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The Joint Effects of Oil Price Volatility and Environmental Risks on Non-performing Loans: Evidence from Panel Data of Organization of the Petroleum Exporting Countries

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ABSTRACT

This paper analyses the joint effects of oil price volatility and environmental risks on non-performing loans (NPLs). Using panel data of 12 Organization of the Petroleum Exporting Countries (OPEC) for 2000-2014, we test hypotheses of joint effects of oil price changes and environmental risks on NPLs. Estimates from static panel model highlights the explanatory power of systemic risks theory in linking the effects of oil price volatility and environmental risks on NPLs and underpins their importance for policy implication purposes in OPEC member states. This calls for concerted policy and management response for assessing oil price sensitive and disaster riskiness of borrowing entities. This paper is of particular value to oil dependent countries such as OPEC member states that are net oil exporting countries. From the policy perspectives, there is need for banking regulators to consistently ensure the conduct of both micro-stress and macro-stress tests of loans against the systemic risks of oil price volatility. In addition, policymakers in the banking system should redesign their prudential guidelines to take care of the credit risks vulnerabilities associated with environmental risks and spread their risks across industries and geographical areas that are less prone to disasters.

Keywords: Oil Price Volatility, Environmental Risks, Non-performing Loans, Organization of the Petroleum Exporting Countries
JEL Classifications: G32, Q43, Q54

1. INTRODUCTION

The global position of non-performing loans (NPLs) is persistent and on the rise as indicated by World Bank's World Development Indicators (WDI) in Figure 1 from 2005 to 2014 which is an alarming scenario that calls for immediate action. The statistics showed that in 2005 the level NPLs stood at 3.9 and dropped to its lowest level of 2.8 in 2007 and rose to its highest level of 4.3 in 2014 (Idris and Nayan, 2016). The situation of NPLs is more pronounced among Organization of the Petroleum Exporting Countries (OPEC) member states because the averages of NPLRs are twice those of the global averages as indicated in Figure 1.

The existence of huge NPLs on the lending banks' balance sheets is phenomena that poses a threat to banking systems of many economies around world. Hence the need for a concerted effort in investigating the root causes. Castro (2013) opined that the recent financial crisis of 2007/2008 drew attention to the negative consequences that banking crises could have on economies, hence, a source of motivation to researchers to search for factors that may trigger NPLs and subsequently banking crises.

In this paper we study the empirical determinants of NPLs using a novel dataset of 12 OPEC member states spanning 2000-2014. Apart from the traditional determinants of NPLs of gross domestic product (GDP), interest rate, inflation rate and unemployment rate we also highlighted the importance of the two systemic risk factors of crude oil price volatility and environmental risks factor. Although, this study does not have sufficient data to fully investigate the channels through which these systemic risk variables affect NPLs.

However, in case of oil price volatility when prices collapse the cash flow generated by economic units will decrease and that will decrease the availability of funds to the borrowing customer thereby affecting NPLs. On the other hand, an increase in the crude oil price can create more value to the customer as it can make more funds available to the economic units and improve their cash flow hence increasing their chances of repaying their loans as at when due. More so, high price can increase the spending limits of government and consumption of economic units thereby stimulating more demand in the economy.

Furthermore, the occurrence of emergency situations in form of natural or technological disasters can interrupt the general business activities of an economy. These interruptions can have direct and indirect effects on the borrowing customers' cash flow and their repayment abilities thereby creating defaults which can lead to NPLs. The direct effect is when the disaster impact on the business activities of a borrower which can be the factory, employees or its supply channels thereby affecting production processes which can stop cash flow hence credit default that leads to NPLs. The indirect effect has to do with second degree impact on economic units' cash flow through drop in the demand of their products or inability to collect accounts receivables. It can also be as a result of litigations against the borrowing economic units that engage in business activities that cause environmental damages as well as their impact on communities which can affect their abilities to pay back their loans hence propelling NPLs.

The channel through which lending interest rate can influence NPLs is most likely to be through upward variation of the loans prices. The growth in economic activities represented by GDP can on the other hand transmit its effect on NPLs by increasing steady cash-flow of the borrowers thereby reducing bad bank loans while drop in GDP can increase NPLs because it will constrain the repayment abilities of the borrowing customers.

