxies and economic variables that represent the South African economic and financial landscape.

## 2. Empirical Literature

A number of researchers (Aggarwal & Jacques, 2001; Casu, Girardone & Molyneux, 2010; Gorton & Pennacchi, 1995; Pavel & Phillis, 1987; Pennacchi, 1988; Shrieves & Dahl, 1992; Uhde & Michalak, 2010) have studied the effects of, and relationship between securitisation and credit risk. From these studies, two conclusions regarding the relationship between securitisation and credit risk were reached. Some studies, i.e. Aggarwal & Jacques, 2001; Cabiles, 2011; Gorton & Pennacchi, 1995 and Loutskina, 2011, decided in favour of a positive relationship between securitisation and credit risk, whereas others, i.e. Jiangli and Pritsker, 2008, and Dionne and Harchaoui, 2003, concluded in favour of the negative relationship between securitisation and credit risk.

Findings in favour of securitisation suggest that banks benefit by increasing the amount of loans provided and reducing their risk by partaking in securitisation. This implies that banks that securitise more loans are able to provide additional loans and funding. By separating the source of funding from the bank, the bank can reduce its credit risk and increase its loan provision, profitability and liquidity (Pavel & Phillis, 1987; Pennacchi, 1988). A study by Demzetz (2000) focused on the diversification advantages associated with loan sales (securitisation) on the open market and found that diversifying the loan portfolio increases the ability to securitise more and provide more loans to customers. Jiangli and Pritsker (2008) also find that the securitisation process has a negative effect on the unsolvability of the United States (USA) of America's banking sector. In the same vein, Casu *et al*. (2010) presented positive supporting evidence with regard to the stability effects of diversification on securitisation in the USA. One of the advantages of securitisation and credit risk is the fact that once the loans are no longer on the bank's Statement of Financial Position, the bank is no longer required to carry the minimum capital requirements as set out by the regulations authority against that asset. This provides savings on the bank's capital.

By applying the Capital Asset Pricing Model (CAPM), Krahnen and Wilde (2006) revealed that most European banks engaged in more risky assets after the announcement of securitisation, and this increased the credit risk due to unstable markets. Similarly, (Awdeh, El-Moussawi & Machrouh, 2011) find that adverse bank regulations affect the bank's credit risks and performance. Moreover, Baur and Joossens (2006) also find evidence that securitisation reduces a bank's capital requirements, and this generally affects credit risk because it encourages banks to prioritise more profitable portfolios and riskier assets. Enforcing regulations, such as the capital requirements, increases the risk of a bank's failure and decreases the customer confidence in banks, which will affect the social repayment system and thereby increasing its credit risk (Kahane, 1977; Kohen & Santomero, 1980).

In the South African context, studies have been done on securitisation and its development, and include those of Tensfeldt, Firer, & Bendixen, 1993; Saayman &

Styger, 2003; Gumata & Mokoena, 2005; Karoly *et al*., 2006; White, 2011; Smit, 2012; and Terblanché, 2012. The findings of these studies reflect that securitisation in South Africa has not developed as much, compared to the securitisation in developed nations, such as the USA. However, the relationship exists and is significantly positive, meaning that South African banks use securitisation as a form of hedging strategy and for speculation purposes. These South African studies focused on the relationship between securitisation and liquidity risk, or mortgage-backed securitisation. Therefore, this paper focuses on the relationship between credit risk and securitisation.

## 3. Methodology

### 3.1. Sample Selection and Data Description

This paper used a quantitative research approach with panel data analysis. The annual secondary data from 2005 to 2014 was collected from the audited financial statements of the selected banks, available from the McGregor BFA database. The securitisation information was collected from the Banking Association of South Africa and the South African macroeconomic variables data was obtained from the South African Reserve Bank (SARB) and Statistics, South Africa. The four major banks in South Africa namely, Absa Bank Ltd, FirstRand Bank Ltd, Nedbank Ltd and Standard Bank of South Africa Ltd, were selected for this paper. These four big banks provide a fair representation of the banking sector in South Africa, and they had securitisation data available for the period of the study.

### 3.2. Model Specification

The model specification is to examine the allocation of assets between different categories of risks faced by a bank. A linear regression model with the independent variable of Risk-weighted Assets/Total Assets (RWATA) is used, while the Altman's Z-score Model will analyse the relationship between securitisation and bank stability.

$$RWATA_{it} = SECTA_{it} + \sum_i^n X_{it} + \mu_t \qquad (1)$$

$$\text{Z-Score} = SECTA_{it} + RWATA_{it} \sum_i^n X_{it} + \mu_t \qquad (2)$$

Where: $RWATA_{it}$ is the credit risk for bank i at period t, measured by the ratio of risk-weighted assets to total assets; $SECTA_{it}$ is the ratio of total securitised assets to total assets; X is the vector of the independent variables representing macroeconomic variables and specific control factors of bank i for the period t. Z-score measures the distance from insolvability, implying that the higher value of Z-Score indicates little default risk and $u_t$ is the error term. Although Z-Score has been used by different authors (Altman et al., 1995, p. 3; Altman & Hotchkiss, 2006: 314; Roy, 1952; Uhde & Heimeshoff, 2009; Boyd, Nicolo, & Jalal, 2006;

Levy, Kanat, Kunin, Tooshknov & Tzruya, 2014). This paper adapted the Z-Score models used by Salah and Fedhila (2012).

$$Z - Score = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_5 \quad (3)$$

Where:

$X_1$: Working capital/Total assets;

$X_2$: Retained earnings/Total assets;

$X_3$: EBIT/Total assets; and

$X_4$: Book value equity/Total liabilities.

The coefficients in Altman's Z-score formula are standard numbers formulated by Altman to accommodate the manufacturers, non-manufacturer industrials, and emerging market credits. The diagram below summarises this classification.

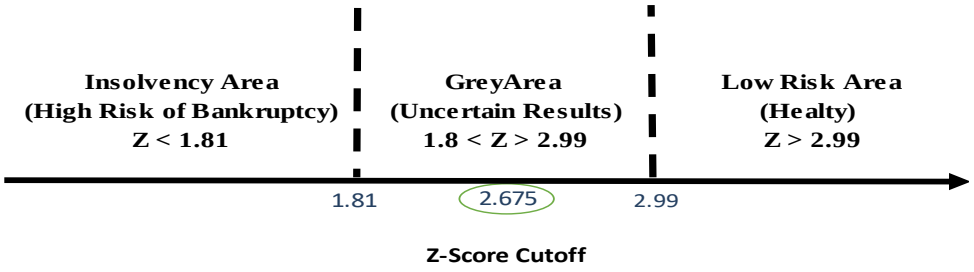


**Figure 1. Z-Score classification areas**

In explaining the risk performance of banks, this paper considers four types of variables: securitisation activity (total securitised assets), variables of banks, the South African macroeconomic variables, and bank specific variables as control variables. These variables are summarised in Table 1.

**Table 1. Definition of variables**

| | Variables | Designation | Description | Expected effect on RC |
|---|---|---|---|---|
| **Dependent variables)** | Credit risk | RWATA | Risk weighted assets/ Total assets | N/A |
| | | Z-Score | X1: Working capital/Total assets; X2: Retained earnings/Total assets; X3: EBIT/Total assets; X4: Book value equity/Total liabilities | N/A |
| **Bank specific variables** | Securitisation | SECTA | Securitisation assets/Total assets | (+/-) |
| | Capital | CAPTAL | Equity capital/Total assets | (+/-) |
| | | ECRWA | Equity capital/Risk weighted assets | (+/-) |
| | Performance | ROE | Net income/Equity capital | (-) |
| | Size | LOGTA | Logarithm of total assets | (-) |
| **Macro-economic variables** | GDP | GDP | A sustained increase in the trend level of either (a) aggregate production, or (b) per capita GDP | (-) |
| | Ave CPI | Ave CPI | Inflation deflated by the Gross Domestic Product using CPI | (+/-) |
| | Exchange rate | EXCR | Country's real exchange rate. | (+/-) |
| **Subprime crisis** | Dummy for subprime crisis | Dummy | 0 = Before or after the crisis and 1= during the crisis | (+) |

### 3.3 Panel Root Unit Test and Cointegration

As the first step in the estimation of the model, the panel unit root test is conducted to determine whether the variables are stationary or non-stationary. Unit root is used to establish the order of integration between variables, i.e. to check if the variables are stationary at level or integrated of order, I(0), and whether a variable is stationary at the first difference or integrated of order 1, I(1). This test is performed to prevent the use of non-stationary variables, which can result in a spurious regression (Brook, 2014). Therefore, for the purpose of the panel unit root test, this paper used Levin, Lin & Chi (LLC), Im, Pesaran and Shin (IPS) and ADF Fisher Chi-square, and compared results to the results of these tests. If variables are stationary, then the normal panel regression is estimated. However, if variables are

non-stationary, then a cointegration test is conducted to see if the linear combination of these variables is stationary.

A panel cointegration model is used to check if there is a long-run or short-run effect between the variables (Brooks, 2014:373–379). The common panel cointegration model includes the Pedroni (Engle-Granger) and Kao cointegration model (Brooks, 2014). The first model is a less restrictive method of testing for cointegration, and is therefore used in this study to conduct the panel cointegration tests, and the Kao cointegration model is used to confirm the Pedroni model results. If both tests confirm that variables are cointegrated, then the cointegrating model, Fully-Modified OLS model (FMOLS), can be estimated and the results interpreted.

## 4. Empirical Results

This paper approximates the securitisation activity (SECTA) by using the total securitised assets to total assets. Dionne & Harchaoui, 2003, and Casu et al., 2010, used this method. Previous studies found that the relationship between securitisation and credit risk could either be positive or negative (Gorton & Pennacchi, 1995; Wagner, 2007). The paper will also use ECRWA and CAPTL. ECRWA being equity capital to risk-weighted assets and CAPTL, the capital per total assets. This paper used both (ECRWA) equity capital to risk-weighted assets and the capital per total assets (CAPTL) as the measures of capital. Return on equity (ROE) will be used to measure performance, while bank size is represented by the natural logarithm of total assets (LOGTA). This paper uses , macroeconomic variables such as Gross Domestic Product (GDP), Ave CPI and exchange rate will be employed to measure country economic growth, the level of inflation and the currency fluctuation, respectively. Lastly, Control Variable (used as a dummy variable) will be used to account for the instability of the global financial system caused by the 2007–2009 subprime crisis. In analysis, the control variable (dummy) is denoted by 1 during the crisis period from 2007–2009 and 0 before 2005–2006 and after 2010–2014.

### 4.1. Descriptive Statistics

Table 2 presents information about the descriptive statistics of both the dependent variable and the independent variables. From the table, we observe that the Z-Score, meaning the distance from solvency in the sample, has a mean of 2.8541 and the standard deviation of 3.6786.This indicates that small banks or banks with small market power present lower solvency compared to big banks. The reason for this is that bigger banks tend to securitise more because they have more capital and market power. This also correlates to the theory of Altman and Hotchkiss (2006); according to their studies, a Z-Score ranking above 2.99 is in the healthy safe risk

area. Therefore, this means that the sample banks perform well in terms of the Z-Score classification.

**Table 2. Descriptive statistics**

| | Z-Score | RWATA | SECTA | CAPTAL | ECRWA | LOGTA | GDP | Ave CPI | EXCR | Dummy |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 2.8541 | 0.4591 | 0.0001 | 0.0767 | 0.3962 | 20.4930 | 0.0301 | 0.0555 | -0.0173 | 0.3000 |
| **Median** | 2.8559 | 0.4950 | 0.0001 | 0.0779 | 0.1584 | 20.4642 | 0.0310 | 0.0576 | -0.0335 | 0.0000 |
| **Maximum** | 12.5492 | 0.6887 | 0.0002 | 0.0933 | 2.7973 | 21.3666 | 0.0560 | 0.1004 | 0.1230 | 1.0000 |
| **Minimum** | -7.4862 | 0.0328 | 0.0000 | 0.0529 | 0.1043 | 19.6799 | -0.0150 | 0.0206 | -0.1040 | 0.0000 |
| **Std. Dev.** | 3.6787 | 0.1772 | 0.0000 | 0.0111 | 0.6748 | 0.4006 | 0.0207 | 0.0212 | 0.0698 | 0.4641 |
| **Probability** | 0.4022 | 0.0001 | 0.2936 | 0.3611 | 0.0000 | 0.7212 | 0.2715 | 0.5665 | 0.1496 | 0.0220 |
| | | | | | | | | | | |
| **Sum** | 114.1647 | 18.3636 | 0.0029 | 3.0686 | 15.8473 | 819.7182 | 1.2040 | 2.2212 | -0.6920 | 12.0000 |
| **Sum Sq. Dev.** | 3.6786 | 1.2240 | 0.0000 | 0.0048 | 17.7577 | 6.2602 | 0.0167 | 0.0175 | 0.1899 | 8.4000 |
| **Observations** | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |

Furthermore, by analysing the total assets allocation to different risk categories from Table 2, this work observes RWATA and identifies that it has a mean of 0.4591 and a standard deviation of 1.2240. This indicates that, on average, only 45.91% of the banks 'total assets are exposed to all the risk faced by the bank. With only almost 46% of the bank's assets exposed to different risk. This places banks in the right position to hedge against soft and hard risk in the industry, and leaves room for growth in the bank's books.

### 4.2 Correlation Analysis

A common assumption is that there is an existence of multicollinearity among variables if the correlation coefficient is higher than 0.8 (Kervin, 1992; Gujarati, 2009; Jurczyk, 2011, p. 262; Studenmund, 2011, p. 258). From the correlation analysis in Table 3, this work observes that only RWATA and ECRWA have the coefficient of -0.9023, which is above the norm. Due to the strong correlation between RWATA and ECRWA, these variables cannot be included in the same model. It is observed that other independent variables are weakly correlated, and this allows us to exclude the possibility of overlapping this variable's significance in a multivariate model.

**Table 3. Correlation matrix**

| Correlation Coefficient | Z-Score | RWATA | SECTA | CAPTAL | ECRWA | LOGTA | GDP | Ave CPI | EXCR |
|---|---|---|---|---|---|---|---|---|---|
| **Z - Score** | 1.0000 | | | | | | | | |
| **RWATA** | -0.1539 | 1.0000 | | | | | | | |
| Prob. | 0.3430 | ----- | | | | | | | |
| **SECTA** | -0.0860 | 0.3497 | 1.0000 | | | | | | |
| Prob. | 0.5978 | 0.0270 | ----- | | | | | | |
| **CAPTAL** | 0.3913 | 0.0021 | -0.2571 | 1.0000 | | | | | |
| Prob. | 0.0125 | 0.9897 | 0.1093 | ----- | | | | | |
| **ECRWA** | 0.2250 | -0.9023 | -0.4040 | 0.1670 | 1.0000 | | | | |
| Prob. | 0.1627 | 0.0000 | 0.0097 | 0.3031 | ----- | | | | |
| **LOGTA** | -0.0537 | -0.2025 | 0.1963 | 0.2205 | 0.0020 | 1.0000 | | | |
| Prob. | 0.7419 | 0.2101 | 0.2247 | 0.1716 | 0.9902 | ----- | | | |
| **GDP** | 0.3071 | 0.0478 | 0.2039 | -0.4676 | -0.0121 | -0.3829 | 1.0000 | | |
| Prob. | 0.0539 | 0.7695 | 0.2069 | 0.0023 | 0.9407 | 0.0147 | ----- | | |
| **Ave CPI** | -0.1538 | -0.0378 | -0.2102 | 0.0552 | 0.0019 | 0.3609 | -0.4835 | 1.0000 | |
| Prob. | 0.3435 | 0.8168 | 0.1930 | 0.7350 | 0.9909 | 0.0221 | 0.0016 | ----- | |
| **EXCR** | -0.3975 | 0.1018 | 0.1423 | -0.1439 | -0.1483 | -0.1554 | -0.2258 | -0.3956 | 1.0000 |
| Prob. | 0.0111 | 0.5321 | 0.3809 | 0.3759 | 0.3609 | 0.3384 | 0.1612 | 0.0115 | ----- |
| **DUMMY** | -0.3482 | 0.0565 | -0.0304 | -0.4708 | -0.1165 | 0.0026 | -0.2063 | 0.7101 | -0.0288 |
| Prob. | 0.0277 | 0.7289 | 0.8523 | 0.0022 | 0.4739 | 0.9873 | 0.2015 | 0.0000 | 0.8599 |

## 4.3. Regression Analysis

### 4.3.1. Results of Panel Unit Root Tests

Using the Levin, Lin & Chi (LLC) (2002); Im, Pesaran; Shin (IPS) (2003) and ADF Fisher Chi-square (ADF Fisher) unit root tests, the following hypotheses apply:

Null hypothesis ($H_0$): panel data has unit root

Alternative hypothesis ($H_1$): panel data has no unit root (stationary).

The unit root results are summarised in Table 4. The panel unit root test results for Z-Score, ROE, GDP and EXCR reveals that at level, the LLC model's p-value **is** less than 0.05, and therefore, the null hypothesis is rejected. While the Im, Pesaran and Shin W-stat method and ADF-Fisher Chi-square method p-values are greater than 5%, meaning that the null hypothesis cannot be rejected. This implies that when the models present mixed results; the decision is made by choosing the one with majority results. Therefore, the null hypothesis cannot be rejected at 0.05 significance level, implying that Z-Score, ROE, GDP and EXCR have a unit root at level and are therefore not stationary. This result leads to further tests for stationarity at first difference. When Z-Score, ROE, GDP and EXCR are converted to the 1st difference, all three methods' (LLC, IPS and ADF) p-values at 1st difference are less than 0.05. The null hypothesis is therefore rejected at 0.05 significance level, since all models' p-values are significant at first difference, compared to level. Then, the alternative hypothesis is accepted, meaning that Z-Score, ROE, GDP and EXCR are stationary at 1st difference or I(1).

