The vulnerability of Islamic bank's credit risk to oil price shocks: evidence from Malaysia based on ARDL approach

Rahman, Syarifah and Masih, Mansur

INCEIF, Malaysia, Business School, Universiti Kuala Lumpur, Kuala Lumpur, Malaysia

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Syarifah Rahman[1] and Mansur Masih[2]

Abstract:

Credit risk analysis is a key to a better financial risk management. This issue has been the primary focus of financial and banking industry since loans are the largest and most prominent source of credit risk. Unlike the conventional banking, there is a lack of empirical study on credit risk about Islamic banking. As such, further research regarding the vulnerability of the Islamic banking industry has become vital. Accordingly, this paper is aimed at determining and assessing the long run vulnerabilities of Malaysian Islamic banks in term of its response to the shocks of the price of crude oil. The fall in oil prices is believed to have an impact on loans' repayment. Additionally, the selected key macroeconomic variables used in this study will be used as controlled variables so that the model will not be spurious. The autoregressive distributed lag (ARDL) methodology is employed to test this relationship, controlling for information in other financial and economic indicators. Based on the result of variance decompositions (VDCs) and impulse response function (IRF), it is found that, sufficient evidence of a long-run relationship exists between credit risk ratio in Islamic banking industry and the selected macroeconomic variables. The results tend to indicate that oil price shocks are an endogenous variable in the short-run dynamics, and the ranking provided byVDCs indicates that oil price shocks are least likely to have affected the Non-performing financing (NPF) ratio of Islamic banks as it is ranked at 6th place.

Keywords: Islamic banks, Non-performing financing (NPF), oil price, ARDL, VDC, Malaysia

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[1] INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

2 **Corresponding author**, Senior Professor, UniKL Business School, 50300, Kuala Lumpur, Malaysia.

Email: mansurmasih@unikl.edu.my

INTRODUCTION (issues motivating the study)

The financial system of an economy plays a crucial role in the development of a nation. This is because while the real sector of the economy produces the country's output of goods and services, the financial sector plays the pivotal role of providing the financing needed to fund this productive capacity through their intermediaries' role. That is by mobilizing the savings of surplus units and channelling them to productive units that need the funds.

There are several advantages of having the financial intermediaries in an economic system. Firstly, transaction costs can be reduced when financial intermediaries bundle all the funds of many investors together due to the advantage of economies of scale. Secondly, financial intermediaries are also better able to develop expertise so that the transaction cost can be reduced. And thirdly, the role of financial intermediaries to diversify the risk exposure of investment will help investors (fund savers) to invest (loan) in more safe or less risky investment (to borrowers). Therefore, a financial intermediary becomes an expert in producing information about borrowers so that it can distinguish good credit risks from bad ones.

However during times of turbulences, sometimes good credit risks may also have difficulties in paying back their loans as per scheduled. While most of the world are still recovering from the impact of 2008/2009 financial crisis, again the global event of steep fall in crude oil prices in 2014 took the turn to stir up the world economy especially to the oil exporting countries.

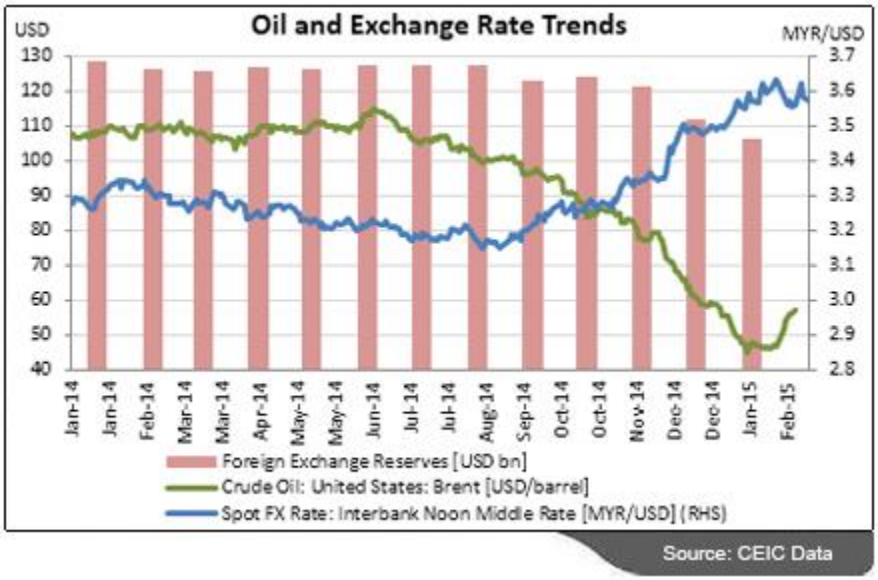


Figure 1: Oil and Exchange Rate Trends

Malaysia as the world's second-largest exporter of liquefied natural gas and the second-largest oil and natural gas producer in Southeast Asia was also profoundly impacted by this event. For the past seventh consecutive month in January 2015, the crude oil prices have been declining to reach USD 45.13/barrel (Brent blend). By the mid-point of the month, the crude oil price reached their lowest level since March 2009. However, as of February 16th, the price registered a mild recovery to USD61.86/barrel. Nevertheless, the current levels of oil prices are severely depressed compared to last years. This declining in the oil prices has severely damaged Malaysia's fiscal revenue base. The reason being, its fiscal receipts rely substantially on contributions from the nationalised oil and gas industry. For example, in 2013, the contribution of petroleum income tax and royalty to total budget revenue is at MYR 29.75 billion (13.9% of central government revenue) and MYR 6.19 billion (2.9% of central government revenue) respectively. The plunging oil prices have seen to further affected the Malaysian Ringgit, which fell to MYR 3.634/USD in January 2015, its lowest level since April 2009. The event which plunging oil prices to change Malaysian currency and government's revenue shows that price shocks of oil received valuable concern for their presumed role on macroeconomic variables (Brown & Yucel, 2002; Caruth, Hooker, & Oswald, 1998; Davis, 2001; Ferderer, 1996).

Since Malaysia is one of the largest oil exporters, it is understood that the country is dependent on oil income. Therefore, exports, government revenues, and fiscal balances have dramatically fallen, together with declining GDP growth as explained above. As a result, the plunging oil prices will put strains on both corporates' and banks' profitability. Hence, worsening the credit growth to the private sectors. This is known as the oil prices direct effect to the economy. Another indirect effect operates via expectations and the overall business sentiment in the country. As explained by Poghosyan & Hesse (2009), "*higher oil prices could lead to higher domestic demand which will feed back into higher bank confidence, lending, and low nonperforming loans. Similarly, on the aggregate supply side, the productive capacity of countries is also likely to be expanded with new public and private investments fueled by high oil prices, pushing growth rates even further*" (Poghosyan & Hesse, 2009). Additionally, Kinda, Mlachila, & Ouedraogo (2016), explained that for commodity-dependent countries, a decline in commodity prices will result in "*reduced export income, which could adversely impact economic activity and agents' (including governments) ability to meet their debt obligations, thereby potentially weakening banks' balance sheets*".