More so, increase in the inflation rate will be channeled through reduction in the value of customer assets thereby reducing customers' ability to pay back loans as at when due. Conversely a decrease in inflation can improve the repayment abilities of borrowers because the value of their assets will increase thereby averting delinquencies (NPLs) and possible insolvencies. Finally, a rise in unemployment rate can be channeled to NPLs through reduced demand for goods and services which will affect the cash-flow of the borrowing economic units hence the emergence of credit default and subsequent NPLs and a decrease in unemployment rate can improve spending limits of economic units thereby averting defaults and NPLs.

The study relied on the systemic risks theory and causal credit-credit theory in explaining the effect of oil price volatility and environmental risks on NPLs (see, for example, Collier and Skees, 2013; Haldane and May, 2011; Love and Ariss, 2014; Sy, 2007).

This article proceeds in the following order: Section 2 highlights related literatures to macroeconmic variables, systemic risks factors and NPLs. The third section examines the empirical method of the study. Section 4 discusses the empirical findings. The last section stated the policy implications of the findings and the conclusions offered.

2. REVIEW OF RELATED LITERATURE

The concept of NPLs, non-performing assets or impaired loans has been defined by several researchers to mean a loan that its interest and/or principal which has been left unpaid for over 90 days. For example, Klein (2013) perceived NPLs as loans on which principal repayment and/or interest have not been made for a period of over 90 days. Akinlo and Emmanuel, (2014) and Minton et al. (2009) considered NPLs as loans that are long overdue with over 90 days.

However, Beck et al. (2015) further stressed that NPL could be a loan that is unlikely to be repaid without recourse to recovery actions such as the sale of obligor's held collateral security, if any. D'Hulster et al. (2014) opined that NPLs is an obligation related to loans and advances that has become over 90 days past-due or when the banks consider the borrower is unlikely to pay back loans. However, this excludes loans that have been realized through recovery efforts such as sales of obligors' securities as well as those that have been restructured (Idris and Nayan, 2016).

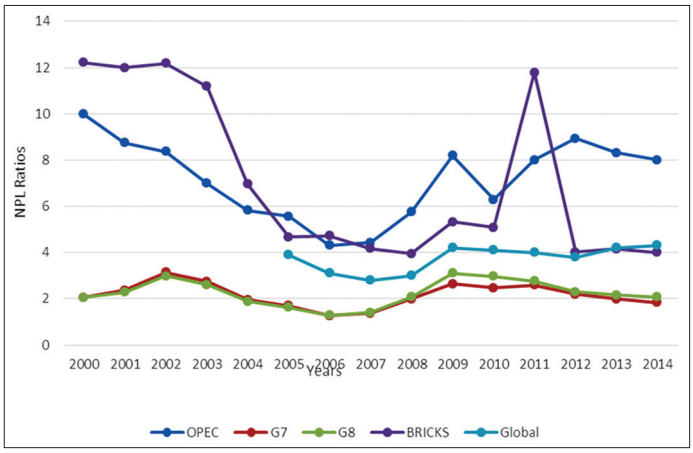
Despite the significance of loans to economies, the WDI revealed a global persistent and rising level of NPLs as revealed in Figure 1. Additionally, it shows that the problem is indeed highly pronounced amongst OPEC member state which reveals the intensity of the problem and the need for all stakeholders and researchers to investigate the root causes of the problem in OPEC with a view of coming up with solutions.

A comprehensive NPLs data from Bankscope[1] spanning 2000-2014 reveals a very high and persistent level NPLs among OPEC members states compared to other major global economic groupings of seven major advanced economies (G7)[2], the group of eight highly industrialized nations (G8)[3] and the association of five major emerging national economies (BRICS)[4]. Also, the effect of on-going oil price shocks among the OPEC members and their persistent NPLs have shown very clearly that a continuous monitoring of the banking system and credit risks to which banks are exposed is of utmost importance to practitioners, investors and policymakers

Several attempts have been made by researchers to understand the causes of NPLs but much emphasis have been placed on bank-specific, industry-specific and macroeconomic variables of bank lending rate, bad management, bank size, credit growth, as well as central bank autonomy, exchange rates, GDP, interest rate, inflation rate and unemployment rate (see for example, Beck et al., 2015;

1 A private data bank firm that keeps global banks data across countries of the world.
2 G7 means seven major advanced economies of Canada, France, Germany, Italy, Japan, United Kingdom and United States.
3 G8 means eight highly industrialized nations of Canada, France, Germany, Italy, Japan, Russia, United Kingdom and United States.
4 BRICS means five major emerging national economies of Brazil, Russia, India, China and South Africa.