**Table 4. Panel unit root tests**

| Method | Z-Score | | RWTA | |
|---|---|---|---|---|
| | Level *P-value* | First difference *P-value* | Level *P-value* | First difference *P-value* |
| Levin, Lin & Chut* | 0.0002 | 0.0000 | 0.8267 | 0.0000 |
| Im, Pesaran and Shin W-stat | 0.0602 | 0.2625 | 0.9966 | 0.0746 |
| ADF - Fisher Chi-square | 0.8434 | 0.0652 | 0.9667 | 0.0185 |
| | SECTA | | CAPTAL | |
| | Level *P-value* | First difference *P-value* | Level *P-value* | First difference *P-value* |
| Levin, Lin & Chut* | 0.1049 | 0.0000 | 0.0737 | 0.0000 |
| Im, Pesaran and Shin W-stat | 0.1717 | 0.0503 | 0.8020 | 0.0362 |
| ADF - Fisher Chi-square | 0.1485 | 0.0037 | 0.9144 | 0.0218 |
| | ECRWA | | ROE | |
| | Level *P-value* | First difference *P-value* | Level *P-value* | First difference *P-value* |
| Levin, Lin & Chut* | 0.1613 | 0.0000 | 0.0330 | 0.0000 |
| Im, Pesaran and Shin W-stat | 0.9456 | 0.0000 | 0.7653 | 0.0000 |
| ADF - Fisher Chi-square | 0.6906 | 0.0000 | 0.8465 | 0.0000 |
| | LOGTA | | GDP | |
| | Level *P-value* | First difference *P-value* | Level *P-value* | First difference *P-value* |
| Levin, Lin & Chut* | 0.0000 | 0.0013 | 0.0005 | 0.0000 |
| Im, Pesaran and Shin W-stat | 0.0355 | 0.1455 | 0.2448 | 0.0065 |
| ADF - Fisher Chi-square | 0.0382 | 0.1373 | 0.3113 | 0.0047 |
| | AVE CPI | | EXCR | |
| | Level *P-value* | First difference *P-value* | Level *P-value* | First difference *P-value* |
| Levin, Lin & Chut* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Im, Pesaran and Shin W-stat | 0.0000 | 0.0422 | 0.0997 | 0.0309 |
| ADF - Fisher Chi-square | 0.0000 | 0.0231 | 0.0814 | 0.0228 |

Unit root test for SECTA, CAPTAL, and CRWA reveals that at level all three models' p-values are greater than 5%, meaning the null hypothesis cannot be rejected and that SECTA, CAPTAL, and CRWA have a unit root at level. However, when converted to 1st difference, all three methods' (LLC, IPS and ADF) p-values at 1st difference are less than 0.05. Therefore, the null hypothesis is rejected at 0.05 significance level, as all models' p-values are significant at 1st difference, compared to level. The alternative hypothesis is then accepted, meaning that SECTA, CAPTAL, and CRWA are also stationary at 1st difference or I(1). Lastly, LOGTA and AVE CPI reveal that at level, all three models (LLC, IPS and ADF) methods' p-value is less than 0.05 and therefore, the null hypothesis is rejected and LOGTA and AVE CPI are found to be stationary at level or I(0).

### 4.3.2. Analysis of the Long-Run Relationship

Since all variables are integrated of I(1), with an exception for LOGTA and AVE CPI, which are both integrated at I(0) and I(1), the cointegration test was used to test for the existence of the long-run relationship. The hypothesis test for cointegration is set as follows:

$H_0$: there is no cointegration between variables.

$H_1$: there is cointegration between variables.

Using the Pedroni cointegration test, only six variables are allowed to be tested, as presented in table 5. First, without trend, second, with trend and intercept (but could not formulate results due to fewer observations), and last, with no intercept or trend. Therefore, only Z-Score, SECTA RWATA, ROE, LOGTA, EXCR and ECRWA were tested.

**Table 5. Pedroni cointegration results**

| | *P-value* | *P-value* |
|---|---|---|
| **Common AR coefs. (within-dimension)** | | |
| Panel v-Statistic | 0.9931 | 0.9869 |
| Panel rho-Statistic | 0.9906 | 0.9910 |
| Panel PP-Statistic | 0.0000 | 0.2290 |
| Panel ADF-Statistic | 0.0001 | 0.3951 |
| **Weighted Statistic** | | |
| Panel v-Statistic | 0.9817 | 0.9855 |
| Panel rho-Statistic | 0.9936 | 0.9875 |
| Panel PP-Statistic | 0.0000 | 0.8317 |
| Panel ADF-Statistic | 0.0153 | 0.7776 |
| **Individual AR coefs. (between-dimension)** | | |
| Group rho-Statistic | 0.9995 | 0.9994 |
| Group PP-Statistic | 0.0000 | 0.6117 |
| Group ADF-Statistic | 0.0137 | 0.8373 |

The Pedroni cointegration results in table 5 reveal that data, with no deterministic trend, six tests out of eleven are significant. This means that the decision is based on the majority results, and therefore the Null Hypothesis: no cointegration test is rejected, and the alternative hypothesis: cointegration is accepted. However, when interception and trend are removed, none of the results is significant, and therefore this study cannot reject the Null Hypothesis: no cointegration. Using the Pedroni Residual Cointegration Test, we have tested a limited number of variables, which also gives this study mixed results, and therefore, the study can use the Kao cointegration test. This method allows us to test all the variables. The results of this test are presented in table 6.

**Table 6. Kao cointegration results**

| ADF | t-Statistic | Prob. |
|---|---|---|
| | -2.198783 | 0.0139 |
| Residual variance | 5.056800 | |
| HAC variance | 1.930092 | |

According to the Kao cointegration test, all variables are significant at 0.139, which is less than 0.05, meaning that we can reject the Null Hypothesis: no cointegration, and accept the alternative hypothesis: there is cointegration among variables, meaning that they have a long-run relationship. Therefore, from the Pedroni cointegration test and Kao cointegration test, it can be concluded that the variable is cointegrated and then the cointegrating model, the Fully-Modified OLS model (FMOLS), is estimated.

### 4.3.3. Regression Output Analysis

Due to the high correlation between the variables, namely, RWATA and ECRWA. The regression results omitted ECRWA for both Z-Score and RWATA models.

**Table 7. Regression output (Altman's Z-Score model and RWATA model)**

| Model variables | Z-Score model | | | RWATA model | | |
|---|---|---|---|---|---|---|
| | Coefficient | t-Statistic | Prob. | Coefficient | t-Statistic | Prob. |
| RWATA | -2.663044 | -1.120955 | 0.2718 | | | |
| SECTA | 2776.553 | 0.288005 | 0.7755 | 1558.383 | 2.363045 | 0.0250 |
| LOGTA | -1.326942 | -4.234481 | 0.0002 | -0.021702 | -0.936611 | 0.3567 |
| CAPTAL | 275.8296 | 5.162268 | 0.0000 | 6.019909 | 1.558962 | 0.1299 |
| EXCR | -2.411420 | -0.298163 | 0.7678 | 1.117668 | 1.899739 | 0.0675 |
| GDP | 60.70279 | 1.706786 | 0.0989 | 5.216535 | 2.055060 | 0.0490 |
| Ave CPI | 1.847546 | 0.053586 | 0.9576 | 4.703387 | 1.919339 | 0.0648 |
| ROE | 45.12035 | 3.915898 | 0.0005 | -0.436309 | -0.520645 | 0.6066 |

$R^2$ = 0.748572 and 0.938781 for Z-Score and RWATA respectively.

### 4.4. Discussion of Results

The regression results in Table 7 reflect that the R-squared for both models are higher with values of 0.748572 for Z-Score and 0.9387810 for RWATA respectively; the implication is that 74.86% variation in Z-Score is explained by the

combination of the independent variables. Likewise, 93.87% variation in RWATA is explained by its independent variables.

The bigger the bank, the more credit risk it can take. Holding other things constant, this work expects the relationship between the bank's size and credit risk to be positive because of the bank's economies of scale, studies by Alexiou and Sofoklis (2009) and Iannotta *et al*., (2007) support this view). However, according to table 7, the bank size (LOGTA) results indicate an inverse relationship to Z-Score, with the coefficient of -1.326942 units. The implication is that the bigger the bank, the lower the securitisation ratio and risk-weighted assets. This demonstrates a non-linear effect on size (Athanasoglou *et al*., 2008, p. 133). This also aligns to the view that small banks can realise scale efficiency. The second variable capital coefficient (CAPTAL) exhibits a positive relationship with the Z-Score model, and is statistically significant at 5%, with the value of 275.8296 units, and not statistically significant for the Z-Score model. The implication is that if the banks' capital increases by 1%, the Z-Score will increase by 275.8296 units. These findings refer to Berger (1995, p. l435), who points out that banks with capital below the set bank's equilibrium ratio, may experience relatively high bankruptcy costs. Likewise, Athanasoglou, Brissimis, & Delis (2008, p. 129) assert that the positive relationship may be due to the capital function as a security and safety box for unexpected developments, such as credit risk. However, higher capital increases profitability, and this will offset the equity costs, which gives the bank the ability to provide more loans and thereby increase securitisation, but hedging the risks with the large capital reserves (García-Herrero, Gavilá, & Santabárbara, 2009, p. 2082). Finally, banks have a minimum capital requirement to hold against the risk-weighted assets as set out by the Basel Accord (Iannotta, Nocera, & Sironi, 2007, p. 2127).

One of the vital and significant variables under the Z-Score and RWATA is the economic growth (GDP), with the positive relationship with the Z-Score and RWAT, the coefficients are 112.8191 units and 5.216535 units, respectively. The implication is that as the economic growth increases by 60.70279 units, the Z-Score will also be increased by 60.70279 units, while RWATA will increase by 5.216535 units. Generally, poor economic conditions have a negative effect on the bank's loan portfolio, causing credit loss and increasing capital reserves to be held by the bank. In contrast, improvement in economic growth, borrower's efficiency and solvency improve the loan (credit) demand, and this has a positive effect on the bank's bankruptcy position and lowers credit risk (Athanasoglou *et al*., 2008). Instejford (2005) and Wagner (2007) assert that higher capital, combined with a booming economy, reduces the credit risk on the bank's books. However, this risk reduction creates possibilities for the bank to take on more risk. Studies observing the economic growth effect on the bank's credit risk include Athanasoglou *et al*., 2008; Bikker & Hu, 2002; Demirguc-Kunt & Huizinga, 2000; and Dietrich &

Wanzenried, 2011. Likewise, Albertazzi and Gambacorta (2009, p. 395) found that the economic cycle affects the interest rate income and loan provisions.

The securitisation coefficient (SECTA) exhibits a positive relationship with the RWATA model, with the value of 1558.383. This means that if securitisation increases by 1558.383, RWATA will also increase by 1558.383 units. This supports the findings of Gorton and Pennacchi (1995), which mention that more securitisation leads to more funding options and more capital reserves.

In addition, the coefficient of the exchange rate and inflation (CPI) exhibits a positive relationship with the RWATA model, with coefficient values of 1.117668 and 4.703387 units, respectively. This indicates that an increase in the exchange rate and CPI will increase RWATA by 1.117668 units for exchange rate and 4.703387 units for CPI units. This represents a linear relationship between RWATA and exchange rate and inflation. Revell (1979), who found that inflation affects borrowers' salaries and bank costs, introduced the relationship between inflation, credit risk, and profitability. Similarly, Perry (199, p. 26) states that the effect of inflation is dependent on the anticipation level. If fully anticipated, both banks and households are able to adjust their resources. Further studies on inflation effects include those of Alexiou & Sofoklis, 2009; Athanasoglou *et al*., 2008; García-Herreto *et al*., 2009; Kasman, Tunc, Vardar, & Okan, 2010 and Pasiouras & Kosmidou, 2007.

The final observation from these results is that return on equity (ROE) is also the significant variable to explain the variations in the Z-Score model, with the coefficient value of 45.12035 units. The implication of this is that a combination of capital and good economic conditions, which direct us to a proper policy coordination, will improve South African credit risk and the securitisation market.

## 5. Conclusion and Recommendations

This paper has empirically investigated the relationship between securitisation and credit risk in South Africa. A pooled analysis, using the panel data analysis of four major banks in South Africa, was tested for the period, 2005 to 2014. Two regressions were performed; first, to analysis the relationship between securitisation and bank stability, using the Altman's Z-Score model, and second, allocation of assets between different categories of risks faced by a bank. The regression results reveal that capital and economic growth are both significant when explaining the relationship between securitisation and credit risk. For the second regression, bank size and capital are significant when explaining the contribution to the allocation of banks' assets in different risk categories.

The results reveal that there is an increase in credit risk when banks securitise more loans. Moreover, the size of the bank plays an important role in securitisation,

credit risk taking and risk-weighted assets kept by the bank. The implication of this is that the bank size explains the increase in securitisation and risk taking by banks. This supports the study of size-credit risk relevant hypothesis. In general, the results from both regressions reflect that capital influences securitisation positively and eventually affects the South African banking stability positively. This means that the South African banking system is still sound and healthy because of its good and strong capital structure and banking regulations.

In light of these findings, the following recommendations are made: banks should increase or maintain an acceptable level of capital to hedge against any unexpected risks. Proper systems should be established to encourage the repayment of loans by borrowers, and proper policy coordination by policy authorities should play a key role in limiting credit risk, securitisation and solvency risk. During the course of this paper, the following topics were identified for future research on the topic:

- The effects of macroeconomics on credit risk;
- Securitisation effects on credit risk: the use of credit spreads;
- Credit risk and liquidity risk: the case of South Africa;
- Contemporary credit risk modelling: a guideline for South African banks.

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# Competition and Stability of Sub-Saharan African Commercial Banks; a GMM Analysis

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**Abstract:** Competition and stability relationship have continued to be debated around the world with mixed results. Our mission is to test how this relationship subsist in SSA region commercial banks in the light of competition-stability and competition-fragility views using the generalised Methods of moment. We studied 440 commercial banks in 37 SSA countries over the periods of 2006-2015. The results provide evidences that support competition-fragility views over the study periods in the SSA region as we found Lerner index, our competition measure and score, the stability measure to be consistently strong and negatively related over the static and dynamic regression analysis that we carried out. While competition may be good as argued, and found in some other quarters, the policy implication of this study is for policy makers, regulators and practitioners alike to tread with caution in dealing with issues of competition given its potential to destabilise the system.

**Keywords:** Competition; Stability; Generalised Method of Moments; Commercial Banks

**JEL Classification:** G29

## 1. Introduction

A lot has been done in literature on the relationship between competition and stability. Yet not much have been done on this in Africa let alone the Sub-Sahara Africa region whether on regional or individual country basis[3]. Theoretical propositions argue competition affects stability of banks both through the charter value and the franchise value, but are far from reaching consensus regarding the direction of relationship. However, the main line of arguments has been across two divides; that competition could be good or bad for the banking system. It is good where competition enhances stability of the system, hence the competition stability view argument. On the other hand, competition is bad if its leads to distress in the banking sector thereby causing the system to fail, this is in line with competition-

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[3] See (Léon, 2015).

fragility views that argued that competition heightens banks incentives to take more risk which in turn threatens the stability of the system. Yet another view which is now gaining momentum in literature is the non-linear relationship between competition and stability theoretically modelled by Boyd and De Nicolo (2005) and have found in empirical literature[1].

The SSA region is underdeveloped and confronted with abject poverty. The financial system that is dominated by the banking system is also being nurtured. Given that competition in the banking system has the potential to drive other sectors of the economy, increase access to finance that could spur economic growth and improve on the lots of the region, there was the debate about increasing competition in this sector. While empirical work has chartered the course of dealing with issue of competition and especially as its borders on systemic stability in most regions of the world, no such work has focused on this region. This is the gap that this study wants to fill.

The study therefore contributes to extant literature in two ways. Firstly, we use large datasets of commercial banks in 37 SSA region countries to test competition and stability relationship. This is the first of its kind. Again, based on the agitation for increasing competition in SSA region, this paper provide evidence to guide policy maker in dealing issues of competition and stability relationship. Our results thus provide evidence that support the competition fragility views over the study period as we found negative and significant relationship between competition, surrogate by Lerner index and stability rep- resent by z-score, consistently over the static and dynamic models. This provides a bit of caution for policy makers in dealing with issues of competition and stability in SSA region. Fu et al 2014 provided evidence to show that the recent financial crisis is a problem of excessive competition in the banking system.

Going forward, the study is structured to capture the review of related literature that include both theoretical and empirical framework in Section 2. In Section 3 are contained the various methods adopted to arrive at the results in Section 4. While Section 5 concludes.

## 2. Literature Review

There is deluge of theoretical and empirical evidences on the relationship between competition and stability around the world. Yet specific literature telling the SSA region part of the story have been wanting. The perception about the relationship between competition and stability in the banking system align with the industry disposition and dated back to the periods of the great depression[2]. These periods up

[1] See (Tabak, Fazio, and Cajueiro (2012); Berger, Klapper, and Turk-Ariss (2009), among others).
[2] See (Vives, 2016).

until the 60'5 in the US and 80's in the EU were characterised by the feelings that competition was inimical to the stability of the banking system and the systemic well-being as whole and hence saw a complacent regulators and practitioners preferring collusion and/or a concentrated banking system. The fact that competition might mean allocative efficiency that could help the stability of the system heralded the change in this trend that procreated the waves of liberalisation that took place in the industry to induce competition. This pattern continued until the recent financial crisis of 2007-2009 of which Africa was not left out as since in the 80s structural adjustment programs were implemented across SSA as a hallmark for liberalising the banking system and putting an end to indigenisation policies that characterised the nations after their independence. The financial crisis however brought a mix feelings as per the role of competition in bringing about the crisis and in some quarters the crisis was blamed on liberalisation and excessive competition in the sector (Fu, Lin, & Molyneux, 2014).

The perception of theories of theories on competition stability views relationship emphasis competition been responsible for excessive risk-taking of banks in the loan market culminating to the probability of individual bank run and eventual failure[1]. The dominance of the assumption in conventional theories that solving banks portfolio problem determined by the allocation of banks assets have in recent literature provide plausible evidences of the likelihood of competition been favourable to their risk portfolio. It follows that in a competitive banking markets, banks face the temptation to offer higher rates in the deposit market while neglecting competition in the loan market thus causes earnings to decline. And so, banks more often than not have no further options than to take on more risky investments to compensate for the lost incomes. Conversely, when faced with competition restrictions, banks arrogate market power with the propensity to charge higher deposit rates with it attendant high profits. The tendency is that markets become uncompetitive with banks overly reluctant to invest in projects that will fetch them as much returns as in the deposit market, hence the probability of banks failure becomes low if not impossible. Other theoretical models; Matutes and Vives (1996) argued bank's fragility is the result of depositors' expectation and not necessarily due to competition in the market, Matutes and Vives (2000) argued more on the effects of regulation and nature of deposit insurance as the main drivers of risk-taking attitude of banks, this is also the position of Allen (2004) even though Niinimäki (2004) believes that the effects of deposit insurance of risk taking depends on the market side competition is taking place. Theory modelling competition on both sides of the statement of financial assumes the main preoccupation of banks is solving the optimal contraction problem. Boyd and De Nicolo (2005) in their work on theory of bank risk-taking and competition argue portfolio problem is transformed to contraction problem in the face of moral hazard

[1] See (Casu, Girardone, & Molyneux, 2012).

concluding on competition stability view. A non-linear relationship was concluded by Martinez-Miera and Repullo (2010) between competition and stability in banks. They argued that's Boyd and De Nicolo (2005) competition-stability view may not hold when loan defaults are imperfectly correlated. That intense competition may result in risk- shifting effects, reduce borrowers' default probability but result in margin effects, that is, reduce interest payment from performing loan that should serve as buffer against loan losses. Measuring competition by the number of banks, they found competition to have a U-shaped relationship with bank stability. Their position was that, risk-shifting effects dominates more concentrated markets such that risk is reduced with competition; while margin effects is associated with highly competitive markets that erode banks' franchise values in an increased competitive environment hence increase risk.