By the principle of financial intermediation, banks are vulnerable to insolvency when the value of their assets are less from the liabilities as a result of the inability of the borrowers to pay

back their debt (Demirguç-Kunt and Detragiache, 1998). The credit risk of banks is measured by the ratio of Non-Performing Loans (NPL) or Non Performing Financings (NPF) which indicates the inability of banks to received payments from the borrower for conventional and Islamic terms respectively. The previous systemic banking crises tremendously contributed to the weaknesses of the financial system, which previously affected negatively on the NPL or NPF ratios. Additionally, Clair (2004) and Bracons et.al (2006) found that the evaluation of the overall quality of asset and credit risk in banking industry becomes a critical element in detecting the vulnerability in the financial sector.

Unlike in conventional banking system which has tonnes of studies that investigated the relation between NPF and macroeconomic variables, we found that there is a lack of empirical literature that explores this relationship in Islamic banking. Further, it is not until recent plunging of oil price that we have found researchers are starting to show some interest to examine the relationship between oil price and bank's vulnerability. Therefore, it is our modest attempt to investigate the influence of oil price to Malaysian Islamic bank's stability by analysing through the effect of non-performing financing.

Malaysia is selected firstly, because of its pole position as a leading Islamic finance hub. Secondly, this study provides a small contribution to the extant literature by providing evidence on the causes of NPFs in an emerging country like Malaysia and most importantly in an Islamic banking system. And finally, the outcome of this paper may be as a guide for evaluating and considering credit risk in Malaysia's Islamic banking system.

The primary objective of this study is to examine the effect of oil price to the non-performing financing in Malaysia. Both long- and short-run relationships between the variables are measured by using ARDL approach. It is found that from the Cointegration test, all variables are moving together in the long run. This implies that the relationship between NPF, LOILP, LIPI, LINT, LCPI, LPPI and LEX are not spurious. Additionally, from the error correction model (ECM) we have found ROILP, LIPI, INT, and NPF to be endogenous variables while LCPI, LPPI, and LEX are exogenous. Further, the findings of the variance decomposition (VDCs) test found that the industrial production index (IPI) became the most exogenous variable wheras the oil price is most endogenous (ranked at 6^{th} place) which implies that the changes in the non-performing loan, in the long run, could be explained more by the industrial production index than the oil price.

This paper is of five sections. Following this chapter of introduction, the remaining parts of the paper are organized as follows: Section 2 provides literature review; Section 3 will discuss the data and methodology intended for this study which is the ARDL model; Section 4 will thoroughly review the empirical findings while Section 5 will exert some concluding remarks and policy implications of the study. And finally, references bring up the end of this paper.

1.0 2.0 LITERATURE REVIEW

Generally, many of researchers, have researched different variables that influence the efficiency and the growth in the Islamic banking and striving to show the possible reasons behind the growth in Islamic banks during financial troubles. Some of the studies that review the efficiency of the Islamic bank were (Samad and Hassan, 1999; Samad, 2004) showed that Islamic banking was less risk and more liquid than the western banking system. These studies have used the financial ratios to measure the efficiency and liquidity of these banks.

Other studies such as (Mostafa, 2007; Al Shamsi et al., 2009; Said, 2013) examined the efficiency of the Arab banks system. These studies revealed that Institutional size and resources had an influence on their efficiency. These studies used the Data Envelopment Analysis model to measure the effect of these variables on the efficiency. Other studies (Alkassim, 2005; Darrat et.al., 2002) revealed that total equity had a positive relationship to profitability, capitalization, and efficiency.

Some studies measured the bank efficiency behavior by review different factors such as managerial capabilities, overhead costs, bank size, risk assessment capacity, The legal and institutional environment, and investment management (Demirgüç-Kunt and Huizinga, 1999; Dell'Arriccia and Márquez, 2004; Demirgüç-Kunt and others, 2004). While other studies that examined the oil price movement influence on significantly economic activities in different countries such as (Cologni and Manera, 2009; Cunado and Perez de Garcia, 2005; Gronwald, 2008; Balaz andLondarev, 2006; Kilian and Vigfusson, 2009; Cologni and Manera 2008).

Nevertheless, not much of literature can be found to examine the correlation between oil price shock and bank performance. Poghosyan and Hesse made the first empirical attempt, (2009) linking oil prices to bank performance in the MENA area for the period 2000-2011. Their findings suggest that oil prices affect bank profitability indirectly, via the macro channel. More recently, Said (2015) measured the influence of the oil prices on the efficiencies scores of the Islamic banks in the same area during the financial crisis and again, found that there no direct relationship exist between the oil price and the efficiencies scores of Islamic banks in the

MENA area. However, the study revealed that the null hypothesis of oil price has no influence on the efficiencies scores of Islamic banks cannot be rejected. Most recently, Kinda, Mlachila, & Ouedraogo (2016) investigated the impact of commodity price shocks on financial sector fragility and presented a more comprehensive analysis of the issue from multiple angles than done so far in the existing literature. They have concluded that adverse shocks to commodity prices are associated with higher financial sector fragility.

And so, we can see that the issue of the shocks in commodity prices and financial sector vulnerability has sparked more interests to the researchers now rather than seven years ago, (since Poghosyan & Hesse made their first attempt in 2009) due to the plunging price of crude oil happened recently. Therefore, this paper is trying to make a humble contribution to the literature on bank vulnerability relating to the shocks in the price of oil. And, to best of our knowledge, no study has clearly reviewed the correlation between the oil prices and banks' vulnerability via assessing their credit risk especially in small emerging economy like Malaysia.

2.0 MODEL, DATA, AND METHODOLOGY

2.1 Method of Estimation

The method selected for the purpose is the Auto Regressive Distributive Lag (ARDL) cointegration procedure developed by Pesaran et al. (2001). It is considered to be a relatively more efficient model in testing for a small sample data size, as in the case of this paper (Pattichis, 1999; Mah, 2000). Secondly, ARDL approach can be applied to the variables regardless of the order of their integration whereby it manages to take care of the series that are entirely I(0), I(1) or a combination of both. This is a contrast with the cointegration test methods based on Engle-Granger (1987), Johansen (1991; 1995) and the Johansen-Juselius (1990) which require all the variables to be of the equal degree of integration, I(1). Thirdly, the ARDL Model applies general-to-specific modelling framework by taking a sufficient number of lags to capture the data generating process. It predicts $(p + 1)k$ number of regressions to obtain an ideal lag length for each variable, where p is the maximum lag to be used, and k is the number of variables in the equation. The selection of the model is dependent on different criteria like SBC, AIC, RBC, and HQC. Fourthly, traditional cointegration methods may also experience the problems of endogeneity. But, ARDL method can distinguish between dependent and explanatory variables and eradicate the problems that may arise due to the presence of autocorrelation and endogeneity through ECM. However, there is still prerequisite

that none of the explanatory variables is off I(2) or higher order, i.e. the ARDL procedure will be inefficient.

