

AN ARDL APPROACH TO THE DETERMINANTS OF NON-PERFORMING LOANS IN ISLAMIC BANKING SYSTEM IN MALAYSIA

Solarin Sakiru Adebola^a

*College of Business, Room 238, Economics Building,
Universiti Utara, Malaysia. Phone: +60122436814*

Prof. Wan Sulaiman b. Wan Yusoff^b

Kulliyah Muamalat, Kolej Universiti Insaniah, Malaysia

Dr. Jauhari Dahalan^c

*College of Business Room 238, Economics Building,
Universiti Utara, Malaysia.*

Abstract

This paper explores the factors propelling Islamic banks' nonperforming loans (NPLs) in Malaysia for the period 2007:1 to 2009:12. We utilised the ratio of NPLs to total financing in Islamic banks to measure the extent of NPLs in Malaysia. The study employs ARDL of [Pesaran and Shin \(1999\)](#) and [Pesaran et al. \(2001\)](#) to examine the effects of some macroeconomic variables which include industrial production index, interest rate and producer price index. The findings indicate two long run relationship among the variables and note that interest rate has significant positive long run impact on NPLs. Industrial production index turns out with a positive but insignificant sign. This reflects the popular believe that Islamic banking system in Malaysia is not fully motivated by profit and loss mechanism, as the impact of interest rate is stronger relative to productivity. Producer price index appears to have negative and significant impact on NPLs. The outcomes of this study are similar to the findings of previous studies including [Bofondi and Ropele \(2011\)](#) work on conventional banks in Italy.

Keywords: non-performing loans; Islamic banking system, ARDL, Granger causality test.

- a. PhD research candidate at Universiti Utara, Malaysia
- b. Professor at Insaniah University, College Malaysia
- c. Associate Professor at Universiti Utara, Malaysia

1. INTRODUCTION

Understanding the nature of bank loan losses has numerous implications. Low level of non-performing loans (NPLs) suggests a relatively more stable financial system. On the other hand, sizeable volume of NPLs signals the existence of financial fragility and a cause of worry for banks management and regulatory authorities. Evidence indicates that global financial crisis of 2007-2009, which started in the US, was triggered by default of borrowers from sub-prime mortgages/loans. The problem is not however restricted to developed countries as high level of NPLs heralded several banking crises in Sub-Saharan African and East Asia countries.

Several factors are responsible for NPLs in several countries. In this regard, there are two strands of literatures. The first strand of literatures considers bank specific variables such as the quality of management, profit margins, policy choices, risk profile of banks, size and market power on problem loans. The second strand of literatures focus more on quantitative variables, which include economic growth, inflation, interest rate and exchange rate among other macroeconomic variables [see [Keeton and Morris, 1987](#); [Louzis, Vouldis and Metaxas, 2010](#); [Kalirai and Scheicher, 2002](#); [Dash and Kabra, 2010](#); [Bercoff, Giovanniz and Grimardx, 2002](#)]

Most of these studies have not only concentrated on developed countries, but also on commercial banks without any consideration for Islamic banks. However, Islamic banks bring another dimension into the fray. This is because, unlike conventional system, Islamic banks do not operate on interest rate system. Instead, Islamic banks operate on profit and loss paradigm, which suggest that NPLs in Islamic banks may transit signal of financial crises faster than conventional banks. To the authors' knowledge there is no study on determinants of NPLs in the Islamic banking system. Thus, macroeconomic determinants of NPLs in Islamic banks in Malaysia are examined in this study. Malaysia is selected because of its pole position as a leading Islamic finance hub. The study has a lot of contributions. It adds to the extant literature by providing evidence on the causes of NPLs in a developing country like Malaysia and most importantly in an Islamic banking system. The outcome of this study may serve as basis for measuring and assessing credit risk in Islamic banks in Malaysia. Moreover, the study may serve as a prelude to other study on the determinants of NPLs in Islamic banking system of other countries.

The remainder of the paper is structured as follows: Section 2 reviews related studies. Trend of NPLs in Islamic banks in Malaysia are discussed in Section 3, followed by data, methodology and model in section 4. In Section 5, the study presents the empirical findings, which include unit root tests, bound test and Granger causality, while the final section presents the conclusions.

2. LITERATURE REVIEW

This role played by NPLs in triggering financial crises in Latin America, Sub-Saharan African, East Asia countries and lately sub-prime loans cannot be deemphasised. This has rekindled interest in investigating the factors responsible for financial exposure; as investigators believe that once the factors are clearly identified, then future occurrence may be easily prevented. Consequently, more literatures are now focussing on the drivers of NPL. In this section we review some of the existing literature.