Empirical reviews align with the perspectives of theories providing evidences that support mixed results in individual and cross country studies. US banks studies found both stability (Akins, 2014) and fragility (Hussain & Hassan, 2012; Rhoades & Rutz, 1982). Results of studies in European banking markets found evidences that majorly support stability views, see (Schaeck & Cihak, 2012; Uhde & Heimeshoff, 2009) among others except Liu, Molyneux, and Wilson (2013) that found a non-linear relationship. In Asian countries studies; Fu et al. (2014) found fragility while Soedarmono, Machrouh, and Tarazi (2013) support stability. Works in Latin America; Tabak et al. (2012) – non-linear relationship and Yeyati and Micco (2007). Individual countries evidences reviewed include Spanish Korean and Japanese banking sectors for which the authors came to ambiguous conclusions[1]. Studies that were also conducted on cross continental basis had similar conclusions[2]. The only African studies related to competition stability relationship found fragility (Kouki & Al-Nasser, 2014). Most of these studies adopted Z-score, distance-to-failure as stability measure and lerner index, H-statistics and concentration ratios as competition measures. In summary, there is no straight answer for competition and stability relationship as shown by evidences around the world. Apart from pockets of empirical works that incorporated a number of African countries which peradventure will include some SSA region we have found no studies dedicated to study this case in SSA region and on commercial banks in particular as they account for the largest shares of market and assets of the SSA financial sectors that burdened with underdeveloped capital market. It is this gap that this study is out to fill especially at a point when policy makers are out to stimulate competition in the region's banking sectors as a catalyst to drive economic growth.

[1] See (Jeon & Lim, 2013; Jiménez, Lopez, & Saurina, 2013; Liu & Wilson, 2013).

[2] See (Agoraki, Delis, & Pasiouras, 2011; Amidu, 2013; Berger et al., 2009; Boyd, De Nicoló, & Jalal, 2009) among others.

## 3. Methodology

Extant literature has employed various methods to investigate the relationship between competition and stability in the banking system. Notable among these methods are OLS[1]; fixed and random effects regression (Anginer, Demirgüç-Kunt, & Zhu, 2013; Hussain & Hassan, 2012), among others) and tobit model (Ariss, 2010). Others include logit model and duration analysis (Schaeck, Cihak, & Simon, 2009), probit regression (Marques-Ibanez, 2014), 2SLS (Soedarmono et al., 2013), granger causality (Fiordelisi & Mare, 2014) and GMM (Berger et al., 2009; Boyd et al., 2009) among others). Each of this method have their merits and demerits, however we are employing the robust system GMM for this study because of its ability to deal with endogeneity issues that is inherent in the regression of stability on competition. This makes our study different from Kouki and Al-Nasser (2014) who studied the implication of market power on stability in Africa with fixed effects regression that does not account for endogeneity. Based on the literature reviewed and for wants of data in the study area, we are surrogate Lerner index for competition and z-score for stability. Lerner index is best at measuring bank level competition which makes it a better choice for the study and the fact that it has strong theoretical basis. Z-score has wide application in literature and it measures the overall stability of the banking sector incorporating most risks that banks may face.

This studies thus pooled together cross-sectional time series data of the sampled banks in the SSA countries under consideration using GMM. The choice of panel data analysis is informed by the benefits that the technique offers to the study. According to Baltagi (2008), panel analysis accommodates the creation and analysis of more difficult behavioural models. Moreover, the technique provides for additional degree of freedom, efficient when compared to time series and cross-sectional data and offers more explanatory analysis. Panel analysis generally meant more variability, fewer collinearity and controlled heterogeneity within individual data[2].

### 3.1. Generalised Method of Moments

The implementation of the regression of the relationship between competition and stability in the SSA region commercial banks is done using the Generalized Method of Moments (GMM) regression. The prevalence of individual cross-sectional data over–time have resulted in the development and the increase in the popularity and/or acceptability of panel data techniques. This no double has ignited the application of dynamic panel data (DPD) that allows finance and economics experts alike to accommodate individual dynamics in their studies. At the same time, the inclusion of lagged endogenous variables in a model where individual

[1] See (Akins, Li, Ng, & Rusticus, 2016) among others).
[2] See (Baltagi, 2008).

effects may be present pose a problem of dynamic panel bias (DPB). Regrettably, the conventional DPD estimators like; first difference, pooled OLS, GLS, among others are inefficient in handling DPB, hence the use of instrumental variables was proposed to alleviate the issue of endogeneity in the lagged endogenous variables. In addition, it is a normality free regression technique, having great adaptability and data generating process assumptions with dependent variables been instrumented by their lagged variables.

Modelling the relationship between the competition and stability of the commercial banks in SSA region with the following linear dynamic panel model;

$$\Gamma_{it} = \rho_1 \Gamma_{it-1} + x_{it}\rho + E_{it} \quad (3.1)$$

Where $i = 1, 2, \cdots, N$, $t = 1, 2, \cdots, T$, $x'$ is a $(1 \times \kappa)$ vector of explanatory variables, $\rho$ is a $(\kappa \times 1)$ vector of coefficients to be estimated and $Eit = \gamma_{it} + \psi_{it}$; where, $\gamma_{it}$ denotes the individual fixed effects capturing individual differences of the cross–sections (banks in the sample), and $\psi_{it}$ is the idiosyncratic term such that $\gamma \sim iidN(0, \delta_\gamma^2)$, $\psi \sim iidN(0, \delta_\psi^2)$,assuming that;

$$E[\gamma_{it}] = [\gamma_{it}\psi_{it}] = 0 \quad (3.2)$$

Since $\Gamma_{it}$ brings up *DPB* given that $\gamma_{it}$ is correlated with $\Gamma_{it}$, it therefore follows that, if $\Gamma_{it}$ is a function of $\gamma it$, then $\Gamma_{it-1}$ will also be a function of $\gamma it$ making one of the explanatory variables to correlate with one of the composed error terms thus given rise to endogeneity problem.

*OLS* could not be used to estimate *equation (3.2)*. This is because the correlation between $\Gamma it-1$ and $Eit$, in other words, $E[\Gamma it-1, Eit] > 0$, leading to overestimation of $\rho 1$ and so the result with be bias upward as well as inconsistent. One way to fix this endogeneity bias is to remove the individual fixed effects through data transformation. Another way is to look for a valid instrument of the lagged endogenous variable. For the purpose of simplicity, let's assume a model of competition and stability relationship with just one regressor;

$$\Gamma_{it} = \rho_1 \Gamma_{it-1} + E_{it} \quad (3.3)$$

Taking one more lag from equation (3.3) will remove individual fixed effects;

$$\Gamma it-1 = \rho 1 \Gamma it-2 + Eit-1 \quad (3.4)$$

This gives;

$$(\Gamma it - \Gamma it-1) = \rho 1(\Gamma it-1 - \Gamma it-2) + (\gamma i - \gamma i) + (\psi it - \psi it-1) \quad (3.5)$$

Therefore;

$$\Delta\Gamma it = \rho 1 \Delta\Gamma it-1 + \Delta\psi it \quad (3.6)$$

Where $\Delta = (1 - L)$ represents the first difference operator. The problem with the transformation is the loss of degree of freedom as T first–period observations is

dropped which could pose a serious challenge for unbalanced panel data. Notwithstanding, in the views of Griliches (1998) the first differencing transformation is able to get rid of the individual effects. The transformation has also MA(1) for Δψit given the assumption of ψ ~ iidN (0, δ2 ). This hence requires the application of GLS that is anle to transform data by means of subtracting the time averaged model from equation (3.1);

$$\bar{\Gamma}_i = \rho_1 \bar{\Gamma}_{t-1} + \bar{\gamma}_i + \bar{\psi}_i \qquad (3.7)$$

So that the transformed model becomes;

$$(\Gamma_{it} - \bar{\Gamma}_i) = \rho_1(\bar{\Gamma}_{t-1} - \bar{\Gamma}_{i,-1}) + (\gamma_i - \gamma_i) + (\psi_{it} - \bar{\psi}_i) \qquad (3.8)$$

In equation (3.8), $(\Gamma_{it} - \bar{\Gamma}_i)$ is regressed on $(\bar{\Gamma}_{t-1} - \bar{\Gamma}_{i,-1})$ using OLS within group estimator. Although within group estimator manages to eliminate individual effects, per Nickell (1981), it is inconsistent due to its inability to deal with dynamic panel bias. Thus, makes first difference conversion a better approach than the within group conversion in resolving endogeneity issues. For instance, in the first difference transformation, on previous error term realised is included in the model, meanwhile, in within group conversion, all preceding realisations are incorporated into the model. For this reason, all OLS estimators are unable to resolve dynamic panel bias and therefore require an alternative approach.

The works of Anderson and Cheng (1982) among others, argued that the failure of the OLS estimator in dealing with the issues arising from the dynamic panel bias orchestrated the popularity that instrumental variable estimator gained in literature. Equation (3.6) requires instrumental variable estimator for implementation since the first difference conversion is unable to recover consistency with the application of OLS estimator. To deal with this, Anderson and Cheng (1982) proposed a two stage least square (2SLS) approach that is able to utilise the first difference transformation to eliminate the fixed effects, as well as employ the lags of the explained variable to instrument the transformed lag endogenous variable. The essence is that, since Γit, a component of ΔΓit−1 is correlated with Eit−1 which is also contained in ΔEit, then the deeper lags of the explanatory variables are not correlated with the error term, as such could be used as instrument. Anderson and Hsiao (1981) proposed Γit−2 to be used as instrument for ΔΓit−1 because it is correlated with Γit−1 − Γit − 2 but orthogonal to ΔEit if error terms are assumed not to be serially correlated. Be that as it may, 2SLS does not utilise all the valid instruments available, thus suffers similar setback as the OLS - not efficient.

Consequently, the generalised method of moments GMM proposed by Arellano and Bond (1991) is applied to efficiently and consistently estimate the relationship between competition and stability of SSA region commercial banks in equation (3.1). GMM can take equations both in first difference and in levels with its specific sets of instrumental variables. To deal with banks specific effects, first difference is taken as in equation (3.5) and the utilisation of the appropriate lag

instruments needed resolves the issues of the correlation between Γit − Γit−1 and ψit − ψit−1. The same approach is deployed to generate instruments for other regressors that are permitted to be dependent on the past and the current realisation of the explained variable. Given the assumptions that regressors are weakly exogenous and that the error term is devoid of serial correlation, dynamic GMM employs the following moments conditions;

$$E[\Gamma_{i,jt-s} \cdot (\mathbb{E}_{i,jt} - \mathbb{E}_{i,jt-1})] = 0 \quad for\ s \geq 2,\ t = 2, \cdots T \qquad (3.9)$$

$$E[\chi_{i,jt-s} \cdot (\mathbb{E}_{i,jt} - \mathbb{E}_{i,jt-1})] = 0 \quad for\ s \geq 2,\ t = 2, \cdots T \qquad (3.10)$$

The outcomes of the above moments of condition produces the first difference GMM. One major drawback associated with this is that, where the lagged endogenous variables and the regressors are persistent overtime, there is every likelihood that the lagged levels may be weak instrument for the first differenced variables. Hence, amount to finite bias with reduced accuracy culminating to the need to regress at levels as well to complement the regression at the first differences. The lagged first differences instrument the regression in levels of the same variables. So that additional moments of condition for the regression in levels are as stated below.

$$E[(\Gamma_{i,jt-s} - \Gamma_{i,jt-s-1}) \cdot (\gamma_i + \mathbb{E}_{i,jt-1})] = 0 \quad for\ s = 1 \qquad (3.11)$$

$$E[(x_{i,jt-s} - x_{i,jt-s-1}) \cdot (\gamma_i + \mathbb{E}_{i,jt-1})] = 0 \quad for\ s = 1 \qquad (3.12)$$

We however applied the orthogonal deviation of Arellano and Bover (1995) which Roodman (2006) argues to be more applicable in the case of an unbalanced panels with pockets of missing data. To be consistent, the instrument of the GMM regressors must be valid. This is verified through the Hansen J statistics in a robust estimation[1]. Also, test of serial correlation among the error terms is required for a valid GMM results. Arellano-Bond test for serial correlation assumes no serial correlation and its applied to the differenced residuals. Once the null hypothesis is acceptable order two, inferring the absence of serial correlation, the study will then employ corresponding moment of conditions.

To estimate the relationship between competition and stability of SSA region commercial banks therefore we employ the following estimation equation;

$$Z_{kit} = \beta_{kit} + Z_{kit-1} + \pi_{kit} LI_{kit} + \zeta_{kit} \Sigma X_{kit} + \xi_{kit} \qquad (3.13)$$

Where $Y_{kit}$ measures the stability for bank i in country *k* at year *t*. $\beta_{kit}$ is a constant; $\pi_{kit}$ is the coefficient of competition measure, *LI*, for *k*s regression in year *t*; $\zeta_{kit}$ is the coefficient of the vector of bank specific variables and other macroeconomics/non-financial variables; $\xi_{kit}$ is the error term.

### 3.2. Data and Variable Description

[1] See (Mileva, 2007).

Data for this study were mainly sourced from BankScope that is considered to house the most comprehensive database on banks. We employed an unbalanced panel of 440 commercial banks from 2006 to 2015 to account for entry and exit and also cater for periods of data unavailability. The focus on commercial banks ensure uniformity in our choice of banks as quite a good number of other deposit money banks still enjoy government support at one time or the other. Data requirement for the estimation of lerner index, competition variable that were collected include personnel expenses, total assets, total revenue, interest and non-interest expense, fixed assets and total deposits. For stability measure, Zscore, we collected equity capital ratio (ECR) and return of assets (ROA). Other data collected include Return on equity (ROE), pre-tax income, GDP annual growth rate and corruption perception. The GDP annual growth rate is available from WDI of World Bank while corruption perception is from Transparency International. We followed literature in carefully selecting the combination of variables that are used in this study. We limit our measure of stability to Zscore[1] in this study for want of comprehensive data of non-performing loans on commercial banks. This study follow the procedure for computation of lerner index as contained in (Kouki & Al-Nasser, 2014).

## 4. Empirical Results

We present the results of the relationship between competition and stability of SSA countries commercial banks in this section. Competition is measured using Lerner index that has the ability to capture bank level market power. We surrogate stability with Zscore. Zscore has been used in literature as a stability test for banks and banking sector stability, measured based on banks performance in terms of employed in ration to their capital. Ongoing results in literature provide evidences that competition may be good or bad for the banking sectors. Specifically, empirical works have supported stability and fragility of banking sector due to competition. Most of this debates have largely been domiciled in the advanced world of US and Europe with pockets of literature in emerging markets like China. We do not expect the SSA commercial banking markets to behave differently, more so with the level of development in the region, and the recent crisis5 that have been partly blamed on excessive competition. To this end, we hypothesis that competition may have contributed significantly to such instability in this part of the world6. In the next three subsections are the summary statistics providing insight to the data used in this study, the correlation results which though not an econometrics analysis, gives a precursor to what the econometrics analysis might be, and finally the regression analysis results.

### 4.1. Summary Statistics

[1] See (Agoraki et al., 2011; Amidu, 2013), among others.

**Table 1. Summary Statistics**

| | Lerner Index | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| year | No | mean | SD | min | max | zscore | size | eqcapratio | roa | roe | pbtarratio | GDPG | cop |
| 2006 | 190 | 0.2556606 | 0.165618 | 0.0006262 | 0.8370308 | 3.54343 | 11.96434 | 0.1611557 | 0.0204855 | 0.1933219 | 0.02701566 | 0.0693923 | 28.78161 |
| 2007 | 215 | 0.2693673 | 0.155672 | 0.0128989 | 0.7842373 | 3.204579 | 12.19327 | 0.1441192 | 0.0181973 | 0.1962862 | 0.02363996 | 0.0704574 | 29.44335 |
| 2008 | 250 | 0.2884124 | 0.1773142 | 0.0109381 | 9.67E-01 | 3.380152 | 12.2133 | 0.1568832 | 0.0205531 | 0.1795552 | 0.02543396 | 0.0546536 | 30.75527 |
| 2009 | 275 | 0.293903 | 0.1883627 | 0.010171 | 9.21E-01 | 3.28502 | 12.33728 | 0.150284 | 0.0140424 | 0.1480773 | 0.01931126 | 0.0389074 | 30.37308 |
| 2010 | 296 | 0.2959355 | 0.182933 | 0.0003647 | 9.79E-01 | 3.273991 | 12.3817 | 0.1563837 | 0.009863 | 0.1317374 | 0.0142714 | 0.0631269 | 29.61176 |
| 2011 | 320 | 0.2821636 | 0.1727403 | 0.0029686 | 9.77E-01 | 2.988873 | 12.57774 | 0.139725 | 0.0116463 | 0.1232481 | 0.0151931 | 0.0585695 | 30.81787 |
| 2012 | 357 | 0.3237032 | 0.1944634 | 0.00499 | 9.98E-01 | 3.235099 | 12.59943 | 0.1542496 | 0.0133897 | 0.1158373 | 0.01711386 | 0.0583529 | 34.54573 |
| 2013 | 392 | 0.3520863 | 0.314314 | 0.0000355 | 9.26E-01 | 3.403835 | 12.6364 | 0.170136 | 0.0116615 | 0.08695642 | 0.01574 | 0.0580944 | 34.6199 |
| 2014 | 430 | 0.3318136 | 0.1854892 | 0.0003017 | 9.96E-01 | 3.624344 | 12.58567 | 0.1810446 | 0.0106149 | 0.07606974 | 0.01365774 | 0.0521768 | 34.92326 |
| 2015 | 440 | 0.3243521 | 0.1964074 | 0.0005727 | 9.96E-01 | 3.484 | 12.61072 | 0.1704147 | 0.0110423 | 0.06922351 | 0.01528944 | 0.0399826 | 34.42263 |

*Authors' computation, 2017*

In Table 1 is the summary statistics. This is to provide an insight into the nature of data used in the study. The four columns immediately to the right of the first two columns in the table relates exclusively to the competition measure. Lerner index is a measure of market power that range from 0 to 1, with indices close to 1 signifying high market power and/or low degree of competition/concentration in the banking sector. Banks at this end of the markets are said to be oligopolistic or at the extreme, monopoly. Whereas, indices close to zero denotes low market and/or high competition, with banks either competing in monopolistic banking market or faced with perfect competition7. We found market power to range almost between 0.355E-04 in 2013 and 0.998E-01 in 2012 giving the minimum and the maximum indices across the 440 banks considered over the study period of 2006 - 20015. This momentarily suggest a mixture of high and low market power. However, further analysis by the mean and the standard deviation suggest a highly competitive commercial banking sector having mean of market power that are below 0.50. The means are closer to the minimum than the maximum in all the years considered and the standard deviation substantiated our claim by not been fundamental far from the mean. The other parts of the Table are the mean of Zscore suggesting a rather stable sector; size, representing the log of total assets used as a control variable; equity capital ratio, which is the ratio of capital to total assets and most times used to denote regulatory capital; return on assets, return on equity and pre–tax income to total assets ratio, as performance measures. Others include the means of GDP annual growth and corruption perception.

### 4.3. Econometrics Analysis

We regressed stability on competition and provided other variables as contained in literature to explain the stability of the commercial banking sector in the SSA region. We also provide the correlation results among variables in Table 2. Our main objective is to measure the impact of competition on stability in SSA Commercial banks. The essence of the other variables is to also look at other factors that may also impact on stability and so the emphasis will be on competition and stability relationship.