ARDL cointegration estimates short run and long run relationship simultaneously and provides unbiased and efficient estimates. The appropriateness of utilizing ARDL model is that the ARDL model is based on a single equation framework. The ARDL model takes sufficient numbers of lags and directs the data generating process in a general to specific modelling framework (Harvey, 1981). Unlike further multivariate cointegration techniques such as Johansen and Juselius (1988), ARDL model permits the cointegration relationship to be estimated by OLS after the lag order of the model has been identified. Error Correction Model (ECM) can also be drawn from by ARDL approach (Sezgin and Yildirim, 2003). This ECM also produced an outcome for long run estimates while other traditional cointegration techniques do not provide such types of inferences. "ECM contains Short-run adjustments and Long-run equilibrium without losing Long-run information" (Pesaran and Shin, 1999). These advantages of the ARDL has justified the application of ARDL approach in this study to analyze the impact of oil price shocks (LOILP) on bank's vulnerability by using non-performing financing rate (NPF) as a proxy. Also, the controlling variables; industrial production index (LIPI) (employed as a proxy for GDP), consumer and producer price index (LCPI and LPPI respectively), the real interest rate (INT) and real exchange rate (LEX) are used for modelling this objective.

2.2 Model Specification and Data

The study follows a model based on the life-cycle hypothesis which assumes that the capacity of households to repay debts depends on several factors, which include expected track of future income and real interest rates. Lawrence (1995) and Rinaldi & Sanchis-Arellano (2006) have previously adopted the life-cycle framework in investigating the determinants of bank loan losses. The results from the work of Rinaldi & Sanchis-Arellano (2006) suggest that the households' financial condition might become more at stake if there are adverse shocks in their income and wealth. Since the falling of oil price will be affecting the commodity-dependent companies, it is observed here in Malaysia; this company would need to lay off its workers, reduced some of the perks that it has been giving to the high-level executives, and some will experience a monthly pay-cut to sustain the organization. And therefore, this situation may lead to an adverse shock to the household income and wealth. Additionally, recent past empirical studies frequently added inflation rate and exchange rate to the list of explanatory variables. Hence, in this study, the model can be expressed as follows:

$$NPF_t = \beta_0 + \beta_1 CPI_t + \beta_2 IPI_t + \beta_3 PPI_t + \beta_4 ROILP_t + \beta_5 INT_t + \beta_6 REX_t + \varepsilon_t \quad (1)$$

Whereby, NPF is the Non-Performing Financing for Islamic banks in Malaysia which is the proxy to measure banks' vulnerability; ROILP is the spot crude oil price in Malaysia while CPI (Consumer Price Index) and PPI (Producer Price Index) both measures the inflation rate in Malaysia. Since the data for Gross Domestic Product (GDP) is not available in monthly, Industrial Production Index (IPI) is used as a proxy. INT measures the real interest rate while REX represents the real exchange rate of Malaysia. β_0 is constant whereas ε_t is the error term.

Our model for this study is then estimated as the following:

$$NPF_t \sim \beta_0 + \beta_1 LCPI_t + \beta_2 LIPI_t + \beta_3 LPPI_t + \beta_4 LOILP_t + \beta_5 LINT_t + \beta_6 LEX_t + \varepsilon_t \quad (2)$$

H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$ - Long - run relationship exist

H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq 0$ - Long - run relationship does not exist

The model is intentionally written in the Vector Error Correction Model (VECM) form even though the traditional time-series analytical method are not followed here. However, we refrained from putting the equality sign in this initial stage.

All of the variables are being transformed to log formed except for NPF and INT as they are already in percentage form. Since the data for NPF only available from January 2007, this study uses monthly time series data dated from January 2007 – Sep 2015 with the total number of observations of 105. All data of this study are collected from International Financial Statistics (IFS), except NPF, which is available via Bank Negara Malaysia's (BNM) monthly statistically bulletin (Bank Negara Malaysia, BNM, 2016).

3.0 EMPIRICAL RESULTS AND DISCUSSION

3.1 Stationarity tests

In time series analysis, to avoid a spurious regression in the model, the stationarity of the variables are necessary. The data is stationary when there is a constant pattern over time or inclination fluctuating around the average value (Gujarati, 2009). Therefore, we begin our empirical testing by determining the stationarity of the variables used. There are two types of unit root tests performed in this study which is Augmented Dickey-Fuller (ADF) tests (1979) and Philip-Perron (PP) test. The difference between these two tests is that ADF can overcome the issue of autocorrelation but cannot solve the problem of heteroskedasticity. On the other hand, PP can tackle both autocorrelation and heteroskedasticity problem using Newey-West adjusted method and therefore, both tests may occasionally produce different results.

In this study, firstly the ADF test is performed on each variable in both log and differenced form then followed by PP test. The differenced form for each variable used is created by taking the difference of their log forms. For example, DOILP = LOILP – $LOILP_{t-1}$.

The results of ADF are tabularized in Table 1.1 and Table 1.2 below for both in level and differenced form respectively. Likewise, the results of PP analyses are summarized in Table 1.3 and Table 1.4.

Table 1.1: Stationarity Test (Level/Log Form) - ADF

Variable	**ADF**	**T-Stat**	**C.V**	**Result**
NPF	ADF(2)	-3.2711	-3.3969	Non-Stationary
LOILP	ADF(2)	-3.3319	-3.3969	Non-Stationary
LCPI	ADF(1)	-4.1294	-3.3842	Stationary
LPPI	ADF(2)	-2.7534	-3.3969	Non-Stationary
LIPI	ADF(2)	-1.8484	-3.3969	Non-Stationary
INT	ADF(2)	-2.1219	-3.3969	Non-Stationary
LEX	ADF(1)	-.24411	-3.3842	Non-Stationary

Table 1.2: Stationarity Test (Differenced Form) - ADF

Variable	**ADF**	**T-Stat**	**C.V**	**Result**
DNPF	ADF(1)	-9.8582	-3.4294	Stationary
DOILP	ADF(2)	-5.0510	-3.3526	Stationary
DCPI	ADF(1)	-6.3208	-3.4294	Stationary
DPPI	ADF(1)	-3.8530	-3.4294	Stationary
DIPI	ADF(1)	-11.1342	-3.4294	Stationary
DINT	ADF(1)	-5.7531	-3.4294	Stationary
DEX	ADF(2)	-4.7815	-3.3526	Stationary

Table 1.3: Stationarity Test (Level/Log Form) - PP

Variable	**T-Stat**	**C.V**	**Result**
NPF	-2.6099	-3.4518	Non-Stationary
LOILP	-1.8625	-3.4518	Non-Stationary