Figure 1: Average non-performing loans ratios of global, Organization of the Petroleum Exporting Countries, G7, G8 and Brazil, Russia, India, China and South Africa



Source: Bankscope, WDI and authors' calculations (2015)

Castro, 2013; Ghosh, 2015; Louzis et al. 2012; Makri et al. 2014; Mileris, 2012; Pesola, 2011; Vogiazas and Nikolaidou, 2011).

Most of these researches were conducted outside major oil exporting countries such as OPEC member states that are characterized by volatile oil price changes and prevalence of environmental risks (natural and technological disasters), based on statistics provided by EM-DAT[5]. However, there were few attempts made by researchers in studying the effects of these systemic risks variables of oil price volatility and environmental risk on NPLs. Therefore, an investigation of the effects of these variables on NPLs will provide us with better understanding of troubled loans (NPLs).

Previous studies have related numerous macroeconomic variables to country level NPLs. Most of the studies used GDP, inflation rate, interest rate and unemployment variables in their models of the determinants of NPLs. Therefore, these variables are included in this article in order to get its model well specified.

GDP is an important determinant of NPLs and has been used by several researchers in their models. For example, Louzis et al. (2012) who used generalized method of moment (GMM) estimator in investigating the effect of GDP on NPLs of nine largest Greek banks from 2003Q1-2009Q3. The study found an inverse relationship between GDP and NPLs. Also, Castro (2013) used the same GMM estimator to investigate the relationship between GDP and NPLs amongst Greece, Ireland, Portugal, Spain and Italy (GIPSI) over the period of 1997q1-2011q3. His study suggested that NPLs are significantly increased by a decrease in GDP growth. Furthermore, Makri et al. (2014) in a similar study of 14 Eurozone countries from 2000 to 2008 using exclusive aggregate data of bank, they suggested that an annual percentage growth rate of GDP denoted significant negative relationship to NPLs and public debt as percentage of GDP was found to be positively and significantly related to NPLs. More so, Ghosh (2015) in a study of 50 US States and the District of Colombia spanning 1984-2013 found a significant inverse relationship between GDP and NPLs.

The rate of inflation influences general price level of goods and service as well as prices of bank loans. Demirgüç-Kunt and Detragiache (1998) opined that this assumption might be true especially if expected inflation is not factored in the pricing of the loans. Abid et al. (2014) in a study of the macroeconomic and bank-specific determinants of household's NPLs in Tunisia used a quarterly dynamic panel date of 16 banks from 2003Q1-2012Q4 with 768 banks-quarter observations, the result revealed a positive relationship between inflation and NPLs. However, Mileris (2012) used a panel data of 22 EU countries to investigate the effect of inflation on loan portfolio credit risk from 2008 to 2010, also found a positive relationship between inflation and NPLs.

Additionally, interest rate is a significant factor in influencing both bank deposit and loans which has attracted a lot of researchers' attentions. For example, Ali and Daly (2010) in the short-term found a significant but negative relationship between interest rate and credit risks (NPLs). On the contrary Louzis et al. (2012) in their study established a significant positive relationship between interest and NPLs but mostly affecting consumer loan and business loan than mortgage loan. More so, Beck et al. (2015) revealed that an increase in lending interest rates tends to increase NPLs. However, Goel and Hasan (2011) suggested an inverse relationship between lending (interest) rate and NPLs. Their study revealed that loan defaults are lower in economies with higher lending (interest) rates than in countries with lower interest rates.

Quagliariello (2007) suggested that high unemployment rate influences business activities of economies which in turn impacts on demand of goods and services thereby reducing households' disposable income and their ability to repay their debts. The assumption is that a gainful employment increases various economic units' opportunities to consume, save, pay back loans and invest the surpluses. The study of Louzis et al. (2012) investigated the relationship between unemployment rate and NPLs between the period of 2003q3 and 2009q3 among 9 largest Greece banks found a strong relationship between the variables. Also, Castro (2013) examined the relationship between unemployment rate and credit risks in GIPSI countries. Their study discovered a significant positive relationship between unemployment rate and NPLs. However, the study Akinlo and Emmanuel (2014) examined the relationship between unemployment rate and NPLs among Nigerian banks. The result revealed a positive but an insignificant relationship between unemployment rate and NPLs. Additionally, Ghosh (2015) found a significant positive relationship between unemployment rate and NPLs.