**Table 2. Correlation Result**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| zscore & lerner index | -0.1346 | -0.2072 | -0.0259 | -0.0098 | -0.3066 | -0.3131 | -0.2533 | 0.0038 | -0.0681 | -0.0174 |
| p-value | 0.0640 | 0.0023 | 0.6834 | 0.8715 | 0.0000 | 0.0000 | 0.0000 | 0.9409 | 0.1586 | 0.7166 |
| zscore & size | -0.4253 | -0.2936 | -0.3279 | -0.2966 | -0.1474 | -0.0913 | -0.1588 | -0.2291 | -0.3007 | -0.2238 |
| p-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0111 | 0.1031 | 0.0026 | 0.0000 | 0.0000 | 0.0000 |
| zscore & eqcapratio | 0.9478 | 0.9480 | 0.7938 | 0.8324 | 0.8105 | 0.8167 | 0.6661 | 0.5692 | 0.6157 | 0.6990 |
| p-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| zscore & roa | 0.1778 | 0.2587 | 0.3241 | 0.1765 | 0.3096 | 0.5014 | 0.3173 | 0.2496 | 0.3083 | 0.5687 |
| p-value | 0.0141 | 0.0001 | 0.0000 | 0.0033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| zscore & roe | 0.0650 | -0.0466 | 0.0490 | 0.0224 | 0.1126 | 0.0175 | 0.0990 | 0.0958 | 0.0883 | 0.0895 |
| p-value | 0.3751 | 0.4991 | 0.4443 | 0.7131 | 0.0546 | 0.7564 | 0.0621 | 0.0585 | 0.0683 | 0.0608 |
| zscore & pbtaratio | 0.0860 | 0.1767 | 0.2094 | 0.0805 | 0.1910 | 0.3483 | 0.0821 | 0.1303 | 0.0589 | 0.4823 |
| p-value | 0.2383 | 0.0094 | 0.0009 | 0.1831 | 0.0010 | 0.0000 | 0.1215 | 0.0098 | 0.2229 | 0.0000 |
| zscore & cop | 0.1158 | -0.0587 | 0.0541 | -0.0115 | 0.0865 | 0.0918 | 0.0448 | 0.0889 | 0.1023 | 0.1291 |
| p-value | 0.128 | 0.4057 | 0.4073 | 0.8541 | 0.1685 | 0.1183 | 0.4186 | 0.0789 | 0.0339 | 0.0071 |
| zscore & GDPG | -0.0215 | -0.0165 | -0.0713 | 0.0853 | 0.0069 | 0.0532 | -0.0787 | -0.0177 | -0.1646 | -0.0532 |
| p-value | 0.7701 | 0.8102 | 0.2613 | 0.1582 | 0.9065 | 0.3427 | 0.1379 | 0.7262 | 0.0006 | 0.2772 |

*Authors' estimation, 2017*

Although we had provided some motivation for using dynamic panel data analysis in this study via GMM, we still however, begin this analysis from the standpoint of static to dynamic analysis, hence the presentation of OLS, fixed effects (FE) and random effects (RE) model results as contained in Table 4 and the outcome produced a rather interesting result. The dynamic panel model employs the robust two-step system GMM with orthogonal deviation, the results displayed in column 4 of Table 3. This has been proven to resolve panel data bias with the ability to handle unbalanced panel data analysis. we found the lagged value of ZSCORE to be positive

**Table 3. Regression Results**

| | OLS Model zscore | FE Model zscore | RE Model zscore | GMM Model zscore |
|---|---|---|---|---|
| VARIABLES | | | | |
| L.zscore | | | | 0.394*** |
| | | | | -0.117 |
| li | -0.0322*** | -0.00904*** | -0.0105*** | -0.0260*** |
| | (0.00562) | (0.00303) | (0.00305) | (0.00887) |
| lnabv | -0.209*** | -0.350*** | -0.322*** | -0.0971 |
| | (0.024) | (0.0404) | (0.0339) | (0.106) |
| eqcapratio | 10.34*** | 12.58*** | 12.08*** | 7.950** |
| | (0.199) | (0.201) | (0.189) | (3.701) |
| roa | 26.93*** | 15.28*** | 16.42*** | 30.02*** |
| | (1.37) | (1.084) | (1.043) | (8.931) |
| roe | -0.00263*** | 0.000187 | 0.000108 | -0.00252 |
| | -0.000995 | -0.000571 | -0.000566 | -0.00197 |
| pbtaratio | -5.531*** | 6.163*** | 4.945*** | -18.21*** |
| | (1.335) | (1.045) | (1.008) | (6.635) |
| cop | 0.0141*** | 0.0171*** | 0.0163*** | 0.00870* |
| | (0.00344) | (0.00539) | (0.00468) | (0.00487) |
| gdpg | -0.462 | -0.514 | -0.476 | -0.112 |
| | (0.932) | (0.51) | (0.509) | (0.519) |
| Constant | 3.626*** | 4.845*** | 4.650*** | 1.589 |
| | (0.329) | (0.471) | (0.42) | (1.376) |
| Observations | 2,955 | 2,955 | 2,955 | 2,552 |
| R-squared | 0.612 | 0.727 | | |
| Number of id | | 438 | 438 | 425 |
| Wald (chi2) | | | | 1030.31 |
| *Prob > chi*2 | | | | 0.000 |
| AR2 | | | | 0.136 |
| Hansen J Stat. | | | | 0.522 |

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

and significant signifying that stability in the past periods has a considerable effect in ensuring current period stability. In fact, it has an impact of up to 0.3% on the current banking stability. Similar to the two previous models, competition as

measured by Lerner index is has inverse but significant relationship with stability. In other words, if competition increases, stability goes down. EQCAPRATIO, ROA and COP are also consistent with previous models as the coefficients that are significant and positive with stability reiterating the fact that banks capital base, return on assets and corruption signalling effects are important determinant of bank stability. Our results in terms of stability and capitalisation relationship therefore does not support Kouki and Al-Nasser (2014) that found capitalisation as not only insignificant with ZSCORE but also negative. Unlike the fixed effect model, ROE is negative but not significant, PBTARATIO is significantly negative showing consistency with the OLS result. Again, GDP annual growth shows no significant and negative relationship with stability, this is consistent across the three models.

Given that the robustness of the panel data estimation, our discussions on economic implication will be based on the GMM results. To begin with, the persistent, positive and significant relationship of stability in the immediate past period with the present reflects the fact that stability in the past is fundamental for the current and future periods stability. This is a wakeup call for an unrelenting effort in ensuring a stable banking environment at all time for the smooth running of the monetary economic system as in the words of Vives (2016), the banking system is so pivotal to an economy to the extent that the modern monetary economy stops functioning with bank failure. That been said, this study found a negative and significant relationship between ZSCORE and LERNERI. In other words, stability is negatively related to competition as measure by the Lerner index in the SSA region commercial banks. We had reported a monopolistic competitive banking market given the outcome of the commercial banks' market power computation in the SSA region. This result suggests that competition is associated with instability and consistent with the competition fragility view of Yeyati and Micco (2007) in a study of 8 Latin American countries between 1993–2002; Beck, De Jonghe, and Schepens (2013) in 79 countries between 1994–2009; Fu et al. (2014) in a study of 14 Asian countries from 2003–2010; Agoraki et al. (2011) who studied 13 CCE countries between 1998–2005 and Ariss (2010) who studied 60 developing countries that included 14 African countries. Most of this studies had employed both Lerner index as Zscore to measure competition and stability respective making our study directly comparable to theirs.

Although, at the moment, our data; bank capital base, bank performance and the stability measure estimated, the ZSCORE, do not suggest any form of instability in the commercial banking sectors of the SSA region, however, banks in this region continues to face the risk of high non-performing loans NPLs among others in their asset portfolios. These are likely to arise from undue competition that makes banks to either wave or not to pay proper attention to processes of KYC and other corporate governance issues that arises during selection of loan assets portfolio. Knowing that potential instability is associated with competition in this region is a call for caution among players, regulators and practitioners alike, so that their

priorities should be aligned to avoid such eventualities. A point to note is that the proponents of competition stability view emphasis the role of efficiency in the relationship between competition and stability. this we have not taken account of in this study and might require further investigation in the case of the SSA region.

The emphasis on banks' capital base and why it is made as the cardinal point of regulation is justified by the direct influence it has on the stability of the banking system as found in this study. As such banks, must at all time maintain an adequate and sound capital base to withstand stress and provide cushion for it survival. We noted from the results that only the return on assets among the performance measures employed is significant and has direct relationship to explaining stability in the SSA region commercial banks. It is not clear at this point why return on equity is negative but not significant to explain stability and also why pre–tax income is significantly negative in explaining stability of banks in the region. Hence, we briefly like to draw the attention of stakeholders in this region this and a need for further studies as well. GDP annual growth proxying economic growth is al seen to be insignificant to explain the stability of the commercial banking sector of the SSA region. The expectation is that growth in an economic should impact positively to improve the well-being of the people in terms of per capital income. Likewise, industry should grow which ultimately should reduce the cost of banking as well as loan default rates hence stability. However, the case of SSA region suggests otherwise. More often than not most SSA countries statistically report growth in their economy annually but what is seen has been as the growth increase so does the level of poverty and underdevelopment. Providing evidences that economic growth might not explain stability in the region since it could not support the necessary parameters that should culminate in the stability of the banking system. The correlation results above support this view as both variables are weakly negatively correlated. Government have works to do in this area ensuring economic growth statistical parameters reflect the status quo and work assiduously to improve it. Finally, it will make sense to increase anti-corruption crusades in the region given that our result suggest that corruption perception plays a significant role in the stability of banks.

Overall, our result meet the various requirements of the regression models as shown in Table 3. In particular, for the GMM, the overall fitness of the result is good indicated by the Wald test probability, AR2 confirms the absence of serial correlation and the result of the Hansen J statistics gives us the confidence that the instruments are not overidentified.

## 5. Summary and Conclusion

This study looked at competition and stability relationship in the SSA region commercial banks in the light of the call to increase competition of the banking system in the region to fight poverty through stimulating economic growth. Models that we reviewed argue for and against competition and stability, expressing that competition may be good and bad for the banking system. The study employed the robust orthogonalized version of the Generalised method of Moments to analyse this relationship. The choice of methods is to avoid the shortfalls of OLS while accounting for possible endogeneity issues between competition and stability. We proxy competition with the Lerner index and stability with the Zscore. Both measures have been used prominently in this kind of literature and has continued to gain relevance. The study concludes based on the findings that competition is detrimental to the commercial banking sector of the SSA region. This is a departure from Moyo, Nandwa, Council, Oduor, and Simpasa (2014)'s results that found otherwise in the SSA region among other studies done elsewhere around the world. However, their study differs from ours in the sense that they looked at competition and stability vis-a-vis efficiency and we suggest further investigations in these areas. Based on the conclusion we might one to recommend caution in the way policies are directed towards increasing competition further in the region pending further studies factoring efficiency into competition stability relationship in the region is carried out. This Study contribute to the literature of competition and stability in Africa as this as far as we know is the second empirical works focusing on this region.

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# Examining the Developed and Emerging Bond Market Interactions: A VAR Analysis

**Kemal Eyuboglu[1], Sinem Eyuboglu[2]**

**Abstract:** Financial markets are growing and getting more integrated. Therefore, the transmission of bond markets across countries has become an important issue for monetary policymaking and portfolio diversification. This study examines interactions among government bond markets of 3 developed (Japan, US, Germany) and 5 emerging countries (Russia, India, China, Brazil and Turkey) that cover the period of January 2006 to September 2015. A VAR analysis is carried out to monthly data in order to determine the linkages among the 10 year government bond yields. The results showed that the impact of US bond market is not dominant while the Japanese market is more influential. Furthermore, Japanese and Chinese bond markets are found less integrated.

**Keywords:** Developed countries; Emerging countries; Bond markets; VAR Analysis

**JEL Classification:** F30; G10; G15

## 1. Introduction

The world economy has been dominated by the dynamics of globalization over the last two decades. Capital movements in the world economy are concordantly associated with it. This process has an effect on many areas, like financial markets. Thus, the global economic conditions have become more effective on the domestic interest rates than the domestic economic conditions and monetary policy.

In the recent years, the issue of interest rates' co-movements of the different countries in the financial markets has interested plenty of researchers, especially after the growing signs of increasing international interactions between capital markets all over the world. Structural changes like regulation of financial markets, removing of capital controls, and development of new financial instruments, improvement of the communication and information technology (reduction of

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information costs) have also increased the flow of capital among the countries. In particular, after the global financial crisis in 2008, the subject of investigating the interaction among the international bond markets gained importance in terms of asset allocation management, portfolio diversification and independent monetary policy.

As stated by Barassi et al. (2001), bond yields can be regarded either in a similar manner to other asset prices or as policy instruments (Yang, 2005a, p. 599). Hence, a good understanding of the linkages among the bond yields provides important guidance for national authorities in organizing their monetary policies to sustain the macroeconomic stability. Therefore, the scope of international bond market interactions is basically a matter of empirical testing. However, most of the literature on the international bond market interactions across government bond markets have focused on the developed bond markets (e.g. DeGennaro et al., 1994; Bremnes et al., 2001; Smith, 2002; Barr & Priestley, 2004; Yang, 2005b; Kumar & Okimoto, 2011), whereas the studies on emerging bond markets are very limited (Vo, 2009; Bunda et al., 2009; Piljak, 2013).

Bond markets in emerging countries have become an important investment tool in recent years by taking the following facts into account; a) The emerging markets tend to grow rapidly; b) bonds of emerging market countries have been the second largest funding source since the early 1990s; c) liquidity and transparency of the emerging bond markets have developed over the past decades (Piljak, 2013, p. 30).

In this respect the study contributes to the literature in several aspects. First, there is a gap in the field of the interactions among the bond markets. Second, most of the previous studies on international bond markets have focused more on interactions between developed markets. Few studies that document such linkages have concentrated on emerging markets. Third, the study examines the effects of changes in emerging markets' bonds to developed markets' bonds and vice versa. Consequently, this study attempts to provide new insights into the field of interaction by examining the both developed and emerging countries' bond markets' perspective.

The purpose of this study is to examine the co-movement of the government bond yields of three developed and six emerging markets that covers the period of 2006:01-2015:9 by applying the Vector Auto Regression (VAR) framework. The rest of this paper is organized as follows. Section 2 explains the literature review. Section 3 describes the data and the methodology. Section 4 presents empirical result and Section 5 presents conclusion.

## 2. Literature Review

Lots of studies have concentrated on linkages among international equity markets. However, few studies have examined the interactions among international bond markets. Besides, the literature on the examining the interactions among international bond markets have mainly focused on developed bond markets. In these studies; Fukao and Okubo (1984) examined the co-movement between the interest rates of Japan and US and they concluded that US's interest rate had an important impact in the determination of Japan's long-term interest rates. Kirchgassner and Wolters (1987) tested the linkages of the interest rates among the US, West Germany and Switzerland. They found that there was no linkage before the 1980 but there were strong linkages between US and two European government bond markets after 1980. Karfakis and Moschos (1990); Edison and Kole (1995); Borio and McCauley (1996) investigated interactions between the short-term domestic interest rates of the European Monetary System (EMS). Findings showed that interest rate of Germany had a dominant role in the EMS. Goodwin and Grennes (1994) analyzed the long-term relations between the interest rates of US and Canada and found two rates were cointegrated. DeGennaro et al. (1994) searched the interactions among the long-term interest rates of the five industrialized countries (Canada, Japan, Germany, UK and US). Findings showed that there was no evidence of the cointegration among the interest rates. Clare et al. (1995) examined the correlation among the four bond markets (Germany, Japan, UK and US). Findings show that there was a weak correlation between the bond markets. Hence, there was an opportunity for the portfolio diversification. Barkoulas et al. (1997) examined the dynamics of the US, Canada, Germany, UK and Japan's long term interest rates. They found a strong interaction between the Canadian and US interest rates. Phylaktis (1999) investigated the long run linkages between the real interest rates of Singapore, Korea, Taiwan, Malaysia, US and Japan. Findings showed that Japan interest rates had more effect than US interest rates on these countries.

Barassi et al. (2001) investigated the cointegration among the long-term interest rates of the G7 countries. They indicated that long-term rates of Italy and Germany were non-cointegrated and their rates were isolated from the others. Bremnes et al. (2001) tested the long run linkages between interest rates of US, Germany and Norway. Results showed that US's interest rates had an important effect on both interest rates of Germany and Norway. Also, Germany had an important impact on Norway. Smith (2002) analysed the linkages among government bond markets of the six countries (US, Canada, UK, Germany, France, and Japan). In the short term, findings indicated some opportunities for the portfolio diversification due to the low correlations. Vuyyuri (2004) tested the influence of Japanese and US short term interest rates on India's interest rates. The results indicated that there was a long-term relationship among the interest rates of India, US and Japan.

Yang (2005a) analysed the co-movements on the European government bond markets of Germany, France, Italy, UK, Belgium and Netherlands. Result showed a little evidence on the long-term relationship among the six markets. Furthermore, Yang found UK and Italy were less cointegrated with other markets. Chinn and Frankel (2005) investigated the interactions among the international interest rates. They found that US interest rates influenced European rates, but German rates did not have a similar effect like the US interest rates. Yang (2005b) searched the linkages among government bond markets of five industrialized countries (US, Japan, Germany, UK and Canada). The findings indicated that there was no long-run relationship which exists among the five major bond markets. Also, dynamic linkage pattern showed that UK and Germany had some noticeable impact on the US and Japan, which was the most unaffected market. Hunter and Simon (2005) analysed the relationships among the US, UK, Germany and Japan government bonds. They concluded that integration increased for the last ten year of the sample period. Kim et al. (2006a) investigated the co-movement of the European government bond markets (Czech Republic, Hungary, Poland, Belgium, France, Ireland, Italy, Netherlands, UK and Germany). He concluded that there were linkages among the Belgium, Italy and Netherland bond markets. Ciner (2007) examined the dynamic relationships among the bond markets of the US, Japan and Germany. Results indicated that those bond markets were not cointegrated for the whole sample period. Georgoutsos and Migiakis (2007) examined the relationship between the European bond markets and the US bond market. He concluded that Greece, Ireland, Portugal, Spain, France and Netherlands were more integrated with US bonds than the European bond markets.

Abad et al. (2010) tested the relationship between US and European government bond markets. Results showed that Belgium and Germany were the most integrated bond markets with US. Kumar and Okimoto (2011) analysed the dynamics among the six of the G7 countries' (Canada, France, Germany, Italy, UK and US) government bond markets. They found correlations for the long-term yields of Canada-UK, UK-US and Canada-US had increased in the sample period. Jeon et al. (2012) analysed the Japanese bond yields' linkages with US, UK and Germany bonds. Results showed that Japanese bond yields are only affected by itself and US bond yield.