LCPI	-1.9514	-3.4518	Non-Stationary
LPPI	-1.5546	-3.4518	Non-Stationary
LIPI	-6.0578	-3.4518	Stationary
INT	-1.4335	-3.4518	Non-Stationary
LEX	-.65838	-3.4518	Non-Stationary

Table 1.4: Stationarity Test (Differenced Form) - PP

Variable	**T-Stat**	**C.V**	**Result**
DNPF	-12.6316	-3.4228	Stationary
DOILP	-5.9429	-3.4228	Stationary
DCPI	-5.3905	-3.4228	Stationary
DPPI	-5.4304	-3.4228	Stationary
DIPI	-27.1063	-3.4228	Stationary
DINT	-8.4425	-3.4228	Stationary
DEX	-6.8894	-3.4228	Stationary

Based on displayed tables above, we can conclude that only one variable is stationary in level form, and all variables are stationary in first difference. However, the variable that is stationary in level form is different in ADF and PP tests. Since both tests reveal the mixed of I (0) and I (1), this study can choose either to employ ARDL approach or to use Engle-Granger test and Johansen test. However, we found that there is no cointegration of variables at all from the empirical results of Engle-Granger test whereas in Johanssen test, there are at least three cointegrating vectors for these variables. Hence, since the results of unit root test are not consistent and the mixed results found on cointegrating vectors using Engle-Granger and Johansen tests, we decided to proceed using ARDL approach to testing for the long run relationship among the variables.

3.2 Selection of Optimal Lag

Before we continue with Cointegration test, we try to determine the order of the vector autoregression (VAR), though it is not necessary to do so since ARDL approach determines the individual lag order to each variable by itself. The selection of optimal lag in this study is based on the highest lag of Akaike Information Criterion (AIC) & Shwarz Bayesian Criterion (SBC). Table 2 shows the result of an optimal lag selection test for NPF model. Based on AIC,

lag order selected based on the criterion for NPF model is 1. However, based on SBC and Adjusted LR Test critical value (10% significance), lag order selected by the criterion for NPF model is 0. Since there is a conflict between the recommendation of AIC and SBC, it will be more efficient to choose the result according to the nature of the data set which we used in this study. AIC focuses on predicting best of the order of lags and large value of likelihood. AIC has less concerned on over-parameter and therefore, tends to choose the higher order of lags. Thus, the lag order selected in this study is 1 following AIC.

Table 2: Optimal Lag

Order	AIC	SBC	Adjusted LR Test [Prob]
6	1443.3	1054.3	-
5	1454.1	1128.4	42.9080[.717]
4	1470.1	1207.7	79.9617[.908]
3	1460.7	1261.6	145.5696[.518]
2	1471.4	1335.7	188.5406[.636]
1	1477.5	1405.2	236.6180[.638]
0	1445.1	1436.0	328.0385[.084]

3.3 Cointegration Analysis

In this step, the analysis is to "test the null hypothesis of no cointegration (H0:δ1δ2 δ3 δ4 δ5 δ6 δ7 = 0) against the alternative hypothesis that there exists cointegration (H1: δ1δ2 δ3 δ4 δ5 δ6 δ7 ≠ 0) between all variables by using F-statistics. Therefore, we first check the long run relation between non-performing finance (NPF), oil price (LOILP), consumer price index (LCPI), producer price index(LPPI), industrial production index (LIPI), interest rates (INT) and exchange rate (LEX) as per table below:

Table 3: F-Stat results based on 5% Critical Bound

Variable	**F-Stat**	**5% Upper Bound**	**Result**
NPF	4.3620[.001]	3.7891	Long-run relationship exists
LOILP	1.3041[.263]	3.7891	Long-run relationship does not exists
LCPI	1.9432[.077]	3.7891	Long-run relationship does not exists
LPPI	2.1068[.055]	3.7891	Long-run relationship does not exists
LIPI	.83765[.560]	3.7891	Long-run relationship does not exists

INT	2.5784[.021]	3.7891	Long-run relationship does not exists
LEX	2.7667[.014]	3.7891	Long-run relationship does not exists

The above F-statistics relates to the 'variable addition test,' a test to know whether the 'lagged level form' of the variables added to the equation is significant. In this regards, two bounds of critical values are generated. The lower bounds critical values serve as a benchmark for I(0) variables while the upper bound critical values serve as a point of reference for I(1) variables. According to the bound test, cointegration exists if the computed statistics exceeds the upper critical value. If computed F-statistic falls within the two limits of critical values, the variables must compose of the level and first difference integrated series for the possibility of cointegration. Finally, if the F-statistic is below the lower critical value, it implies no Cointegration.

If the 'F' statistic is significant, this means that the null hypothesis of no long-run relationship between the variables is rejected. From the result, it is seen that when other variables besides NPF taken as the dependent variable, there is no evidence of long-run relationship as the calculated F-Statistics are below the 5% critical upper bound. However, when NPF took as the dependent variable, the F-Statistics of 4.3620 exceeds the critical bound which implies that a long run relationship exists and in fact not spurious.

That means, there is a theoretical relationship between the variables, and this indicates that each variable has information for the prediction of other variables and they are in equilibrium in the long-run. In other words, bank policymakers can monitor their NPF rate by taking into account the changes in oil price (LOILP), consumer price index (LCPI), producer price index(LPPI), industrial production index (LIPI), interest rates (INT) and exchange rate (LEX). Now that we have observed this, we need to estimate the long-run coefficients and see if they are significant in showing the variable's endogeneity based on the t-ratios and the p values.

3.4 Static Long Run Results

In this particular stage, the short- and long-run linkage are examined by using the error correction model (ECM). The ARDL approach to cointegration involves estimating the unrestricted error correction model version of the ARDL model for Islamic non-performing loan rate and its determinants: The error correction equation is used to find the adjustment speed to the equilibrium in the third stage.

First, we will analyse on the long-run coefficient analysis with NPF as our dependent variable as suggested from the F-bound test previously. Table 4 below summarized the results of long-run coefficient analysis based on the AIC.

The error correction version of the ARDL (1, 1, 1, 1, 1, 1, 1,) model is as follows:

$$\Delta 1NPL_t = \alpha + \sum_{i=1}^{1} \alpha \Delta 1NPL_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1LCPI_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1LIPI_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1LPPI_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1LOILP_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1LEX_{t-1} + \sum_{i=1}^{1} \alpha \Delta 1INT_{t-1} + \delta_1 1NPL_{t-1} + \delta_2 1LCPI_{t-1} + \delta_3 1LIPI_{t-1} + \delta_4 1LPPI_{t-1} + \delta_5 1LOILP_{t-1} + \delta_6 1LEX_{t-1} + \delta_7 1INT_{t-1} + \varepsilon_t$$

Table 4: Long Run Results for NPF based on AIC. ARDL (4,1,3,3,0,1,3)			
Variable	**Coefficient**	**Standard Error**	**T-Ratio [Prob]**
LCPI	2.1332	8.2341	.25907[.796]
LIPI	-4.2541	2.9395	-1.4472[.152]
LPPI	-5.2617	3.8367	-1.3714[.174]
LOILP	-0.28415	.68192	-.41670[.678]
LEX	-2.4984	3.0718	-.81333[.418]
INT	0.46272	.43003	1.0760[.285]
INPT	46.8189	18.9654	2.4686[.016]**

Note: ** Significant at 5% level

Our results show that there are no significant long-run relationships among given variables as none of the T-ratios stated here are above 2 nor are their probability values below 5%. The only significant variable in this model is that of INPT, which known as the 'constant' term. We then proceed to the error correction model, (ECM) for estimating the short run dynamics.