Apart from these macroeconomic variables that affect the NPLs there are systemic risks which can also affect loan performance such as oil price volatility and environmental risks.

As stated earlier, this article has not come across any paper that investigated the relationship between oil price volatility and NPLs. More so, it has not found a study that investigated the relationship between multi-environmental risks and NPLs among datasets of

5 EM-DAT et al., The CRED/OFDA International Disaster Database-www.emdat.be-Université Catholique de Louvain-Brussels-Belgium.

multiple countries because the previous studies mainly used single environmental risk and/or single country in their investigations. Therefore, this paper relies on wider literature of the effect of oil price volatility and environmental risks on other economic activities.

Attempts were made by previous researchers to explain the relationship between oil price and other economic and financial activities. The studies of Hamilton (1983), Mork (1989), Farzanegan and Markwardt (2009) and Aguiar-Conraria and Soares, (2011), established relationship between changes in oil price and macroeconomic variables. However, the study of Poghosyan and Hesse (2009), investigated the relationship between oil prices shocks and bank profitability amongst Middle East North Africa oil-exporting countries. The study was conducted between 1994 and 2008 using a panel data and GMM estimation approach. The result revealed that oil price shocks have indirect effect on bank profitability.

Furthermore, Breunig and Chia (2015) in a study of 115 oil-exporting countries from 2003-2008 using panel dataset investigated the effects of high and rising oil price on sovereign credit rating of the studied countries. They used ordinary least squares (OLS) in their investigation and concluded that persistently high oil prices changes over the period of 2003-2008 were accompanied by a positive shift in sovereign ratings for high oil-exporting countries.

More so, Sotoudeh and Worthington (2014) investigated the effect of global oil price changes on macroeconomics and financial markets. The study indicated that as opposed to net oil producing countries, the macroeconomics of net oil consuming countries have long-term co- integrating relationships with oil price. The financial markets of both country panels exhibited long-term co-integrating relationships with oil price. Therefore, based on the above studies we presume that oil price volatility can have an effect on other banking activities such as loan performance.

More so, the studies of Aintablian et al. (2007) and Weber (2012) investigated the relationship between environmental credit risk management (ECRM) and bank performance. Additionally, Klomp (2014) studied the relationship between financial fragility, bank solvency and natural disasters. More specifically the work of Weber (2012) investigated the relationship between ECRM and bank performance. His study involved the six largest Canadian banks that constituted 90% of Canadian assets. He also suggested that one of the key businesses of banks is the loan business, and thus credit risk management is a major activity to guarantee the success of a bank.

Additionally, Klomp (2014) investigated relationship between financial fragility and natural disasters and banks performance. The study suggested that disasters will affect assets quality by increasing default rate as a result of deaths, physical disabilities and loss of sources of income of their borrowing and deposit customers. Furthermore, it suggested that disaster occurrences may also affect operational activities of the banks, that is, their infrastructures that might have been impacted by the disasters hence a serious challenge to their liquidity positions.

On the other hand Collier and Skees (2013) found that disasters can create both asset losses and liquidity shortages for inclusive finance institutions. Also they stressed that deposit-taking financial institutions will experience liquidity shortages if depositors withdraw their deposits to manage the disaster or borrowers failing to repay loans. Collier and Skees, used historical data of previous disasters that occurred within the periods of their studies as provided by EM-DAT of the international disaster database of Centre for Research on Epidemiology of Disasters. The database contains chronology of all reported major natural and technological disasters across the world from 1900 to 2015. This article relies on these established relationships and believes that same environmental risks can have effects on NPLs.

From the above we can conclude that banking systems of OPEC member states can be affected by oil price volatility and environmental risks. Therefore, we are motivated by the persistent and rising levels of global NPLs and amongst the OPEC member states and the latter's current predicaments of falling oil prices and vulnerability to both local and global environmental risks. Furthermore, there were very scantly studies linking the systemic risk variables of oil price volatility, environmental risks and NPL.

3. EMPIRICAL METHODOLOGY

This section critically examines the likely determinants of NPLs. The essence is to determine if the systemic risks factors of oil price volatility and environmental risks variables possess additional explanatory power when added to the baseline model of macroeconmic determinants of NPLs, especially in oil export dependent countries of OPEC. More so, the paper investigated whether decline in oil price and high frequency of natural and technological disasters can provide explanation of the deterioration of loan qualities among OPEC member states. Finally, for the model to be well specified the control variables of GDP, inflation rate, lending interest rate and rate of unemployment are added to the equation.