The studies have focused on the emerging bond markets; Bunda et al. (2009) investigated the co-movement among the eighteen emerging bond markets. Results showed that there were a co-movement in Hong Kong SAR market crash of October 1997, the Russian crisis and the collapse of LTCM in 1998 and the Argentinean crisis of 2001 among the bond markets. Vo (2009) examined the linkages among the Asian bond markets (Thailand, Hong Kong, Japan, Malaysia, Korea, Singapore and Philippine) to US, Australia and New Zealand. He found that Australia government bond was integrated with the yields of US, Japan and New Zealand bonds. Also, he indicated that Asian government bond yields' linkages

were high except Korea. Piljak (2013) analysed the linkages among the fourteen government bond markets. He found that US bond market has a positive impact on all markets (except Ecuador). He also indicated that the linkages among the emerging markets are relatively high.

## 3. Data and Methodology

Our empirical analysis consists of 5 emerging (Brazil, China, India, Russia and Turkey) and 3 developed government bond markets (US, Japan and Germany). The selection of countries is dictated by data availability. The empirical analysis is based on VAR analysis. Using an eight-variable VAR model, this study examines whether there is an interaction among the eight countries' 10 year government bond yields.

Long-term bonds are selected because of their comparability across countries. They not only have an impact on long-term saving and investment strategies, but also on business cycle and forming of macroeconomic policies (Orr et al., 1995, p. 76). The bond yields are obtained from the website of Eurostat, investing.com and the ieconomics.com. The sample period extends from January 2006 to September 2015, leading to a sample size of 117 observations. The starting point of the sample period is determined by data availability.

The VAR analysis, which is developed by Sims (1980) is used for examining the linkages among the 10-year government bond yields. The VAR is an efficient model for analysing the dynamic linkages among economic variables. This model provides a multivariate framework related with changes in a variable and its own lags and also changes in other variables. No limitations are enforced on the structure of system and the VAR assumes all variables as jointly endogenous (Maghyereh, 2004, p. 31; Acikalin et al., 2008, p. 12). In this study, after estimating the VAR model, impulse-response functions and variance decompositions are also derived from the estimates.

## 4. Findings

Table 1 shows descriptive statistics of 10-year government bond yields in logarithm form. As can be seen from Table 1 during the sample period, all emerging markets have higher average bond yields than the developed markets. The highest yields are recorded for Brazil and Turkey. The lowest yields are found for Japan and Germany. Also, the volatilities of the developed bond markets are lower than the volatilities of the emerging bond markets. The lowest volatile market is US and the highest volatile market is Turkey. The distributions of bond market yields are statistically non-normal and show negative skewness (except China, Turkey and Russia).

**Table 1. Descriptive statistics of the 10-year government bond yields**

| | LUS | LJAP | LGER | LBRE | LCHI | LTUR | LIND | LSAF | LRUS |
|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 1.073 | 0.006 | 0.785 | 2.507 | 1.295 | 2.427 | 2.070 | 2.088 | 2.089 |
| **Maximum** | 1.638 | 0.662 | 1.532 | 2.852 | 1.532 | 3.100 | 2.231 | 2.370 | 2.645 |
| **Minimum** | 0.385 | -1.251 | -1.687 | 2.217 | 1.011 | 1.819 | 1.660 | 1.793 | 1.836 |
| **Std. Dev.** | 0.062 | 0.075 | 0.085 | 0.126 | 0.123 | 0.328 | 0.089 | 0.095 | 0.206 |
| **Skewness** | 0.096 | -0.757 | -1.291 | -0.041 | 0.152 | 0.400 | -1.553 | -0.548 | 0.894 |
| **Kurtosis** | 1.946 | 2.623 | 3.520 | 3.459 | 2.189 | 1.953 | 6.163 | 3.954 | 2.938 |
| **Observation** | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 |

Before estimating the model, series are analysed in terms of stationarity with using Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests in order to avoid the possibility of spurious relationships.

Table 2 shows unit root results of the eight government bond yields. We determine that there is not unit root in bond yields at level in Japan, China and India. We find that there are unit roots in the bond yields of Germany, Turkey, US, Russia and Brazil at level, but no unit root in their first differences in significance at the 5% level. These results are important for VAR analysis, given the importance of using stationary variables.

**Table 2. Unit root results of the government bond yields**

| | I (0) | | | | I (1) | | | |
|---|---|---|---|---|---|---|---|---|
| **Variables** | **ADF** | | **PP** | | **ADF** | | **PP** | |
| | **Intercept** | **Trend and Intercept** | **Intercept** | **Trend and Intercept** | **Intercept** | **Trend and Intercept** | **Intercept** | **Trend and Intercept** |
| **LUS** | -1.627 | -2.617 | -1.607 | -2.775 | -10.465[a] | -10.423[a] | -10.465[a] | -10.423[a] |
| **LJAP** | -0.008 | -3.312[c] | 1.168 | -3.217[c] | | | | |
| **LGER** | -0.535 | -3.374[b] | -0.481 | -2.908 | -5.872[a] | -5.886[a] | -11.201[a] | -11.224[a] |
| **LBRE** | -2.303 | -1.923 | -2.134 | -1.739 | -11.078[a] | -11.209[a] | -11.105[a] | -11.310[a] |
| **LCHI** | -3.653[a] | -3.534[b] | -2.676[c] | -2.571 | | | | |
| **LTUR** | -1.216 | -2.077 | -1.292 | -2.365 | -9.531[a] | -9.487[a] | -9.499[a] | -9.454[a] |
| **LIND** | -3.227[b] | -3.882[b] | -3.390[b] | -3.517[b] | | | | |
| **LSAF** | -2.806[c] | -3.014 | -2.754[c] | -2.971 | -12.075[a] | -12.022[a] | -12.163[a] | -12.108[a] |
| **LRUS** | -1.565 | -2.051 | -1.671 | -2.137 | -10.113[a] | -10.078[a] | -10.114[a] | -10.077[a] |

[a] denotes significance at the 1% level. [b] denotes significance at the 5% level. [c] denotes significance at the 10% level.

Using the Akaike Information Criteria (AIC) the appropriate lag length is determined to be seven or one. However, in the VAR (1,1) model, autocorrelation has occurred. Therefore, appropriate lag length is selected seven.

### 4.1. Impulse Response Functions

Impulse response functions are used to analyse dynamics of the variables. The goal of the investigation is to find out how each of bond markets responds to shocks by other bond markets. It is also important for investors who want to make portfolio diversification. If the shocks are not transmitted to other markets, there is an opportunity to make diversification.

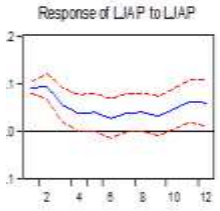



**Figure 1(a)**

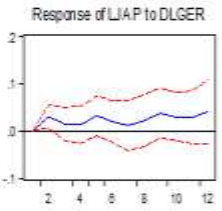



**Figure. 1(b)**

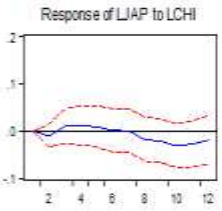



**Figure. 1(c)**

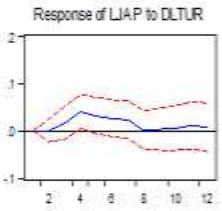



**Figure. 1(d)**

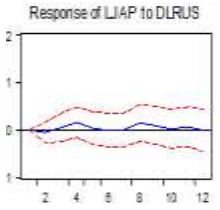



**Figure 1(e)**

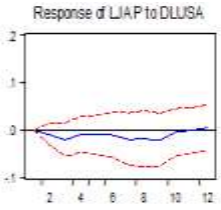



**Figure 1(f)**

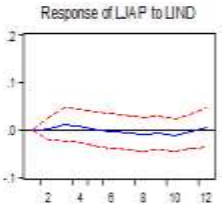



**Figure 1(g)**

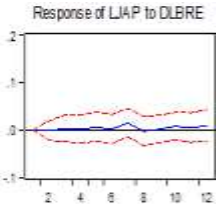



**Figure 1(h)**

In the case of Japan[1] Fig. 1a shows that the Japanese bond yield responds significantly only to its own shocks. Fig. 1b plots the response of bond yields in Japan to a German bond yield shock and the response is insignificant. Fig. 1c, d, e, f, g, h plot the responses of yields in Japan to China, Turkey, Russia, US, India and Brazil respectively. All these bond markets are insignificant in explaining the movement of bond yields like Germany.

[1] Fig. 1(a) Japan to Japan 10 year government bond yield Fig. 1(b) Japan to Germany 10 year government bond yield. Fig. 1(c) Japan to China 10 year government bond yield. Fig. 1(d) Japan to Turkey 10 year government bond yield Fig. 1(e) Japan to Russia 10 year government bond yield. Fig. 1(f) Japan to US 10 year government bond yield. Fig. 1(g) Japan to India 10 year government bond yield. Fig. 1(h) Japan to Brazil 10 year government bond yield.

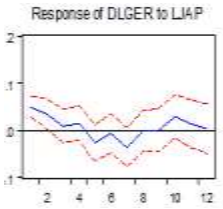



**Figure 2(a)**


**Figure 2(b)**

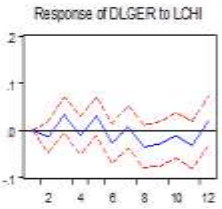
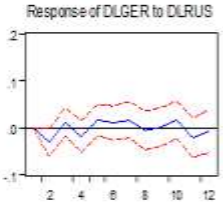



**Figure 2(c)**


**Figure 2(d)**


**Figure 2(e)**

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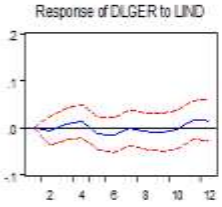


**Figure 2(g)**

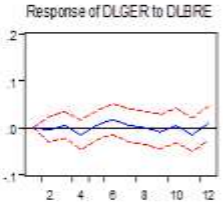


**Figure 2(h)**

Figure 2[1] shows that Germany bond yield responds significantly to shocks from Japan, Turkey and its own shocks. Fig. 2a plots the response of German bond yield to Japan bond yield and shows that it is significant and positive around the first month. Fig. 2b plots the German bond yields' response to own shocks. There is a short but positive and significant response in the first month. Fig. 2d plots the effect of the Turkish bond yield on the German yield and shows that the response is positive and significant in the third month and the fifth month. Fig. 2c, e, f, g and h plot the response of yields in Germany to China, US, Russia, India and Brazil respectively. There are no evidences of significant exposure of yield of Germany to bond yields of five markets.

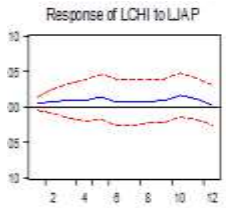


**Figure 3(a)**

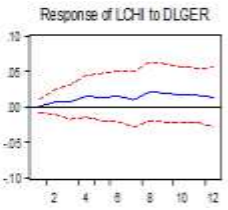


**Figure 3(b)**

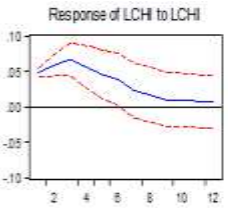


**Figure 3(c)**

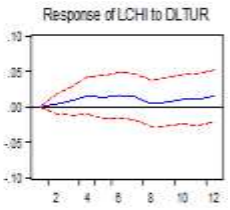


**Figure 3(d)**

[1] Fig. 2(a) Germany to Japan 10 year government bond yield Fig. 2(b) Germany to Germany 10 year government bond yield. Fig. 2(c) Germany to China 10 year government bond yield. Fig. 2(d) Germany to Turkey 10 year government bond yield. Fig. 2(e) Germany to US 10 year government bond yield. Fig. 2(f) Germany to Russia 10 year government bond yield. Fig. 2(g) Germany to India 10 year government bond yield. Fig. 2(h) Germany to Brazil 10 year government bond yield.

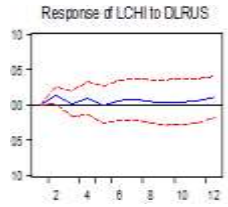


**Figure 3(e)**

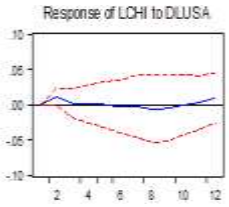


**Figure 3(f)**

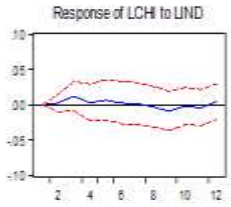


**Figure 3(g)**

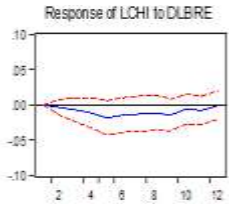


**Figure 3(h)**

In the case of China[1], bond yield responds only its own shocks. The response functions in Fig. 3a, b, d, e, f, g, h indicate that Chinese bond yield does not respond significantly to Japanese, German, Turkish, Russian, US, Indian and Brazilian bond yields in the sample period.

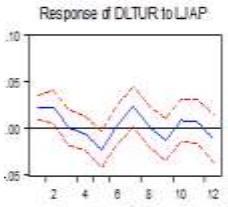


**Figure 4(a)**


**Figure 4(b)**

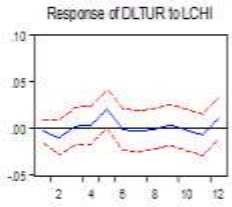


**Figure 4(c)**

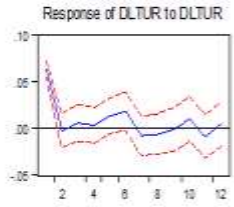


**Figure 4(d)**

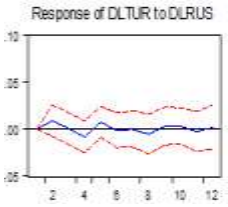


**Figure 4(e)**

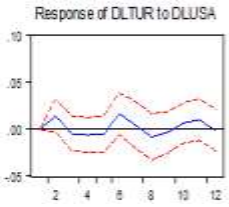


**Figure 4(f)**

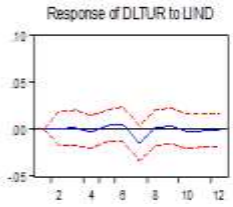


**Figure 4(g)**

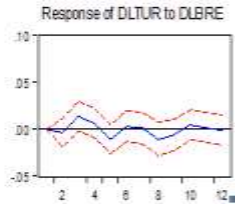


**Figure 4(h)**

The impulse response functions for Turkey[2] indicate that Turkey bond yield responds significantly to shocks from Japan, China and its own shocks. Fig. 4a plots the response of Turkish bond yield to Japan bond yield and shows that it is significant and positive at about first two months. Fig. 4c plots the effect of the Chinese bond yield on the Turkish yield and indicates that the response is positive and significant in the fifth month. Fig. 4d plots the Turkish bond yields responds to

[1] Fig. 3(a) China to Japan 10 year government bond yield Fig. 3(b) China to Germany 10 year government bond yield. Fig. 3(c) China to China 10 year government bond yield. Fig. 3(d) China to Turkey 10 year government bond yield Fig. 3(e) China to Russia 10 year government bond yield. Fig. 3(f) China to US 10 year government bond yield. Fig. 3(g) China to India 10 year government bond yield. Fig. 3(h) China to Brazil 10 year government bond yield.

[2] Fig. 4(a) Turkey to Japan 10 year government bond yield Fig. 4(b) Turkey to Germany 10 year government bond yield. Fig. 4(c) Turkey to China 10 year government bond yield. Fig. 4(d) Turkey to Turkey 10 year government bond yield Fig. 4(e) Turkey to Russia 10 year government bond yield. Fig. 4(f) Turkey to US 10 year government bond yield. Fig. 4(g) Turkey to India 10 year government bond yield. Fig. 4(h) Turkey to Brazil 10 year government bond yield.

its own shocks. There is a short, positive and significant response around the first month. Fig. 4b, e, f, g and h plot the response of yields in Turkey to Germany, Russia, US, India and Brazil respectively. There are no evidences in explaining the movement of Turkish bond to five markets.


**Figure 5(a)**

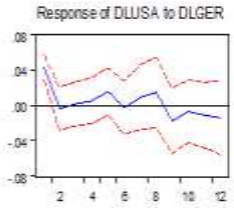


**Figure 5(b)**


**Figure 5(c)**

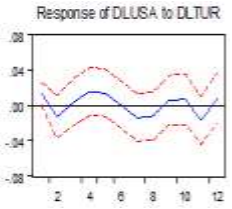


**Figure 5(d)**

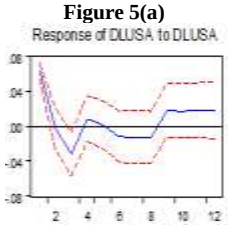


**Figure 5(e)**

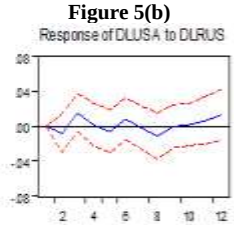


**Figure 5(f)**

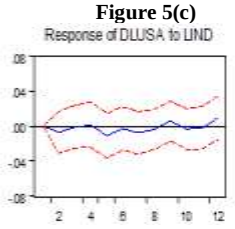


**Figure 5(g)**

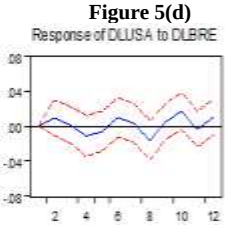


**Figure 5(h)**

In the case of US[1], bond yields respond significantly to shocks from Japan, Germany, and in addition to its own shocks. Fig. 5a plots the response of US yields to Japan. The response is positive and significant in the first two months and negative by the third month. Fig. 5b plots the response of US bond yield to German bond yield and shows that bond yield increase leads to a positive movement in bond yield of US. Response is short and significant in the first two months. Fig. 5c, d, f, g and h plot the response of yields in US to China, Turkey, Russia, India and Brazil, respectively. All these bond yields are insignificant in explaining the movement of bond yields in US. Also Fig. 5e shows that US bond yield responds significantly to its own shocks.

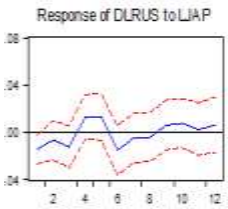


**Figure 6(a)**

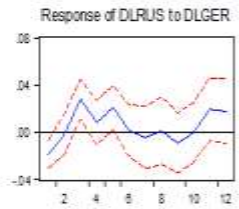


**Figure 6(b)**

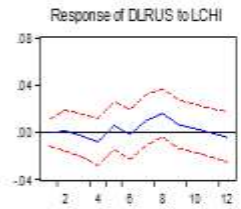


**Figure 6(c)**

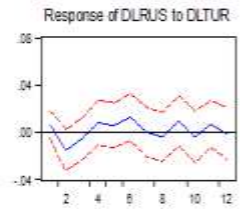


**Figure 6(d)**

[1] Fig. 5(a) US to Japan 10 year government bond yield Fig. 5(b) US to Germany 10 year government bond yield. Fig. 5(c) US to China 10 year government bond yield. Fig. 5(d) US to Turkey 10 year government bond yield Fig. 5(e) US to Russia 10 year government bond yield. Fig. 5(f) US to US 10 year government bond yield. Fig. 5(g) US to India 10 year government bond yield. Fig. 5(h) US to Brazil 10 year government bond yield.