3.5 Short Run Dynamics Results

The deviation from equilibrium (represented by the error-correction term) is examined whether it has a significant feedback effect on the dependent variable and this is shown by the "t-ratio"

or the "p-value" of the error-correction coefficient. Cointegration shows the existence of the long-term relationship, but occasionally there could be deviations from long-run in short-term relationships. Thus, cointegration does not tell us much about short-run relationship and how it affects the long-run relationship. That is the reason we used ECM to explain the effect of short-run influence on the long-run relationship. In simple words, ECM defines which variable is endogenous and which is exogenous. As shown in Table 5, the error correction model based on AIC reveals the exogeneity and endogeneity of a variable by looking at the p-value of ECM. The null hypothesis for this test is that the variable is exogenous whenever the p-value exceeds 5% critical value and vice versa, the variable is deemed endogenous whenever the p-value is lower than the critical value of 5%.

Table 5: Error Correction Model based on AIC

ecm(-1)	**Coefficient**	**Standard Error**	**T-Ratio [Prob]**	**C.V**	**Result**
***d**LOILP*	-.26796	.053052	-5.0509[.000]	5%	Endogenous
***d**LCPI*	-.0060407	.040650	-.14860[.882]	5%	Exogenous
***d**LPPI*	-.030016	.041963	-.71529[.476]	5%	Exogenous
***d**LIPI*	-.31290	.13857	-2.2581[.026]	5%	Endogenous
***d**INT*	-.19617	.031678	-6.1925[.000]	5%	Endogenous
***d**LEX*	-.041268	.065307	-.63190[.529]	5%	Exogenous
dNPF	-.18569	.061609	-3.0140[.003]	5%	Endogenous

From the result table above, there are four endogenous variables identified in this study; (i) the oil price; (ii) the industrial production index which we have used as a proxy for measuring GDP; (iii) interest rate and (iv) non-performing financing. Whereas, CPI, PPI, and exchange rate are determined as exogenous variables. Hence, this implies that CPI, PPI, and exchange rate play important roles in determining the changes in NPF. The findings of the exchange rate and inflation to influence Islamic bank's credit risk is further supported by Nursechafia & Abduh, 2014. From the theoretical point of view, it has already proven that the non-performing financing is expected to be dependent on other variables which taken into the consideration in this study and it is also empirically shown in other studies which were carried out by the conventional banks. About interest rate as an endogenous variable, although our source of data to determine the level of interest rate differ, our results discover that interest rate to be an endogenous variable (Shamsudheen & Masih, 2015). Shamsudheen & Masih (2015) argued that the theoretical underpinnings suggested interest rate should be an independent variable. However, due to the close linkage between inflation and interest rate, it is possible for the

interest rate to be endogenous, as the government will have the upper hand to change the interest rate targets so that the economy will be kept in balance.

However, our findings on IPI variable seem to be contradicting. While this study found IPI to be an endogenous variable, Shamsudheen & Masih (2015) found that IPI can be exogenous to explain NPF, which is consistent witih the presumptions and the previous literature. However, Shamsudheen & Masih (2015) provided supportive literature that mention the industrial production take place only in the long-run and the variable is not in short-term effects.

Finally, our interest in looking at the shock of oil price to the response of NPF is rather unsuccessful because the short-run dynamics has identified the oil price to be endogenous. This is true because it is found that the demand and supply of oil are regulated and thus, have caused the oil price to be endogenous (Yip, Lim, & Golam Hassan, 2009)

By staying true to our objective, it is revealed from Table 5 the error correction statistics and p-value show NPF is highly significant. The coefficient estimated at -.18569 (0. 061609) is significant, has the correct sign and implies a moderate speed of adjustment to equilibrium after a shock. Approximately 18.57% of disequilibria from the previous quarter's shock adjust to the long run equilibrium in the current quarter. Finally, the't' or 'p'value of the coefficients of the Δ (i.e., differenced) variables indicate whether the effects of these variables on the dependent variable (i.e., NPL) are significant or not in the short-run. Furthermore, since oil price has been identified as endogenous, we have found the variable cannot be explaining the changes in NPF. Therefore, since ECM does not tell us much about the relative ranking of a variable from the most exogenous to the most endogenous, we need to employ the Variance Decompositions (VDCs) technique to identify the classification regarding the relative exogeneity or endogeneity of these variables.

3.6 Variance Decompositions (VDCs)

In the short run dynamics, the results only show us which of the variables are exogenous and endogenous. It does not explain the relative degree of endogeneity or exogeneity among the variables. Therefore, VDCs are applied so that the relative degree of endogeneity or exogeneity of the variables can be determined. The relative exogeneity or endogeneity of a variable can be examined by the proportion of the variance explained by its past. The most exogenous variable which is the most leader and independent than others is explained mostly by its shocks (and not by others) while the least endogenous variable is the variable whose variation is explained mainly by its past variations.

This study applied generalized VDCs as opposed to orthogonalized VDCs because generalized VDCs do not depend on the particular ordering of the variables in the VAR as compared to orthogonalized VDCs. Secondly, generalized VDCs do not hold the assumption that when a particular variable is shocked, all other variables in the system are switched off. Therefore, for the purpose of this particular study, generalized VDCs are more preferred than orthogonalized VDCs. Since the previous result provides no significant long run relationship among the variables; the forecast horizon is chosen at shorter period namely; 3 months, 6 months, 9 months and 12 months (1 year) respectively shown in Table 6 below.

Table 6 depicts the forecasted error VDCs. The results exhibit in the table is consistent across the horizons where the most exogenous variable is industrial producer index then followed by interest rate, non-performing loan, exchange rate, producer price index, oil price and consumer price index. This result is contradicting to the results obtained from ARDL findings above as IPI was identified as endogenous variable in ARDL. Furthermore, the variables that were identified as exogenous such as CPI and PPI seem to be the most endogenous as they are ranked at 7^{th} and 5^{th} place respectively. Additionally, our interest in looking at the shock in the price of oil to the NPF shows that oil price seems to be the least factor in affecting the NPF as it is ranked at 6^{th} place. This finding is non-contradict to the previous studies done as they have also found no direct relationship between oil-price and bank's stability in MENA area (Poghosyan & Hesse, 2009; Said A., 2015).