3.1. Data Descriptions

The paper used annual secondary data that have already being made available by the banks to relevant agencies and general public in the case of the dependent variable while data on the explanatory variables were obtained from independent sources. The NPLs is measured as a ratio of NPLS to total loans. Therefore, following the study of Boudriga et al. (2009) we used aggregate NPLR data of the OPEC member states. The reason for this is as opined by Boudriga et al. that aggregated data best reflect the level of NPL of the banks in a country as opposed to individual bank data.

The NPLRs data of the banks for the countries over the period of the research were obtained from Bankscope DataStream. Additionally, the data on oil price volatility, environmental risks, GDP, lending interest rate, inflation and unemployment variables were obtained from OPEC databank, EM-DAT database and World Bank WDI respectively. Therefore, the study used annual

Table 1: Summary of the definition of variables

Variables	Measurement	Sources	Expt. outcome
NPLR	NPL/total loans	Bank scope date base	N.a
GDP	Real GDP (constant 2005 US$)	WDI-World Bank database	(−)
INF	Consumer price index	WDI-World bank database	(+)
INT	Lending Interest rate	WDI-World bank database	(+)
UNE	Unemployment rate (%)	WDI-World bank database	(+)
OLP	OPEC basket price	OPEC database	(±)
ERK	Environmental risk	EM-DAT[7]	(+)

NPLR: Nonperforming loans ratio, GDP: Gross domestic product, INF: Rate of inflation, INT: Interest rate, UNE: Unemployment rate, OLP: Oil price, ERK: Environmental risks

panel data of the 12 OPEC member states[6] for the period spanning 2000-2014. Table 1 presents the summary and definition of the variables.

3.2. Econometric Technique

Following the work of Makri et al., (2014) with some modification this paper used Equation (1) as the model specified for this study. It incorporates all sets of variables, that is, the dependent variable represented as NPLR; the variables of interest which are made up of oil price volatility and environmental risks as well as the control variables of GDP, lending interest rate, inflation rate and unemployment rate.

$$NPLR_{it}=\beta_0+\beta_1 OPR_{it}+\beta_2 ERK_{it}+\beta_3 GDP_{it}+\beta_4 INiF_{it} +\beta_5 LIR_{it}+\beta_6 UNE_{it}+\varepsilon_{it} \quad (1)$$

Where: NPLR represents ratio of NPL to total loan. OPR and ERK mean oil price volatility and environmental risk respectively. GDP refers to real GDP. INF stands for rate of inflation. LIR indicates lending interest rate. UNE is the unemployment rate and Ɛ means error term, whereas it represents every country overtime.

4. EMPIRICAL FINDINGS

The correlation analysis is presented in Table 2. A correlation above 0.7 indicates evidence of multicollinearity (Hair et al. 2009). Based on that, statistical evidence from the correlation in Table 2 shows the absence of multicollinearity among variables.

Similarly, statistical evidence from information matrix normality tests (Cameron and Trivedi, 1990) in Table 3 shows the data is normally distributed. Whereas the Breusch-Pagan test indicates that the error term is homoscedastic in nature. In addition, the Ramsey test indicates no evidence of omitted variable.

The estimated results of the models are presented in Table 4, where the coefficients of OLS (Model 1), random effect (Model 2) and fixed effect (Model 3) are documented. More interestingly, it emerged that all the coefficients did not deviate from theoretical expectations.

The coefficient of OPR is statistically negative and significant at conventional level. This suggests that on average an increase in oil price by 1 US dollar ($) is accompanied by a corresponding decrease of NPLs by 0.0756, all things being equal. This means an appreciation of crude oil price will improve the net worth position of borrowing customer and decrease their chances of credit default. This finding is in line with the findings of Poghosyan

Table 2: Correlation analysis

	NPL	OPR	GDP	INF	LIR	UNE	ERK
NPL	1.000						
OPR	0.073***	1.000					
GDP	−0.280	−0.591***	1.000				
INF	0.040	0.210***	−0.248***	1.000			
LIR	0.065	0.237***	−0.405***	0.691***	1.000		
UNE	0.230***	0.069**	−0.070***	−0.102	0.013	1.000	
ERK	0.248***	0.211***	−0.053	0.104***	0.246	0.112	1.000