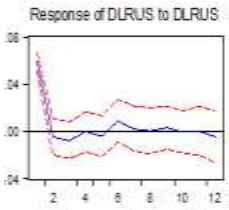


**Figure 6(e)**

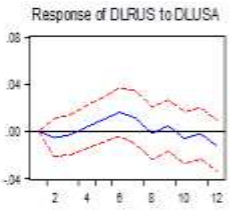


**Figure 6(f)**

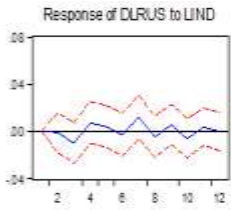


**Figure 6(g)**

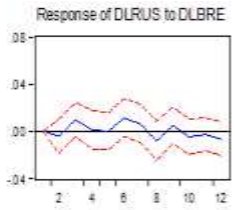


**Figure 6(h)**

Figure 6 shows the impulse response function for Russia[1] Fig. 6a, c, d, f, g, and h indicate that shocks to Japan, China, Turkey, US, India and Brazil have no significant responses in the Russian market. The significant yields are Germany and its own. Fig. 6b plots the response of yields to the German yield and shows that it is significant and positive around the third month. Fig. 6e plots the Russian bond yields responds to own shocks. There is a positive and significant response in the first two months.

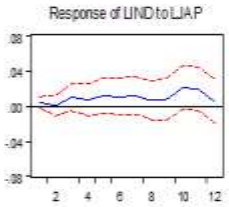


**Figure 7(a)**

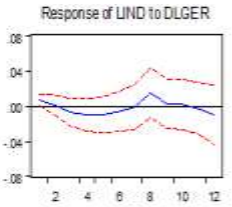


**Figure 7(b)**

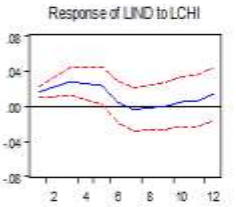


**Figure 7(c)**

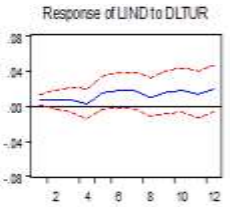


**Figure 7(d)**

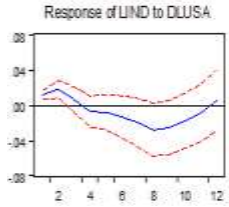


**Figure 7(e)**

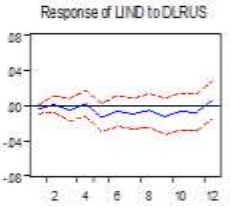


**Figure 7(f)**

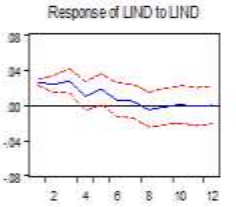


**Figure 7(g)**

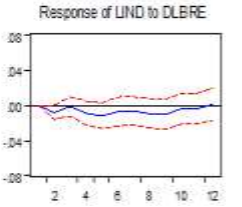


**Figure 7(h)**

In case of India[2], bond yield responds significantly to shocks from China, US, and in addition to its own shocks. Fig. 7c plots the response of Indian bond yield to China bond yield and shows that it is significant and positive in about five months.

[1] Fig. 6(a) Russia to Japan 10 year government bond yield Fig. 6(b) Russia to Germany 10 year government bond yield. Fig. 6(c) Russia to China 10 year government bond yield. Fig. 6(d) Russia to Turkey 10 year government bond yield Fig. 6(e) Russia to Russia 10 year government bond yield. Fig. 6(f) Russia to US 10 year government bond yield. Fig. 6(g) Russia to India 10 year government bond yield. Fig. 6(h) Russia to Brazil 10 year government bond yield.

[2] Fig. 7(a) India to Japan 10 year government bond yield Fig. 7(b) India to Germany 10 year government bond yield. Fig. 7(c) India to China 10 year government bond yield. Fig. 7(d) India to Turkey 10 year government bond yield Fig. 7(e) India to US 10 year government bond yield. Fig. 7(f) India to Russia 10 year government bond yield. Fig. 7(g) India to India 10 year government bond yield. Fig. 7(h) India to Brazil 10 year government bond yield.

Fig. 7e plots the effect of the US bond yield on the Indian market and indicates that the response is positive and significant in first three months. Fig. 7g plots the Indian bond yields responds to its own shocks. The effect is positive and significant in the first four months. Fig. 7a, b, d, f and h indicate that Indian bond market do not respond significantly to Japanese, German, Turkish, Russian, and Brazilian bond markets in the sample period.


**Figure 8(a)**

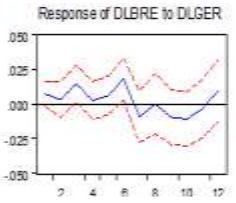


**Figure 8(b)**

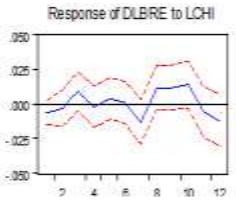


**Figure 8(c)**

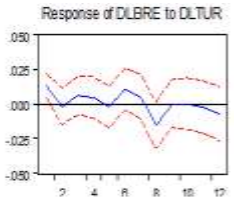


**Figure 8(d)**

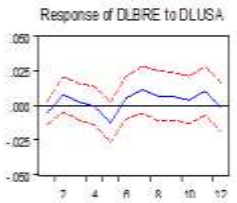


**Figure 8(e)**

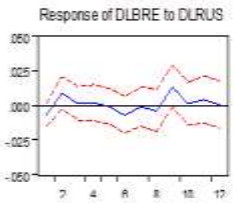


**Figure 8(f)**

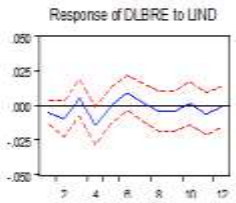


**Figure 8(g)**

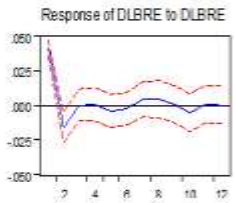


**Figure 8(h)**

In case of Brazil[1], the significant bond yields are Germany and its own shocks. Fig. 8b plots the response of bond yields in Brazil to a German bond yield shock and the response is significant and positive in the sixth month. Fig. 8a, c, d, e, f and plot the responses of yields in Brazil to Japan, China, Turkey, US, Russia and India, respectively. All these bond yields are insignificant in explaining the movement of bond yields of Brazil. Fig. 8h plots the Brazilian bond yields' response to its own shocks. The impact is positive and significant in the first two months.

### 4.2. Forecast Error Variance Decompositions

We also present the forecast error variance decompositions in Table 2 to indicate how variance of bond yield in a country is explained in percentage points by shocks to eight countries listed in the first row.

As can be seen from the Table 2, bond yield of the US is the most affected by other bonds in contemporaneous time. For instance, foreign bond yields explains over 52.2% of US price variations at the 1-month interval, compared with 0% for

[1] Fig. 8(a) Brazil to Japan 10 year government bond yield Fig. 8(b) Brazil to Germany 10 year government bond yield. Fig. 8(c) Brazil to China 10 year government bond yield. Fig. 8(d) Brazil to Turkey 10 year government bond yield Fig. 8(e) Brazil to US 10 year government bond yield. Fig. 8(f) Brazil to Russia 10 year government bond yield. Fig. 8(g) Brazil to India 10 year government bond yield. Fig. 8(h) Brazil to Brazil 10 year government bond yield.

Japan, 16.2% for Germany, 1% for China, 11.1% for Turkey, 16.2% for Russia, 43.7% for India and 20.3% for Brazil in contemporaneous time.

Chinese and Japanese bond markets are relatively independent as each explains a larger percentage of their own error variance relative to other bond markets. The effect of foreign shocks on Chinese and Japanese bond markets increase only moderately over forecast intervals unlike in all the other countries. Thus, China and Japan are the least influenced countries by others at the 12-month interval. Gains from diversification are less when foreign markets account for a greater percentage of the forecast error variance than the shocked market accounts for. Hence, investors have some opportunities to make portfolio diversification in these two markets. Foreign bond markets account for 29.4% of total China price variations. The Germany, Turkey and Brazil, respectively, account for 9.18 %, 5.8% and 5.4% of price variations in the China at the 12-month interval.

For Japan, foreign bond markets account for 35.2% of total Japan price variations. The Germany, Turkey and China, respectively, account for 14.6%, 7.9% and 5.9% of price variations in the Japan. Also, Japanese bond market plays a very important role in the international linkages of yields at the longer interval. For instance, at the 12-month interval, Japanese bond market on average accounts for 14% of price variations in the other countries.

Interestingly, US bond market is not a dominant international factor for other seven countries' bond markets, except India. Also, US bond market is relatively dependent because the bond market explains only 33.5% of its own error variance at the 12-month interval. The Japanese bond market explains 24% of the US bond market, while the German and Chinese government bond markets explain 15.7% and 7.9%, respectively.

Germany, Turkey, Russia and Brazil are slightly influenced by other countries at the 1-month 16.2%, 11.1%, 16.2% and 20.3%, respectively. However, they become highly vulnerable to foreign influence at the longer interval. Foreign bond markets explain 62%, 55%, 64.6% and 71.2% of price variations respectively at the 12-month interval in the four countries. For instance, the German bond market explains only 38% of its own shocks. The Turkish bond market explains 21% of the German bond market, while the Japanese and Chinese bond markets explain 13.3% and 12.9%, respectively.

**Table 2. Forecast error variance decompositions (percentage)**

| Month | Japan | Germany | China | Turkey | US | Russia | India | Brazil |
|---|---|---|---|---|---|---|---|---|
| **Variance of United States Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 26.49 | 22.69 | 0.85 | 2.17 | 47.77 | 0.00 | 0.00 | 0.00 |
| **3** | 30.19 | 15.75 | 6.24 | 2.99 | 41.24 | 2.40 | 0.44 | 0.71 |
| **6** | 26.54 | 15.47 | 8.97 | 5.58 | 36.71 | 2.82 | 1.31 | 2.48 |
| **12** | 24.05 | 15.70 | 7.94 | 7.78 | 33.51 | 3.63 | 1.97 | 5.33 |
| **Variance of Japan Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **3** | 89.27 | 5.18 | 0.94 | 1.19 | 2.42 | 0.36 | 0.55 | 0.04 |
| **6** | 73.62 | 8.69 | 1.38 | 11.69 | 2.57 | 1.24 | 0.61 | 0.17 |
| **12** | 64.79 | 14.61 | 5.92 | 7.92 | 3.40 | 1.55 | 0.95 | 0.81 |
| **Variance of Germany Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 16.14 | 83.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **3** | 15.87 | 55.06 | 5.69 | 12.54 | 4.97 | 5.13 | 0.47 | 0.24 |
| **6** | 13.85 | 45.64 | 9.33 | 17.16 | 4.09 | 5.77 | 2.20 | 1.91 |
| **12** | 13.39 | 38.07 | 12.94 | 21.05 | 3.89 | 5.81 | 2.73 | 2.08 |
| **Variance of China Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 0.79 | 0.017 | 99.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **3** | 1.35 | 0.85 | 92.34 | 0.72 | 1.45 | 1.25 | 1.39 | 0.61 |
| **6** | 2.28 | 3.49 | 83.45 | 3.83 | 0.84 | 1.28 | 1.04 | 3.75 |
| **12** | 4.08 | 9.18 | 70.65 | 5.83 | 1.44 | 1.96 | 1.34 | 5.48 |
| **Variance of Turkey Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 10.67 | 0.21 | 0.20 | 88.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| **3** | 17.52 | 0.52 | 1.92 | 71.54 | 4.17 | 0.86 | 0.03 | 3.40 |
| **6** | 19.43 | 1.54 | 6.94 | 57.59 | 7.01 | 2.30 | 0.62 | 4.53 |
| **12** | 22.86 | 7.84 | 6.92 | 45.04 | 7.38 | 2.19 | 2.79 | 4.94 |
| **Variance of Russia Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 5.29 | 8.526 | 0.01 | 1.05 | 1.27 | 83.82 | 0.00 | 0.00 |
| **3** | 7.48 | 19.71 | 0.19 | 5.52 | 1.80 | 61.45 | 1.85 | 1.95 |
| **6** | 12.64 | 20.85 | 1.51 | 7.25 | 6.20 | 46.13 | 2.32 | 3.08 |
| **12** | 11.33 | 23.67 | 5.21 | 7.25 | 8.28 | 35.48 | 4.29 | 4.45 |
| **Variance of Brazil Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 3.48 | 2.28 | 1.93 | 7.63 | 1.29 | 2.43 | 1.18 | 79.73 |
| **3** | 6.06 | 8.59 | 4.27 | 6.48 | 2.99 | 4.09 | 4.79 | 62.68 |
| **6** | 4.93 | 14.94 | 3.63 | 8.00 | 6.51 | 4.27 | 10.54 | 47.14 |
| **12** | 12.64 | 14.51 | 13.50 | 9.05 | 8.48 | 5.52 | 7.42 | 28.85 |
| **Variance of India Explained by Shocks to the Eight Countries** | | | | | | | | |
| **1** | 1.26 | 3.98 | 20.47 | 4.4 | 11.68 | 1.86 | 56.32 | 0.00 |
| **3** | 2.57 | 2.33 | 32.90 | 3.33 | 11.32 | 1.18 | 44.76 | 1.56 |
| **6** | 5.14 | 4.41 | 33.33 | 8.66 | 9.922 | 3.68 | 30.52 | 4.30 |
| **12** | 10.37 | 4.91 | 20.56 | 15.53 | 21.28 | 5.34 | 17.57 | 4.39 |

Russia and Brazil are also barely influenced by other countries at the 1-month interval (16.2%-20.3%). However, Russian and Brazilian bond markets become one of the most vulnerable countries to the influence of foreign bond markets at the 12-month interval. Only 35.4% and 28.8% of the price variations are explained by

their own shocks. For Russia; Germany and Japan account for about 23% and 11%, and for Brazil; Germany and China explain 14.5% and 13.3% of the price variations, respectively.

Interestingly, Turkish bond markets account for a significant portion of price differentials in many other countries. For instance, it is 21% for the Germany, 15.5% for India and 9% for Brazil at the 12-month interval. Also, Japan explains about 22.8% of the price variations in Turkey.

Lastly, India is similar to US, being among the most influenced countries by the others at the 1-month interval (43.7%) as well as the 3-month interval (55.3%). Indian markets account for a smaller percentage of its own error variance than any other markets. At the 12-month interval, a shock to the Indian market indicates that the US bond yield explains 21.2%, while the Indian bond market explains only 17.5% of its own forecast error variance. Also, India is fragile to shocks originating from China (20.5%) and Turkey (15.5%).

## 5. Conclusion

The co-movement of international markets has been increased since the structural changes like regulation of financial markets and removing of capital controls etc. are put into practice in the last two decades. This paper contributes to the knowledge of the dynamic relationships among the developed and emerging bond markets perspective. Interactions among government bond markets (Japan, US, Germany, Russia, India, South Africa, China, Brazil and Turkey) are examined with VAR analysis. Before estimating the model, series are analyzed in terms of stationary using the ADF and PP tests in order to avoid possibility of spurious relationships. ADF and PP tests indicate that bond yields of Japan, China and India are stationary at level; bond yields of Germany, Turkey, US, Russia and Brazil are stationary in their first differences. Appropriate lag length is determined by using the AIC. Afterwards, impulse response functions are used to analyze the dynamics of the variables. Findings show that foreign bond yield generally appears to have a positive effect.

Japanese and Chinese bond yields respond only significantly to own shocks. In terms of Germany, market responds to shocks from Japan and Turkey. For US, Japanese and German are the significant markets. In case of Turkey, the significant bond markets are Japan and China. In case of Russia, the significant market is Germany and in case of India, market responds to shocks from China and US.

The forecast error variance decompositions indicate that Japan bond yield is not influenced by any other bonds, but generally explains the movement on all the other markets except China (13.3% on Germany, 22.8% on Turkey, 24% on US, 11.3% on Russia, 10.3% on India, 12.6% on Brazil) at the 12-month interval. It is

also interesting to note that the Chinese and Japanese markets seem to be less integrated with the other six markets. Specifically, their market exogeneity is showed by the percentage of self-explained variation as 70% and 64%, respectively. Hence, investors have some opportunities to make portfolio diversification in these two markets. In addition, Japan (13.3%), China (12.9%), Turkey (21%), and to a lesser extent, Russia (5.8%) can noticeably influence Germany.

It is interesting to note that US bond yield is not dominant for other seven countries' bond yields except India. Japan bond yield has more effect than US bond yields on these countries. In addition, US bond market is relatively dependent because the bond yield explains only 33.5% of its own error variance at the 12-month interval. The Japanese bond yield explains 24% of the US bond yield, while the German and Chinese government bond yields explain 15.7% and 7.9%, respectively. Turkey, Russia and Brazil are slightly influenced by other countries in 1-month 16.2%, 11.1%, 16.2% and 20.3%, respectively. However, they become highly vulnerable to foreign influence at the longer interval. Foreign bond yields explain 62%, 55%, 64.6% and 71.2% of price variations respectively at the 12-month interval.

Lastly, India is like US, being the most influenced country by the others at the 1-month interval (43.7%) as well as the 3-month interval (56%). Indian yield accounts for a smaller percentage of its own error variance than any other markets. Also, at the 12-month interval, a shock to the Indian yield indicates that the US bond yield explains 21.2%, while the Indian bond yield explains only 17.5% of its own forecast error variance. Moreover, India can be fragile to shocks originating from China (20.5%) and Turkey (15.5%).

The findings may have important implications for international investors and policy makers. For instance, the low level of dynamic linkages of markets may help international investors to choose target countries with the maximum diversification potential, creating some opportunities to make diversification that the shocks are not transmitted to other markets like China, Japan and Russia markets. In addition, developed market shocks have been found to be consistently important in all emerging markets (except China) for policy-makers. Therefore, they need to concentrate to shocks from developed markets.

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# Monetary Policy and Bank Excessive Risk-Taking

**Taha Zaghdoudi[1], Samir Maktouf[2]**

**Abstract:** The aim of this paper is to investigate the relationship between monetary policy and bank excessive risk-taking for a panel of 22 countries over the period 1990- 2014. The sample covers countries from Latin America, OECD and South East Asia. By performing panel cointegration and panel GMM models, results indicate that the adoption of an expansionary monetary policy through high money supply and low interest rates increases non-performing loans. However, a restrictive monetary policy with high interest rates attracts riskier investors.

**Keywords:** Monetary policy; non-performing loans; fully modified ols; panel GMM

**JEL Classification:** E44; E51; E52; G21

## 1. Introduction

La crise financière de 2008 a démontré la réelle fragilité des systèmes financiers qu'on disait les plus avancés au monde. La défaillance et l'effondrement des marchés financiers internationaux ont eu des effets destructeurs sur l'économie réelle dans le monde entier. L'expansion rapide des crédits et l'éclatement d'une série de bulles d'actifs dans les marchés immobiliers ont, d'une part, attisé la flamme de la crise entrainant des perturbations dans les marchés mondiaux du crédit et, d'autre part, fragilisé la stabilité économique mondiale.