Table 6: The VD Matrix

	HORIZON	LCPI	LIPI	LPPI	LOILP	LEX	LNPL	LINT	TOTAL	SELF-DEP	RANKING
LCPI	3	54.09%	0.21%	21.36%	18.66%	2.72%	1.85%	1.11%	100.00%	54.09%	7
LIPI	3	1.66%	88.36%	0.68%	4.55%	1.11%	2.99%	0.66%	100.00%	88.36%	1
LPPI	3	2.81%	0.09%	65.39%	27.23%	1.08%	1.38%	2.02%	100.00%	65.39%	5
LOILP	3	0.86%	0.31%	29.26%	62.19%	0.25%	0.51%	6.62%	100.00%	62.19%	6
LEX	3	4.57%	1.12%	2.55%	1.92%	82.58%	3.71%	3.55%	100.00%	82.58%	4
LNPL	3	2.44%	3.56%	2.91%	0.77%	2.25%	85.29%	2.78%	100.00%	85.29%	3
LINT	3	0.20%	1.07%	3.13%	4.17%	2.42%	0.73%	88.28%	100.00%	88.28%	2

	HORIZON	LCPI	LIPI	LPPI	LOILP	LEX	LNPL	LINT	TOTAL	SELF-DEP	RANKING
LCPI	6	53.54%	0.21%	21.58%	18.78%	2.76%	1.83%	1.30%	100.00%	53.54%	7
LIPI	6	1.67%	88.27%	0.69%	4.51%	1.13%	3.05%	0.68%	100.00%	88.27%	1
LPPI	6	2.81%	0.10%	65.34%	27.21%	1.11%	1.38%	2.06%	100.00%	65.34%	5
LOILP	6	0.87%	0.32%	29.25%	62.16%	0.26%	0.51%	6.63%	100.00%	62.16%	6
LEX	6	4.60%	1.14%	2.56%	1.92%	82.51%	3.71%	3.55%	100.00%	82.51%	4
LNPL	6	2.44%	3.74%	2.91%	0.78%	2.26%	85.10%	2.77%	100.00%	85.10%	3
LINT	6	0.20%	1.08%	3.14%	4.17%	2.43%	0.73%	88.25%	100.00%	88.25%	2

	HORIZON	LCPI	LIPI	LPPI	LOILP	LEX	LNPL	LINT	TOTAL	SELF-DEP	RANKING
LCPI	9	53.54%	0.21%	21.57%	18.78%	2.76%	1.83%	1.30%	100.00%	53.54%	7
LIPI	9	1.67%	88.27%	0.69%	4.51%	1.13%	3.06%	0.68%	100.00%	88.27%	1
LPPI	9	2.81%	0.10%	65.34%	27.21%	1.11%	1.38%	2.06%	100.00%	65.34%	5
LOILP	9	0.87%	0.32%	29.25%	62.16%	0.26%	0.51%	6.63%	100.00%	62.16%	6
LEX	9	4.60%	1.14%	2.56%	1.92%	82.51%	3.71%	3.55%	100.00%	82.51%	4
LNPL	9	2.44%	3.74%	2.91%	0.78%	2.26%	85.10%	2.77%	100.00%	85.10%	3
LINT	9	0.20%	1.08%	3.14%	4.17%	2.43%	0.73%	88.25%	100.00%	88.25%	2

	HORIZON	LCPI	LIPI	LPPI	LOILP	LEX	LNPL	LINT	TOTAL	SELF-DEP	RANKING
LCPI	12	53.54%	0.21%	21.57%	18.78%	2.76%	1.83%	1.30%	100.00%	53.54%	7
LIPI	12	1.67%	88.27%	0.69%	4.51%	1.13%	3.06%	0.68%	100.00%	88.27%	1
LPPI	12	2.81%	0.10%	65.34%	27.21%	1.11%	1.38%	2.06%	100.00%	65.34%	5
LOILP	12	0.87%	0.32%	29.25%	62.16%	0.26%	0.51%	6.63%	100.00%	62.16%	6
LEX	12	4.60%	1.14%	2.56%	1.92%	82.51%	3.71%	3.55%	100.00%	82.51%	4
LNPL	12	2.44%	3.74%	2.91%	0.78%	2.26%	85.10%	2.77%	100.00%	85.10%	3
LINT	12	0.20%	1.08%	3.14%	4.17%	2.43%	0.73%	88.25%	100.00%	88.25%	2

Also, the contributions of own shocks towards explaining the forecast error variance of each variable for forecast horizon of 3 months is slightly different compared to 6 months, 9 months and 12 months. Nonetheless, they provided the same ranking across the horizons.

3.7 Impulse Response Function (IRF)

In this section, the same information as the VDCs is presented in the graphical form known as impulse response functions (IRFs). IRF will explain the sensitivity of NPL to the shocks of the selected macroeconomic variables.

Table 7 summarizes information from Figure 2 which shows that sensitivity's direction of NPF towards the selected macroeconomic variables. For example, one standard deviation shock of exchange rate leads to a decrease in default ratio (NPF) of Malaysia's Islamic banks. Like other countries, depreciation of currency value could potentially influence the changes in capital goods which are mostly imported from abroad. The majority of the export based industries and infrastructure investments strictly dependent on imported tools and machinery. When import prices increase, it will impact on the ability of the companies in paying back their loan to the bank. Again, the finding is similar to Nursechafia & Abduh (2014).

Table 7: Impulse Response Function Summary

Shock	**Response of NPF**
DIPI	Positive and stabilize in 13th period
DINT	Positive and stabilize in 9th period
DEX	Negative and stabilize in 9th period
DPPI	Positive and stabilize in 9th period
DOILP	Positive and stabilize in 13th period
DCPI	Positive and stabilize in 9th period