***, ** and *: denote significance at 1%, 5% and 10% respectively, NPL: Nonperforming loans, OPR: Oil price volatility, GDP: Gross domestic product, INF: Rate of inflation, LIR: Lending interest rate, UNE: Unemployment, ERK: Environmental risks

Table 3. Diagnostic checks

Tests	χ^2	P value
Skewness IM-test	8.54	0.201
Kurtosis IM-test	2.13	0.145
Breusch-pagan test	0.03	0.855
Ramsey test	2.29	0.081

IM: Information matrix

Table 4: Regression coefficients of OLS; fixed effect and random effect

Variables	1	2	3
	OLS	Fixed	Random
OPR	−0.0756**	−0.180***	−0.0756**
	(0.0295)	(0.0503)	(0.0295)
LGDP	−4.722***	−11.58***	−4.722***
	(1.203)	(2.661)	(1.203)
INF	0.0294	0.0148	0.0294
	(0.0280)	(0.0316)	(0.0280)
LIR	−0.0956	−0.111	−0.0956
	(0.0676)	(0.0845)	(0.0676)
UNE	0.292**	0.237	0.292**
	(0.139)	(0.266)	(0.139)
ERK	0.241**	−0.110	0.241**
	(0.102)	(0.147)	(0.102)
Constant	120.7***	290.9***	120.7***
	(29.72)	(65.69)	(29.72)
R^2	23%	10%	21%
Hausman test		0.08	
B-P LM test			0.07

Standard errors and robust standard in in parentheses ******.*: Denotes statistical significance at 1%, 5% and 10%, respectively. B-P denotes, Breusch-Pagan, LM: Lagrangian multiplier. OPR: Oil price volatility, LGDP: Log of gross domestic product, INF: Inflation, LIR: Lending interest rate, UNE: Unemployment, ERK: Environmental risks, OLS: Ordinary least squares. Estimates from Model 1 are the OLS; Model 2 is the fixed effect; while Model 3 is the random effects

6 As at 2015: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirate and Venezuela.

7 (EM-DAT et al., 2016).

and Hesse (2009) which suggested that an increase in oil price lead to a corresponding increase in bank profitability. The finding is also in consonance with both systemic risk theory and causal credit-default theory.

Additionally, the coefficient of GDP is statistically significant at 1%. This suggests that an increase in GDP will reduce NPLs by 4.722. The result also confirms that GDP has a negative impact on NPLs as reported by Makri et al. (2014) and Ghosh (2015). At 5% level of significance, result in Table 4 indicates that on the average an additional occurrence of natural and/or technological disaster increases NPLR in OPEC member states by 0.241. This finding is in conformity with the systemic risks theory and empirical findings of Collier and Skees, (2013) and Klomp (2014). The occurrence of disaster will either directly or indirectly affect the net-worth of businesses and individuals thereby increasing their chances of credit defaults. Result in Table 4 reveals that UNE is positively and statistically significant at conventional level, indicating that an increase in unemployment increases NPLs by 0.292. This finding is in line with theoretical expectation and also concurs with empirical studies of Castro (2013) and Ghosh (2015). The higher the unemployment rate the more the financial difficulties of the affected households and the higher their chances of credit default. Furthermore, a fall for demand of goods and services as a result of rise in unemployment rate can affect businesses' cash-flows which eventually increase credit default hence higher NPLs.

5. CONCLUDING REMARKS

The consequences of the presence of huge NPLs as indicated in Figure 1, can be severe and devastating on the global banking system and more particularly on OPEC economies. Although, there were several previous studies on the effect of macroeconomic variables on NPLs and overall loans qualities. In this paper, we investigated the explanatory power of systemic risks factors of oil price volatility and environmental risks on NPLs using panel dataset of OPEC member states spanning 2000-2014.

Based on the econometric model, we conclude that NPLs is significantly affected by the systemic risks factors of crude oil price volatility and environmental risks when added to the baseline of macroeconomic determinants of NPLs of GDP, inflation, lending interest and unemployment rates. The results further indicated a statistically significant inverse relationship between oil price volatility and NPLs whereas the relationship is statistically positive between environmental risks and NPLs.

In the area of policy implications, there is the need for banking regulatory authorities to consistently ensure conduct of both micro-stress and macro-stress tests of loans against the systemic risks of oil price volatility. More so, bank management and policymakers in the banking system should redesign their prudential guidelines to take care of the credit risks vulnerabilities associated with environmental risks and spread their risks across industries and geographical areas that are less prone to natural and technological disasters.

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