Les décideurs et les chercheurs ont mis en doute les réelles causes de la crise, en essayant de fournir des explications sur les forces créatrices de la fragilité du système financier mondiale. Il semble y avoir un consensus sur les causes possibles de la crise telles que: l'échec de la règlementation et de contrôle, le développement d'instruments de crédit complexes sur les marchés et les pratiques de mauvaise gouvernance. D'autre part, les banques centrales sont également blâmées pour leurs adoptions fréquentes des politiques monétaires trop accommodantes, qui ont attisé

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un vif débat parmi les économistes. Selon cet argument, une période prolongée de taux d'intérêt extrêmement bas et les conditions de liquidité laxistes encouragent les institutions financières à prendre plus de risques. Les partisans de ce point de vue soutiennent que la politique monétaire est une force motrice importante dans l'émergence de la crise financière. Cette affirmation est encore plus controversée, car de nombreuses banques centrales ont abaissé les taux d'intérêt en réponse à la crise dans une tentative pour surmonter la récession.

À la lumière de ces développements, le débat sur la relation entre la politique monétaire et la stabilité financière s'est intensifié. Au cours de la période de pré-crise, les banques centrales ne tiennent pas compte, la plupart du temps de l'aspect de la stabilité financière, car la sagesse conventionnelle pour la pratique de la politique monétaire est uniquement de maintenir la stabilité des prix. Assurer la stabilité des prix est avancée comme étant la meilleure contribution des banques centrales pour améliorer le progrès économique, alors que les outils macroprudentiels sont pris en charge par les autorités de règlementation et de surveillance. Cependant, les récentes crises ont démontré que les actions de la politique monétaire peuvent avoir des conséquences sur la stabilité des banques et peuvent influencer leurs comportements et les rendre insensibles aux risques.

Toutefois, l'évolution des techniques de transfert de crédit due à l'innovation financière a souvent été considérée comme pouvant contribuer à la stabilité financière. Certes, les mutations financières ainsi que les nouveaux instruments financiers ont contribué à l'amélioration de la rentabilité, mais ils ont poussé les banques à prendre plus de risques. Cette prise de risque est principalement due aux changements apportés au comportement des banques après la vague de la libéralisation financière dans les années 70. D'abord, la concurrence résultante de la dérèglementation du système bancaire devrait éroder la valeur de la franchise de la banque et de l'encourager à poursuivre des politiques plus risquées dans une tentative de maintenir ses anciens bénéfices. Puis, la hausse des opérations de hors bilans et l'accroissement des activités de transfert du risque via la titrisation que les banques utilisent généralement, d'une part, pour diversifier et atténuer la concentration du risque de crédit et, d'autre part, comme source de financement alternative. Mais, après la crise des subprimes de 2007, une réévaluation générale des risques inhérents aux instruments financiers structurés est observée dans l'ensemble de la communauté financière.

Suivant cette optique, nous considérons que la politique monétaire visant à baisser le taux d'intérêt réel, la soif de rentabilité et l'accroissement de la concurrence des marchés financiers sont des facteurs fortement responsables de la mutation comportementale des banques qui optent pour une prise de risque qui les rend plus vulnérables à la survenue d'une crise bancaire. Ainsi, ce chapitre sera consacré, d'abord à l'étude de l'effet de la politique monétaire et du comportement spéculatif des banques sur leurs prises excessives de risque et ensuite à l'évaluation de l'effet

de cette prise excessive de risque sur la survenue d'une crise bancaire.

## 2. Revue de la Littérature

### 2.1. Fondements Théoriques

Plusieurs auteurs comme (Fisher, 1933), (Hayek, 1939) et (Kindleberger, 1978) auparavant, soutiennent que les conditions monétaires accommodantes sont un ingrédient classique de la fluctuation des activités financières et économiques entre croissance et récession. En effet, un faible taux d'intérêt pourrait induire un déséquilibre financier par une baisse de l'aversion des banques et d'autres investisseurs aux risques. Cette partie du mécanisme de transmission monétaire a été récemment référencée comme le premier des trois canaux de prise de risque qui se rapportent à la façon dont les variations des taux de la politique monétaire affectent la perception ou la tolérance au risque (Borio et Zhu, 2008). De même, veine, Adrian et (Shin, 2010) font valoir que la faiblesse persistante des taux faibles impliquent une courbe abrupte de rendement pendant un certain temps, une marge nette d'intérêts plus élevés à l'avenir, et donc une plus grande capacité de prise de risque du secteur bancaire.

Le second mécanisme concerne la recherche de plus de rendement, avec un faible taux d'intérêt nominal, ce qui incite les gestionnaires d'actifs des banques à prendre davantage de risques (Rajan, 2005). Les faibles taux d'intérêt peuvent augmenter les incitations qui poussent les gestionnaires d'actifs à prendre davantage de risques pour un certain nombre de facteurs. Certains facteurs sont d'ordre psychologique ou comportemental comme la soi-disant illusion monétaire: les investisseurs peuvent ignorer le fait que les taux d'intérêt nominaux peuvent refuser de compenser l'inflation. D'autres peuvent refléter des contraintes institutionnelles ou règlementaires. Par exemple, les compagnies d'assurance-vie ainsi que les fonds de pension gèrent généralement leurs actifs en faisant référence à leurs passifs. Dans certains pays, les engagements sont liés à un taux nominal minimum garanti de retour ou rendements qui reflètent les hypothèses actuarielles à long terme plutôt que le niveau actuel des rendements.

De façon générale, lorsque les taux d'intérêt sont bas pour une période prolongée de temps, les banques, pour faire face à une réduction de la marge entre le débiteur et le taux de dépôt, se trouvent incitées à passer à des actifs plus risqués avec des rendements attendus plus élevés. Dés lors, un mécanisme plus ou moins similaire pourrait être mis en place lors de la rémunération des cadres gestionnaires des banques et qui serait directement lié à leurs rendements. Une baisse des rendements sûrs des actifs sûrs tells que les obligations à forte notation émises par le gouvernement impliquent des compensations inférieures pour les gestionnaires qui veulent jouer en toute sécurité, et vice versa. Plus largement, le lien entre les taux d'intérêt bas et la prise de risque excessive est également influencée par la

concurrence, la structure des systèmes de primes de gestion et les lacunes en matière de surveillance et de régulation (Salas & Saurina, 2003; Kouwenberg & Ziemba, 2007).

Le troisième mécanisme est que la politique monétaire pourrait également influer sur la prise de risque par le biais de la façon dont la banque centrale va réagir face aux chocs négatifs. L'engagement, par exemple, d'une banque centrale pour les taux d'intérêt plus bas futurs dans le cas d'un choc menaçant, réduit la probabilité de subir des grands risques à la baisse, ce qui encourage les banques à assumer plus de risques (effet de transparence). C'est un problème typique de l'aléa moral. Il convient de souligner ici que cet effet opère à travers les taux attendus d'intérêt plutôt que les faibles taux actuels eux-mêmes. Cependant, l'ampleur de cet effet dépend toutefois du niveau actuel du taux directeur. Par ailleurs, (De Nicolò & Lucchet, 2011), expliquent que la réduction des taux d'intérêt prévus ont tendance à correspondre à une position de risque plus élevé quand il y à plus de place pour l'expansion monétaire, c'est à dire lorsque les taux actuels sont élevés.

Dans la même optique (Altunbas et al., 2010), expliquent que la prise de risque peut aussi être influencée par le niveau de l'activité économique. En effet, au cours de l'expansion économique, les agents deviennent moins averses au risque en raison de l'anticipation des profits plus élevés de leurs investissements. Par conséquent, l'assouplissement monétaire pourrait, en stimulant l'activité économique réelle, inciter les gestionnaires d'actifs à occuper des postions à risque élevé.

### 2.2. Evidences Empiriques

Plusieurs études empiriques ont essayé de vérifier l'existence d'un lien entre la baisse du taux d'intérêt et le comportement de prise de risque des banques et de mettre en évidence les principales caractéristiques de cette relation. Néanmoins, les études empiriques sur les canaux de prise de risque sont encore peu nombreuses. Dans ce qui suit, nous résumons brièvement ces études et leurs principales conclusions.

(Angeloni et al., 2010), en utilisant un modèle à vecteur autoregressif, cherchent à identifier les canaux de prise de risque des banques en Europe et au États-Unis. Ils emploient trois mesures de risque différentes: la consommation et le ratio des prêts hypothécaires au total des prêts comme risque de financement bancaire, le ratio des actifs aux dépôts pour calculer le levier bancaire comme mesure du risque du coté de l'actif bancaire et, en fin, la volatilité du marché boursier pour le risque général du secteur des entreprises. Ces auteurs montrent que l'orientation de la politique monétaire affecte, avec un décalage, la prise de risque bancaire, cependant la force, le profil et l'importance de l'impact de la politique monétaire sur le risque de la banque dépendent de la mesure du risque employé et sont différents entre la zone US et l'euro. Plus précisément, ils constatent que la baisse des taux de la politique

monétaire a une influence positive et significative sur le risque de bilan des banques à la fois aux États-Unis et dans la zone euro, et une influence positive significative sur l'endettement bancaire uniquement aux États-Unis. D'autre part, les effets sur la volatilité du marché boursier sont insignifiants dans les deux zones.

(De Nicolo et al., 2010) tentent d'illustrer l'effet de la politique monétaire sur la prise de risque des banques aux États-Unis à travers deux approches différentes. Ces auteurs ont mené une enquête trimestrielle sur les conditions de prêts aux entreprises, puis sur la base de cette enquête ils construisent deux mesures ex-ante de la prise de risque des banques: la notation moyenne de risque interne et la moyenne de la propagation relative entre les taux de prêt et le taux effectif des fonds fédéraux. Leurs résultats montrent que, d'une part, les taux de la politique monétaire affectent négativement à la fois la notation du risque et la propagation et que, d'autre part, cet effet négatif est d'autant plus prononcé que le secteur bancaire se caractérise par une faible capitalisation. Cependant, et dans un deuxième exercice, ils étudient l'impact des variations des taux directeurs sur le niveau de risque global des portefeuilles d'actifs des banques en utilisant des données au niveau des banques individuellement. En utilisant le ratio des actifs à risque pondérés par le total de l'actif comme mesure du risque bancaire, ils constatent une forte relation négative entre les taux d'intérêt réels et le degré de risque des actifs des banques. En fait, l'augmentation des actifs à risque pondérés en réponse à la baisse des taux de la politique monétaire est absolument faible lorsque la banque et faiblement capitalisée.

Se basant sur un modèle vecteur autoregressif à facteurs augmentés (FAVAR), (Buch et al., 2010) ont utilisé à la fois des séries chronologiques et des données en niveau des banques aux États-Unis collectées à partir des rapports annuels des banques durant la période 1985-2008 pour explorer l'effet net des chocs macroéconomiques et la politique monétaire, sur le risque de crise bancaire. En utilisant la part des prêts non performants dans le total des prêts comme un indicateur de prise de risque de la banque, ils observent une diminution du risque de la banque suite à un choc d'une politique monétaire expansionniste. Leur résultat est semblable aux conclusions de (De Graeve et al., 2008), mais pas aux conclusions d'autres études empiriques qui fournissent des preuves en faveur des canaux de prise de risque. En ce qui concerne les sources d'hétérogénéité entre les banques, les résultats montrent que la réponse négative du risque bancaire à un choc de politique monétaire est plus faible pour les banques dont les ratios de capital est élevé, alors qu'il est plus élevé pour les banques qui sont fortement engagées dans le prêt immobilier. D'autre part, la taille des banques n'a montré aucun effet significatif sur la réponse aux risques de chocs d'une politique monétaire.

(Brissimis et Delis, 2010) ont analysé l'impact de la politique monétaire sur les prêts bancaires, la prise de risque et la rentabilité pour la zone Euro et les États-

Unis. Dans le cadre de leur étude sur les canaux de prise de risque, ces auteurs sont plutôt plus soucieux de savoir si les taux d'intérêt ont un effet différentiel sur le risque bancaire en raison de certaines caractéristiques des bilans bancaires. Ils analysent la réponse hétérogène des banques aux États-Unis et dans 12 pays de la zone Euro pour la période s'étalant de 1994 à 2007 en termes de leurs décisions de prise de risque suite à un changement dans la politique monétaire. Pour leur étude, ces auteurs, ont choisi la liquidité, la taille des banques et la part du marché comme indicateurs spécifiques aux banques et ils ont constaté que l'impact d'un changement de la politique monétaire sur le risque de crédit est plus faible pour les banques bien capitalisées et liquides.

D'autres, comme (Delis & Kouretas, 2011), examinent l'impact des faibles taux d'intérêt sur la prise de risques des banques en utilisant une grande base de données trimestrielles collectée des bilans des banques dans les 16 pays de la zone euro pour la période 2001-2008. Cependant, ces auteurs, dans leur étude, se sont plus préoccupés par le niveau des taux d'intérêt que par des changements de politiques monétaires. Le ratio des actifs risqués à l'actif total et le ratio des prêts non performants au total des prêts étant leurs indicateurs de risque, ils estiment des équations de risque en utilisant différents taux d'intérêt. Les auteurs constatent que les faibles taux d'intérêt augmentent la prise de risque des banques, alors que ce résultat est robuste aux différentes spécifications et à l'utilisation des données annuelles. En outre, leur analyse empirique révèle que l'impact de la faiblesse des taux d'intérêt sur les actifs à risque est plus faible pour les banques bien capitalisées, mais il est amplifié pour les banques avec des activités de hors bilan élevées.

Par ailleurs, (Maddaloni & Pedyro, 2011), ont utilisé les données des enquêtes sur l'offre de crédit dans la zone Euro et États-Unis pour analyser l'impact de la faiblesse des taux d'intérêt sur les normes de crédit qui s'appliquent aux entreprises et aux ménages au cours de la période de 2003 à 2008. Ces derniers ont montré que l'application de faibles taux d'intérêts à court terme favorise l'assouplissement des normes standards. Par contre, ceci n'est pas observé avec des taux d'intérêt à long termes. Plus encore, ils montrent aussi que l'activité de titrisation affaiblit la supervision bancaire et que l'application prolongée de faibles taux d'intérêts augmente le laxisme bancaire.

Généralement, ces études empiriques se sont focalisées sur l'impacte des changements des politiques monétaires principalement via la baisse des taux d'intérêts sur la prise excessive de risque des banques. Alors que l'acte de prendre plus de risque est souvent lié au changement de comportement des banques. En effet, de nouveaux outils financiers ont favorisé la mutation des comportements bancaires si bien que l'activité de titrisation permettant aux banques de se débarrasser des créances douteuses devient une pratique plus rentable que l'activité d'intermédiation traditionnelle. Certes, ces outils améliorent la rentabilité bancaire

mais un retournement brusque ou une attaque spéculative soudaine conduit inévitablement à une crise bancaire.

## 3. Données et Méthodologie

### 3.1. Données

Les données exploitées dans cette étude ont été extraites de la base de données de la Banque Mondiale (2015) ainsi que la base de donnée de (Demirgüç-Kunt & Levine, 2012). Notre panel est constitué de 22 pays d'Amérique latine, de l'OCDE et du Sud-Est Asiatique, qui ont connu des crises bancaires entre 1990 et 2014. Notre échantillon de pays est regroupé dans le tableau suivant :

**Tableau 1. Pays qui ont connu des crises bancaires entre (1990-2014)**

| **Pays** | |
|---|---|
| Argentine (1990/91/95/01/02/03) | Mexique (1994/95/96) |
| Colombie (1998/99/2000) | Philippines (1997/98/99/00/01) |
| France (2008/09/10) | Poland (1992/93) |
| Allemagne (2008/09) | Portugal (2008/09/10) |
| Greece (2008/09/10/11/12) | Spain (2008/09/10) |
| Indonesia (1997/98/99/00/01) | Thailand (1997/89/99/00) |
| Ireland (2008/09) | Tunisie (1991/92/93/95/01) |
| Italie (2008/09/10) | Turquie (2000/01) |
| Japon (1997/98/99/00/01) | UK (2007/2008) |
| Korea (1997/98) | USA (2007/2008) |
| Malaysie (1997/98/99) | Uruguay (2000/01/02/03/04/05) |

*Source: Base de données de la banque mondiale (2015) et Systemic Banking Crises Database: An Update (Luc Laeven and Fabián Valencia ) IFM 2012*

#### 3.1.1. Variable Dépendante

Pour mesurer la prise de risque des banques trois variables sont mises à contribution; le ratio des crédits non performants (NPL), l'indice de stabilité bancaire (Zscore) et le ratio des provisions sur les créances douteuses (Provnpl). En effet, le ratio NPL donne une indication de la qualité des actifs en termes du potentiel de l'exposition adverse aux gains et aux valeurs de marché des fonds propres due à l'aggravation de la qualité des prêts. Généralement, les crédits non performants permettent de refléter le niveau de risque de portefeuille des crédits ou des prêts d'une banque. Les niveaux plus élevés de ce rapport indiquent un portefeuille de prêts plus risqués car une partie des prêts non performants se traduirait probablement par des pertes pour la banque (Delis & Kouretas, 2011). La deuxième mesure proposée par Roy (1952) et utilisée par (Goyeau & Tarazi, 1992), (Boyd et al. 2006), (Laeven & Levine, 2006) et (Uhde & Heimeshoff, 2009), indique la distance d'éloignement de l'insolvabilité. Ainsi, une valeur plus élevée de

Zscore indique un faible risque de défaut. Mathématiquement, Zscore peut être notée comme suit:

$$Zscore_i = \frac{ROA_i + (\frac{E}{TA})_i}{\sigma(ROA_i)} \ldots\ldots\ldots\ldots\ldots 1$$

Où $ROA_i$est le rendement des actifs des banques, $(\frac{E}{TA})_i$ le ratio des capitaux propres et $\sigma(ROA_i)$ représente l'écart-type du rendement d'actifs. Par ailleurs, le ratio Zscore représente la probabilité d'un choc négatif sur les bénéfices qui poussent les banques à faire défaut (Yeyati & Micco, 2003). En effet, lorsque Zscore augmente avec une rentabilité et une capitalisation boursière élevée, il diminue avec un bénéfice instable capturé par l'écart de rendement des actifs. Par conséquent, une valeur plus élevée de Zscore implique un bon niveau de stabilité bancaire et donc moins de risques.

Nous avons choisi comme troisième mesure de risque la variable des provisions sur les créances douteuses (Provnpl). Cette dernière est souvent sollicitée en tant que baromètre de la santé bancaire. De façon générale les banques constituent des provisions pour esquiver d'éventuels risques de contre partie et de non remboursement de prêts accordés. Ainsi, l'augmentation des provisions est souvent synonyme de montée de risque. En effet, l'application d'une politique monétaire restrictive qui vise à baisser le volume de la masse monétaire en circulation, augmente le taux d'intérêt, diminue les réserves et les dépôts bancaires, ce qui conduit à une dégradation de la qualité des prêts et à une montée significative des provisions.