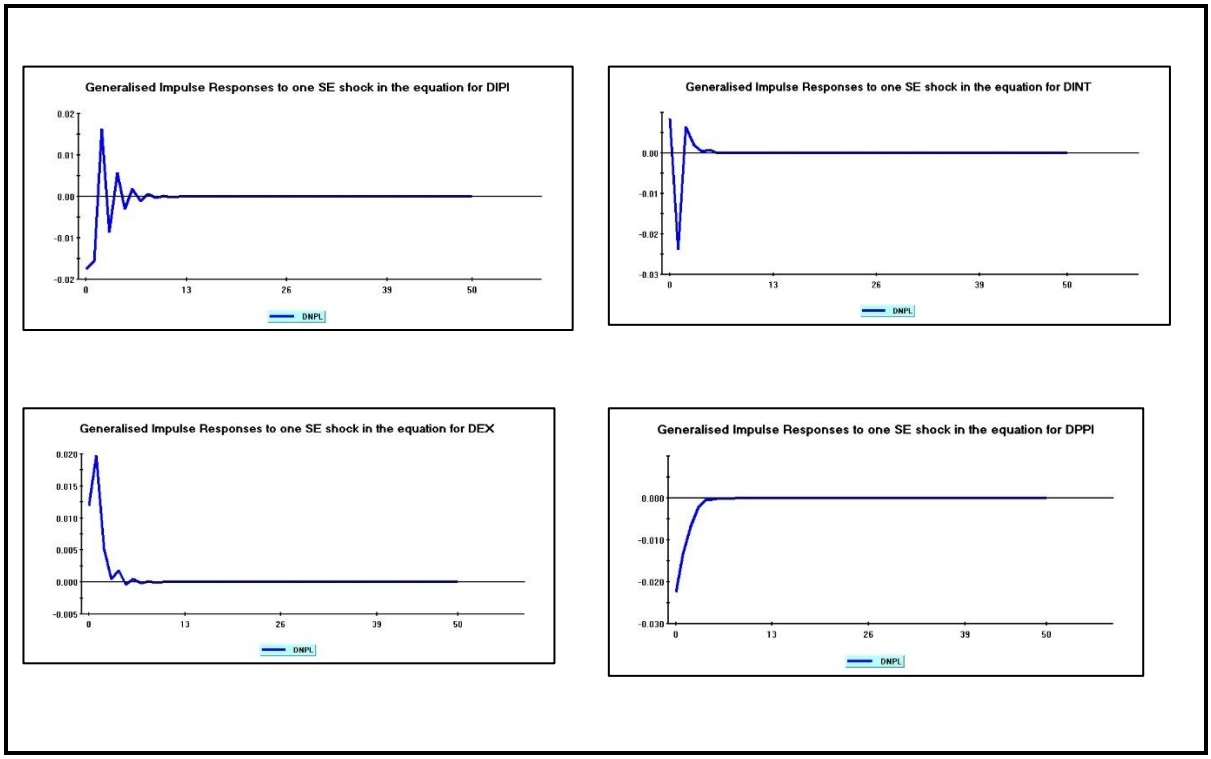
The shock of inflation in both Consumer Price Index (CPI) and Producer Price Index (PPI) depict the positive response of NPF. That means, the higher inflation in a nation, the higher the rate of NPF would be. This study takes both CPI and PPI as a proxy to measure inflation because CPI represents of a common basket of goods and services (Mercurio, 2004) while PPI measures the price change from the perspective of the seller. In either case, both measures the level of price and associated with inflation. And, in both instances, the price increase will have an impact on both consumers' and sellers' purchasing power. As studies have shown, in the long run, inflation will expect to have a positive response on NPF because, inflation wears down the purchasing power of the individuals and therefore, leads to a reduction in the repayment ability of the loans/financing. Nonetheless, it is forecasted for both CPI and PPI are ranked 7th and 5th place respectively indicating that they are both among the followers (or most endogenous) which have least impact to the NPF.

Interestingly, interest rates also posit positive response of NPF, which implies that banks who charge comparatively higher real interest rates will face greater loan delinquencies. This finding is also consistent with most of the studies; (one of them is Nkusu (2011)) which have found that the hike in interest rates results in worsening of creditor's repayment ability which,

therefore, causes an increase in non-performing loans. Since interest rate is ranked at 2nd place, this variable plays a significant role in explaining variations in NPF. Thus, policymakers should also take this measurement into account when deciding to lower their NPF levels.

Another interesting finding is that the industrial production index (IPI) (which is a proxy for measuring 'monthly GDP') also postulates positive response of NPF. While most studies found that real GDP should be negatively related to NPF, this finding tends to differ. The inverse association between gross domestic product and NPLs suggest that high performance in the real economy resulted in lower number of delinquencies (reduce the NPF rate). However, IRF result shows the opposite, whereby high performance in the real economy will lead to higher number of delinquencies which is rather perplexed. In terms, of relative exogeneity, IPI is the most exogenous variable, hence, will make a substantial impact on the rate of NPF.

Finally, the oil price shocks that the study intended to see to have also a positive impact of NPF. This variable is identified as endogenous in the short run dynamics and to be ranked at 6th place in VDCs. The positive shock postulates that with the increase in oil price, will result in higher number of delinquencies.



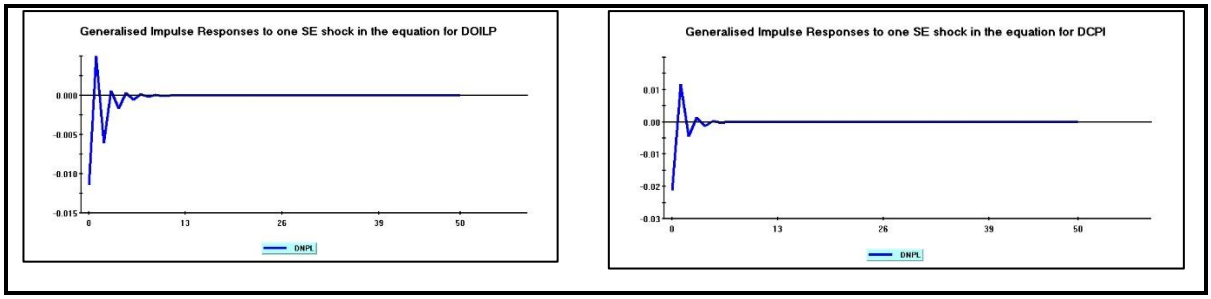


Figure 2. Impulse Response Function Graphs

3.8 CUSUM Test

Since the data obtained intercede with the 2008/2009 sub-prime financial crisis, this study also employs CUSUM test to see if structural break exists in the model. CUSUM test was introduced by Brown et al. (1975) for the study of structural change, and the first test statistic was constructed based on cumulated sums of recursive residuals.

If the plot of the CUSUM stays within the 5 percent critical bounds, the null hypothesis that all coefficients are stable cannot be rejected. If however, either of the parallel lines is crossed then the null hypothesis of parameter stability is rejected at the 5 percent significance level.

The ARDL estimates are further shown to be stable as Figure 3 demonstrates that Cumulative Sum of Recursive Residuals test statistics does not exceed the bounds of the 5% level of significance.

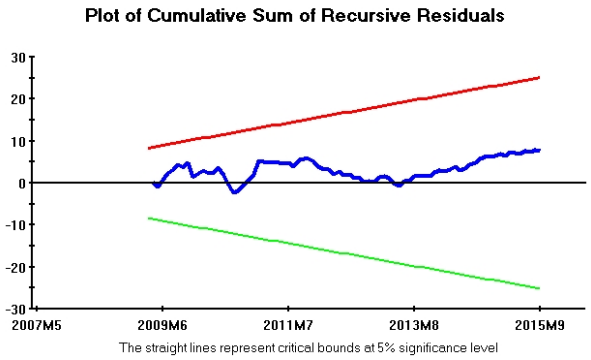


Figure 3: Plot of CUSUM test

4.0 POLICY IMPLICATIONS AND CONCLUDING REMARKS

In four years' time, Malaysia is about to becoming a self-sufficient industrialised nation which is the ideal Vision of 2020 outlined by the then Prime Minister, Tun Mahathir Mohamad. However, within past few years, we have seen a lot of crises have affected the world since the last major financial crisis in 2008/2009. While most of the world are still recovering from the impact of 2008/2009 financial crisis, again the global event of steep fall in crude oil prices in 2014 took the turn to stir up the world economy especially to the oil exporting countries. Malaysia as the world's second-largest exporter of liquefied natural gas and the second-largest oil and natural gas producer in Southeast Asia was also profoundly impacted by this event. Therefore, we do not wish to see that these strands of unfortunate events will dampen the growth of Malaysia of becoming a developed nation by 2020.

Furthermore, since Malaysia's income is highly dependent on oil exports, the link between oil prices and the banks'performance and vulnerability is of interest. The reason being, plunging oil price can have a direct impact on the economy and hence, result in the contractions of banks' profitability. For example, Blanchard and Gali (2010) found that adverse commodity price shocks lead to a substantial rise in the unemployment rate which Makri, Tsagkanos, and Bellas, (2014) found that a higher unemployment rate could increase non-performing loans, thereby jeopardizing the health of the banking sector.

The study employs ARDL approach to cointegration introduced by Pesaran and Shin (1999), and Pesaran et al. (2001) to examine the impact of oil price shocks on non-performing financing (NPF) in the Islamic banks in Malaysia for the period of 2007: M1 to 2015: M9. The variables in this study have proven to move together in the long run which indicates the relationship between the variables are not spurious by the Cointegration test. Further, the results of ECM have identified LOILP, LIPI, INT, and NPF to be endogenous variables whereas LCPI, LPPI and LEX to be exogenous variable. In the long run, VDCs are used to forecast the relative exogeneity and endogeneity of the variables. Hence, found that the ranking to be; LIPI, INT, NPF, LEX, PPI, LOILP and CPI.

From the findings, we have found that the direct relationship between oil price and NPF does not exist as oil price is considered to be endogenous variable. We have discovered this case to be valid in Malaysia because when the demand increases, OPEC will increase production to offset the demand to a stable. Likewise, when the supply increases, OPEC will decrease the production of oil. This shows that as a whole, the demand and supply of oil are regulated.

Therefore, since we have not made any adjustment to the oil price data to tackel on the endogenity effect of oil price, as suggested in Yip, Lim, & Golam Hassan, (2009) we hope that further study can be developed to address on this limitation as we can see, in the long-run the relationship between oil-price and NPF exists, as the result found not to be spurious. To support our findings, empirical evidence of Poghosyan & Hesse (2009) found that oil prices affect bank profitability indirectly which is via micro channel. Secondly, we are aware of our limitations on the methodology used. Since oil price is volatile, a more appropriate model like the exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) can be used to measure this volatility. The reason being, given the oil price behavior,oil price volatility may not react to both bad and good news at a similar fashion due to asymmetry problem whereby, EGARCH tests this asymmetric effects on volatility.

The important step which helps the policy makers will be to look at the results from variance decompositions (VDCs) test. The test found that oil price is the least likely to explain relatively more fluctuations of the NPF of Islamic banks in Malaysia than controlling variables (IPI, INT, EX & PPI). However it is found that in Impulse Response Functions (IRFs), oil price will have a positive impact on NPF. In other words, the rise in oil price will lead to higher NPF rate. Since we have not found, a direct link between NPF and oil price, we conclude that the oil price is indirectly affecting NPF. Therefore, the rise in oil price usually, will associates with the rise in goods and services (for consumers) and input prices (for producers). Thus, will increase the inflation rate in the economy, which will lead to lower purchasing power of the people. As a result, this will distort the repayment of the financing to the banks as customers have less cash in their hands. However, during this time, the oil producers will benefits from the high price level of oil and make more profits. Therefore, from the policy perspective, the banks should be wary of the customers who will be highly affected from the rise in inflation, which is those customers who are in lower bucket income of below RM 3000 as they are more vulnerable to the rise in prices of goods and services. Similarly, if the NPF tend to be increased during this period, banks are advisable to help the customers to reschedule or restructure their financing on case-to-case basis as the impact will not be the same for all customers. During this period as well, banks can also make profit by giving financing to the oil producers companies as they are making profits from the hike in oil price. Since Islamic banking are fonder on risk and profit sharing, this period will be the right time to do financing and investing. However, since the price of oil is volatile, it is advisable for the banks to do the financing in a short period

From the VDCs result, IPI (a proxy for GDP) could explain relatively more fluctuation of the non-performing loans of Islamic banks in Malaysia as it is the most exogenous variables. This means that the fluctuation of NPF is substantially dependent on the cycle of economic growth. Although IPI is endogenous in the short-run, but in the long-run, IPI is highly important to determine the NPF rate. The IRF further illustrates that IPI will have a positive impact to the NPF rate implying that when the economy is booming, the NPF rate will be increasing. Although the finding is rather contradicted to the strand of literature available, in the authors' humble opinion this result can be explained from the problem of information asymmetry perspective. It is during the booming period, the tolerance for risk might be higher, because markets perceived that the economy is stable, and less people are suffering from job loss. But the theory of lemons developed by Akerlof (1970) says that, most of the available borrowers who are actively seeking for financing are bad borrowers compared to good borrowers. This is an adverse selection that banks have to face; to distinguish good borrowers from bad ones. When banks unintentionally chose the bad borrowers, this will result in higher NPF rates even though the economic is booming as the banks risk tolerance are high. Hence, bankers will need to solve this issue by employing a more robust method for distinguishing the bad and good credit risks.

The result on other variables are rather consistent with literatures whereby interest rates and exchange rate to play a vital role in determining the change in NPF rate in Malaysia. Another point worth to highlight is that all instruments of macroeconomic variables indicated similar response of faster stability period which is within ninth to thirteenth period. It is significantly proven that NPF model is stable in responding the macroeconomic shocks. Only exchange rate negatively drives the NPF rate of Islamic while other variables positively drive the NPF rate of Islamic banks which are industrial production index, interest rate, producer price index, oil price, and consumer price index.

Finally, the authors are aware of the limitations that are present in this study which some have been explained previously. For example, to first address the endogeneity attributes in oil price as well as to address the issue of the volatility in oil price by using EGARCH model. Secondly, we would like to highlight that due to time constraint this study only employs macro variables and did not include bank specific indicators which are also believed to have a significant impact on the NPF rate. Thirdly, the data period is relatively small due to the availability of NPF, which is only available since 2007. Therefore, it would be our humble suggestion for future research to incorporate all of these limitations so as to produce a more robust result.

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