### 3.1.2. Variables Éxplicatives

Pour expliquer la prise excessive de risque des banques nous retenons 5 variables relatives aux différentes dimensions macroéconomiques et monétaires des banques. Elles représentent les différents indicateurs de mesure de la prise excessive de risque des banques et elles sont regroupées dans le tableau suivant ainsi que leurs signes respectifs attendu:

**Tableau 2. Indicateurs de mesures de prise de risque excessive par les banques**

| Variables | Signes | Interprétations |
|---|---|---|
| GPIB | (+/-) | (+) Une bonne condition économique signifie des investissements rentables et donc une baisse du risque .<br>(-)Par ailleurs une bonne condition économique incite les banques à chercher plus de profits et donc s'exposer à plus de risques. |
| INF | (+/-) | (+) la hausse de l'inflation se traduit par une hausse des couts de dépenses des entreprises locales et donc augmente la probabilité de leurs insolvabilités.<br>(-) la baisse de l'inflation détériore la liquidité bancaire et augmente ainsi l'insolvabilité des banques |
| TIR | (+/-) | (-) un faible taux d'intérêt pourrait induire un déséquilibre financier |

| | | |
|---|---|---|
| | | par une baisse de l'aversion des banques et d'autres investisseurs aux risques.<br>(+) un taux d'intêret élevé attire les investisseurs à rique |
| M2R | (+) | Une augmentation de la masse monétaire par rapport aux réserves de change augmente la vulnérabilité des pays aux sorties soudaines de capitaux et ce qui conduit à un effondrement rapide du taux de change. |
| CAP | (-) | Une baisse de la capitalisation boursière augmente le risque bancaire |

*Source: L'auteur*

### 3.2. Méthodologie

Dans cette étude nous adoptons une stratégie empirique à deux volets méthodologiques nous permettant de choisir la méthode d'estimation la plus appropriée. La règle de choix réagit à ce que les variables de nos modèles sont cointegrées ou pas. S'il existe au moins une variable cointegrée alors on utilise la méthode des moindres carrés modifiée (FMOLS) pour le modèle en panel cointegré et sinon on applique la méthode des estimateurs GMM système sur des données de panel dynamiques de (Arellano & Bover, 1995) et (Bundell & Bond, 1998).

#### 3.2.1. Méthode GMM-système

Cette approche nous permet de faire face à un certain nombre de défis d'identification et, par conséquent, c'est la méthode d'estimation appropriée pour plusieurs raisons.

Nous choisissons d'estimer un modèle empirique dynamique dans lequel nous introduisons la variable dépendante retardée avec les variables explicatives qui expliquent la persistance et la nature dynamique du risque. En outre, les taux d'intérêt sont considérés comme endogènes dans les équations de risque bancaire. En d'autres termes, le sens de la causalité entre la politique monétaire et le risque de la banque n'est pas évident et, par conséquent, il est nécessaire de contrôler la causalité inverse comme une forme particulière d'endogénéité. Parallelement à la variable de politique monétaire, certaines des variables de contrôle ne sont pas strictement exogènes. L'endogénéité entre le risque et les caractéristiques spécifiques des banques, qui sont des variables explicatives dans notre modèle, pose un autre problème d'identification. Dans ce contexte, l'estimateur GMM proposé par (Arellano & Bover, 1995) et (Blundell & Bond, 1998) est la méthode la plus pratique car elle intègre à la fois la persistance du risque et la possible endogénéité des caractéristiques spécifiques de la banque en utilisant des instruments appropriés, représentés par leurs retards respectifs.

Cet estimateur assure l'efficacité et la consistance, à condition que le modèle de régression dynamique n'soit pas soumis à l'autocorrélation de second ordre, et que les instruments utilisés soient valides. Pour cela, nous utilisons les tests

d'autocorrélation du premier et du second ordre AR(1) et AR(2). En effet, on pourrait s'attendre à la présence d'une autocorrélation de premier ordre dans les premiers résidus différenciés, la p-valeur de AR (2) doit largement acceptée l'hypothèse nulle d'absence de corrélation en série d'ordre deux en différences premières des erreurs. Parce qu'un ordre supérieur d'autocorrélation impliquerait que les retards de la variable dépendante n'est pas réellement endogène et donc de mauvais instruments. En outre, la validité des instruments est vérifiée à l'aide de test de restriction et de sur-identification de Sargan.

Notre modèle s'écrit de la manière suivante :

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + \eta_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots 2$$

Où $y_{it}$ est respectivement pour chaque modèle, les crédits non performants (NPL), l'indicateur de stabilité bancaire (Zscore) et la provision constituée sur les créances douteuses (Provnpl). $X_{it}$ est la matrice des variables de contrôles, $\eta_i$ représente l'effet spécifique individuel et $\varepsilon_{it}$le terme d'erreur.

Donc nous aurons trois modèles de mesure de risques qui peuvent êtres écrits comme suit:

$$NPL_{it} = \alpha NPL_{t-1} + \beta_1 GPIB_{it} + \beta_2 CAP_{it} + \beta_3 INF_{it} + \beta_4 TIR_{it} + \beta_5 M2R_{it} + \eta_i + \varepsilon_{it} \ldots\ldots\ldots\ldots 3$$

$$Zscore_{it} = \alpha Zscore_{t-1} + \beta_1 GPIB_{it} + \beta_2 CAP_{it} + \beta_3 INF_{it} + \beta_4 TIR_{it} + \beta_5 M2R_{it} + \eta_i + \varepsilon_{it} \ldots\ldots\ldots\ldots 4$$

$$Provnpl_{it} = \alpha Provnpl_{t-1} + \beta_1 GPIB_{it} + \beta_2 CAP_{it} + \beta_3 INF_{it} + \beta_4 TIR_{it} + \beta_5 M2R_{it} + \eta_i + \varepsilon_{it} \ldots\ldots\ldots\ldots 5$$

### 3.2.2. Méthode des Moindres Carrées Modifiée

Une régression impliquant des niveaux d'intégration d'ordre 1 I(1) des variables estimée par la méthode des moindres carrés ordinaires (MCO), peut produire de faux résultats. En particulier, la présence d'une intégration I(1) des variables peut provoquer une régression fallacieuse. Cependant, il est bien connu que si les séries sont cointégrées, le MCO statique est conforme, convergeant à un rythme plus rapide que ce qui est standard (Hamilton, 1994). La méthode des moindres carrés modifiée (FMOLS), nous permet de vérifier l'existence ou pas d'une relation de long terme entre les variables du modèle à estimer. Cette méthode d'estimation a été proposé par (Phillips et Hansen, 1990), puis étendue par (Phillips, 1995). C'est une procédure semi-paramétrique d'estimation des paramètres d'une relation de cointégration qui permet de corriger le biais d'endogénéité de long terme. Cette technique utilise des estimateurs de noyau des paramètres de nuisance qui affectent la distribution asymptotique de l'estimateur MCO. Afin d'atteindre une efficacité asymptotique, cette technique modifie la méthode des moindres carrés en prenant

en compte les effets de corrélation des séries et test l'endogénéité des variables explicatives résultant de l'existence d'une relation de cointégration.

(Phillips et Hansen, 1990) montrent que l'estimateur FMOLS fonctionne bien, même avec de petits échantillons quand on veut faire des inférences sur un système cointégré. L'utilisation de FMOLS nous permet de contribuer à la littérature empirique concernant l'estimation d'un modèle de panel cointégré avec des variables non-stationnaires. C'est, par FMOLS que nous pouvons estimer un modèle à variables multiples qui identifie les principaux déterminants du niveau de prise de risque et explique, au moins dans une mesure notable, la variation dans le temps du risque bancaire.

## 4. Résultats et Interpretations

Dans le but d'éviter toute régression factice, il est obligatoire de vérifier la stationnarité des séries en panel ainsi que l'absence de relation de cointégration entre elles.

Pour vérifier la stationnarité des séries en panel nous avons sollicité les test de (Levin, Lin et Chu, 2002) et (Im, Pesaran & Shin, 2003) suivant lesquels, l'hypothèse nulle signifie la présence d'une racine unitaire et, donc, la non stationnarité de la série en question. De plus, la particularité de ces deux tests réside dans le fait que le premier (LLC, 2002) permet la présence d'effets spécifiques individuels et d'hétérogénéité entre les individus, alors que le second (IPS, 2003) permet la possibilité d'une hétérogénéité quant à la présence même d'une racine unitaire dans le panel.

Les résultats des tests sont fournis par le tableau suivant:

**Table 3. Test de racine unitaire en panel en niveau**

| **Variables** | **Levin,Lin et Chu** | | **Im,Pesaran et Shin** | |
|---|---|---|---|---|
| | **Statistique** | **P-value** | **Statistique** | **P-value** |
| **NPL** | -6.21049 | 0.0000 | -2.12234 | 0.0169 |
| **GPIB** | -9.35229 | 0.0000 | -8.58800 | 0.0000 |
| **INF** | -183.310 | 0.0000 | -87.9998 | 0.0000 |
| **TIR** | -1.42433 | 0.0772 | -1.33671 | 0.0907 |
| **m2r** | -17.0940 | 0.0000 | -22.1136 | 0.0000 |
| **CAP** | -9.94980 | 0.0000 | -3.51186 | 0.0002 |
| **zscore** | -0.87092 | 0.1919 | -0.74039 | 0.2295 |
| **Provnpl** | -3.77521 | 0.0001 | -3.62873 | 0.0001 |
| **NPL** | -6.21049 | 0.0000 | -2.12234 | 0.0169 |

*Source: Calcul L'auteur*

L'hypothèse nulle de présence de racine unitaire n'a pas pu être rejetée en niveau pour les séries TIR et zscore. En vue de rendre ces séries stationnaires nous les

avons différenciées au premier ordre et les résultats sont fournis par le tableau suivant:

**Table 4. Test de racine unitaire en panel en première différence**

| Variables | Levin,Lin et Chu | | Im,Pesaran et Shin | |
|---|---|---|---|---|
| | **Statistique** | **P-value** | **Statistique** | **P-value** |
| **TIR** | -27.0216 | 0.0000 | -23.2066 | 0.0000 |
| **zscore** | -9.55112 | 0.0000 | -8.09777 | 0.0000 |

*Source: Calcul L'auteur*

Après une première différenciation, les variables sont stationnaires en différence première " I(1) ", ce qui laisse supposer une relation de cointegration entre ces variables non stationnaires en niveau.

Pour tester l'existence de relation de cointegration entre les variables de nos trois modèles nous avons sollicité le test proposé par (Pedroni, 1997; 1999; 2004) selon lequel, l'hypothèse nulle signifie l'absence de cointegration.

**Table 5. Test de Pedroni cointegration en panel**

| Variables | Levin,Lin et Chu | | Im,Pesaran et Shin | |
|---|---|---|---|---|
| | **Stat. Panel** | **Stat. Groupe** | **Stat. Panel** | **Stat. Groupe** |
| **TIR** | -0.985223 (0.1623) | 0.585561 (0.7209) | −1.015572 (0.1549) | −0.369783 (0.3558) |
| **zscore** | −2.217880 (0.0133) | −4.394762 (0.0000) | −2.699923 (0.0035) | −4.600342 (0.0000) |
| **ProvNpl** | 1.896614 (0.9711) | 0.432692 (0.6674) | 1.752641 (0.9602) | −0.526751 (0.2992) |

*Source: Calcul L'auteur*

Ce tableau montre que le test de (Pedroni, 1997 ; 1999 ; 2004) accepte l'hypothèse nulle d'absence de relation de cointégration entre les modèles NPL et ProvNpl et leurs variables explicatives. Par ailleurs, le test rejette l'hypothèse nulle d'absence d'une relation de cointégration entre les variables du modèle Zscore. Par la suite, on peut dire qu'il existe une relation de long terme entre la stabilité bancaire et ses variables explicatives.

Les résultats des estimations des trois modèles sont donnés par le tableau suivant:

**Tableau 6. L'effet de la politique monétaire sur la prise excessive de risque des banques**

| Modèles | $ME_{NPL}$ (GMM) | $ME_{\text{ProvNpl}}$ (GMM) | $ME_{Zscore}$ (FMOLS) |
|---|---|---|---|
| | **t-Statistic** | **t-Statistic** | **t-Statistic** |
| $ME_{t-1}$ | 84.77200 (0.0000) | 1.01E+11 (0.0000) | - |
| **GPIB** | −3.954368 | −3.684187 | 5.593271 |

| | | | |
|---|---|---|---|
| | (0.0001) | (0.0003) | (0.0000) |
| **CAP** | −3.669624<br>(0.0003) | 4.225457<br>(0.0000) | 2.686414<br>(0.0075) |
| **INF** | 4.216202<br>(0.0000) | 4.066478<br>(0.0001) | −0.250905<br>(0.8020) |
| **TIR** | −2.968566<br>(0.0032) | −3.193535<br>(0.0015) | 0.608066<br>(0.5435) |
| **M2R** | −3.134413<br>(0.0018) | −3.096506<br>(0.0021) | 3.218823<br>(0.0014) |

*Source: Calcul L'auteur*

Signif. codes: 0 (***) 0.001 (**) 0.01 (*) 0.05 (.) 0.1 ( ) 1

Les résultats des estimations concernant le premier modèle $ME_{NPL}$ , montrent que toutes les variables sont statistiquement significatives avec un signe négatif à une exception faite pour l'inflation (INF) qui affiche un signe positif. En fait, l'orientation de la politique monétaire mesurée par la variation du taux d'internet réel donnant une significativité négative à 5%, suggère que la baisse de ce taux impacte négativement la qualité du portefeuille de prêts et par conséquent, la solidité financière des banques. En d'autres termes, la prise de risque des banques augmente lorsque le taux d'intérêt réel diminue. Ceci est en cohérence avec les conclusions de la littérature empirique précédente (Diamond & Rajan, 2005) selon lesquelles une baisse du taux d'intérêt à long terme incite les gestionnaires d'actifs à prendre plus de risque pour plus de rendement. Par contre, et comme c'est indiqué dans (Altunbas et al. 2010), la baisse de la qualité du portefeuille de prêts est probablement renforcée par la réduction du financement des coûts de liquidité des banques suite à la baisse des taux d'intérêt à court terme (Diamond et Rajan, 2009; Adrian et Shin, 2009).

Par ailleurs, la variable masse monétaire par rapport aux réserves est statistiquement significative à 5% avec un signe négatif pour les deux modèles $ME_{NPL}$, $ME_{\mathrm{ProvNpl}}$ et positif pour $ME_{Zscore}$ Cela signifie qu'une politique monétaire expansionniste augmentant la masse monétaire, induit à long terme une baisse du risque ainsi que la provision sur le risque et favorise la stabilité bancaire. Cela peut être expliqué par le fait qu'une augmentation de la masse monétaire favorisant la baisse du taux d'intérêt attire les emprunteurs averses aux risques et stabilise le rendement des prêts bancaires. De plus, les ménages et les investisseurs ayant des projets à risques ont plutôt une préférence aux taux d'intérêt plus élevés puisqu'ils pensent qu'ils seront gagnants si leurs investissements sont rentables. Mais, un phénomène contraire peut se produire lorsque ces taux bas sont pratiqués sur des prêts immobiliées qui attirent les ménages les plus faibles en pouvoir de remboursement désirant acquérir un logement.

D'autre part, la variable relative à l'inflation est statistiquement significative à 1% avec un signe positif indiquant qu'une hausse du taux d'inflation augmente le risque

$ME_{NPL}$et $ME_{\text{ProvNpl}}$. En effet, la croissance de la masse monétaire implique une hausse des niveaux des prix attendus et par conséquence une augmentation de l'inflation, ce qui affecte négativement la capacité des emprunteurs à rembourser leur dettes puisque les coûts des dépenses ont augmenté.

En ce qui concerne l'impact des variables macroéconomiques, la croissance du PIB est significativement négative à 1%, comme indiqué dans la première colonne du tableau 2.6, ce qui implique que la probabilité de défaut de paiement est liée négativement au taux de croissance du PIB. Une bonne condition économique est toujours associée à une augmentation du nombre de projets pouvant êtres rentables à terme, qui, à son tour, conduit à une réduction du risque de crédit global d'une banque (Kashyap & Stein, 1995; Altunbas et al, 2010). En outre, les emprunteurs gagnent plus et, par conséquent, leur capacité à rembourser leurs prêts serait plus élevée en période de bonne conjoncture économique. Ce résultat est cohérent avec les conclusions de (Gambacorta, 2009), (Altunbas et al., 2010) et (Lopez et al., 2012), alors qu'il est à l'opposé de (Delis & Kouretas, 2011) font état d'une relation positive entre la croissance du PIB et des risques dans le secteur bancaire européen. Une interprétation possible de cette relation positive est que dans les moments de bonnes conditions macroéconomiques, les banques à la recherche d'un rendement élevé ont tendance à accorder plus de crédits et adoucissent leurs normes de contrôle. Par contre, et comme l'indiquent nos résultats, ce n'est pas le cas des systèmes bancaires de notre étude.

La variable relative à la capitalisation bancaire est statistiquement significative à 1% avec un signe négatif, signifiant que les banques bien capitalisées accordent moins de prêts non performants et donc un niveau de risque assez bas. L'impact négatif du capital sur le risque bancaire suggère que les banques qui affichent une bonne capitalisation et un ratio des capitaux propres par rapport aux actifs élevé sont moins exposées aux risques de l'aléa moral et ont tendance à se comporter de manière plus prudente. Les banques utilisent ce capital en tant que tampon pour contrecarrer le risque de possibles pertes des actifs à risques. D'autre part, les régulateurs ainsi que les marchés n'encouragent pas les banques les plus risquées à accumuler du capital (Altunbas et al. 2012), c'est-à-dire qu'ils n'ont pas à compenser le risque par des niveaux plus élevés de capitalisation. De plus, notre résultat s'aligne avec l'hypothèse de l'aléa moral, qui suggère que lorsque le niveau de fonds propres des banques est faible, les dirigeants des banques ont plus d'incitations à prendre des risques excessifs découlant de l'existence de problèmes d'agence entre les dirigeants des banques et les actionnaires. Ainsi, nous pouvons dire que les banques ayant des niveaux d'investissement plus élevés ont tendance à avoir une meilleure qualité du portefeuille de prêts et, donc, à profiter de la baisse du risque de crédit.

## 5. Conclusion

Les dernières crises bancaires et financières ont soulevé de nombreuses questions au sujet de la conduite de la politique monétaire. En particulier, des questions concernant la relation entre la politique monétaire et la stabilité financière et bancaire. C'est pourquoi, dans cette étude, nous avons beaucoup insisté sur la façon dont la politique monétaire influence, d'une part, la perception et augmente, d'autre part, l'appétit du risque des intermédiaires financiers.

Nos résultats empiriques montrent que l'adoption d'une politique monétaire expansionniste via l'augmentation de la masse monétaire et l'application de taux d'intérêt bas, peut induire une augmentation de la prise de risque des banques, entrainant un changement dans l'offre de crédit en particulier vers la hausse. Ceci se traduit par une augmentation du volume des crédits non-performants et par conséquent le risque.

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