Some works have been done on US. An example is [Keeton and Morris \(1987\)](#) that examines the determinants of loan losses for over 2,400 US commercial banks for the period 1979–1985. The authors utilise simple linear regressions and observe that local economic conditions in addition to poor performance of agriculture and energy sectors explain the variation in loan losses in commercial banks of US. In a related study, [Sinkey and Greenwalt \(1991\)](#) utilises log-linear regression on data of big commercial banks in the US for the period covering 1984 to 1987. They identify several factors such as high interest rates, excessive lending and volatile funds as having positive impact on NPL of commercial banks in the US. [Sinkey and Greenwalt \(1991\)](#) further show that economic downturn can as well be responsible for commercial banks loan loss. Recently, [Gambera \(2000\)](#), utilising US quarterly data for 1987 to 1999, investigates the effect of macroeconomic variables on loans. The findings indicate that incomes and unemployment rate are among the macroeconomic variables explaining quality of bank asset.

Financial exposure is not peculiar to US. Therefore, beyond the US, studies have been conducted on some EU countries, which include Spain, wherein [Salas and Saurina \(2002\)](#) examine the determinants of loans loss of commercial and saving banks. The authors employ dynamic model on dataset spanning the 1985-1997 period. [Salas and Saurina \(2002\)](#) demonstrate that real growth in GDP, rapid credit expansion, bank size, capital ratio and market power explain variation in NPLs. In a follow up work, [Jimenez and Saurina \(2006\)](#) assess the impact of macroeconomic variables on NPLs in Spanish banking sector for the 1984 to 2003 period. The findings suggest that NPLs are determined by GDP growth, compassionate credit terms and high real interest rates.

[Hoggarth, Sorensen and Zicchino \(2005\)](#) assess the determinants of bank loan loss on UK quarterly data spanning from 1988 to 2004. The authors utilizes banks' write-off to loan ratio as proxy for bank loan losses. [Hoggarth et al. \(2005\)](#) report significant and negative relationship between changes in the output gap and the write-off ratio. Besides, bank loan loss is shown to be positively affected by retail price inflation and nominal interest rates.

[Louzis, Vouldis and Metaxas \(2010\)](#) employ dynamic panel data methods to examine the determinants of nonperforming loans in 9 largest Greek banks (which account for approximately 90% of Greece's banking sector) for the period spanning 2003Q1 to 2009Q3. The author notes that macroeconomic variables such as real GDP growth rate, the unemployment rate and the lending rates have a strong effect on the level of NPLs. [Kalirai and Scheicher \(2002\)](#) apply linear regression on Austrian banks for period 1990–2001. They provide evidence for short-term nominal interest rate, industrial production, the stock market return and a business confidence index as determinants of loan quality in Austria.

[Bofondi and Ropele \(2011\)](#) examine the main macroeconomic determinants of banks' loan losses in Italy over the period 1990Q1–2010Q2. The study uses a single-equation time series

approach. Banks' loan losses are measured by the ratio of new bad loans to the outstanding amount of loans in the previous period. [Bofondi and Ropele \(2011\)](#) observe that loan losses is positively associated with the unemployment rate and the short-term nominal interest rate, while inversely associated with the growth rates of real gross domestic product and house prices.

As evident from the literatures reviewed so far, most authors devoted their focus on developed and European countries. Recently, studies on developing countries commenced. For example, [Dash and Kabra \(2010\)](#) investigate several key macroeconomic and bank specific variables on non-performing loans, using a panel dataset covering 1998-99 to 2008-09. The authors report that changes in real income exert a significant negative effect on NPLs and further reveal that commercial banks with higher interest rates incur greater NPLs. Earlier, [Rajan and Dhal \(2003\)](#) observe that GDP growth influences the volume of NPLs of commercial banks in India. In Argentina, [Bercoff, Giovanniz and Grimardx \(2002\)](#) demonstrate that macroeconomic variables effect had positive influence on NPLs. On Hong Kong, for the period 1995–2002, [Shu \(2002\)](#) observe that NPLs is negatively affected by consumer price inflation rate, gross domestic product growth, property prices growth, but positively affected by nominal interest rates.

[Khemraj and Pasha \(2009\)](#) study the determinants of non-performing loans in the Guyanese banking sector for 1994 to 2004 period. The macroeconomic variables in the study include annual inflation rate, real effective exchange rate (REER), and annual growth in real GDP over the period of analysis. The findings reveal that appreciation in the real effective exchange rate translates into higher NPLs. [Khemraj and Pasha \(2009\)](#) also find evidence for significant inverse and instantaneous relationship between GDP and non-performing loans, which is interpreted to mean that strong performance in the real economy results in lower non-performing loans. However, inflation is shown not to be an important determinant of NPLs in the Guyanese banking system.

Beyond the aforementioned empirical literatures, theoretical exercises on the determinants of bank loan loss identified some factors, which include GDP, interest rate and unemployment. For instance, [Lawrence \(1995\)](#) introduces a model which postulates that borrowers with level low incomes have higher rates of default. Besides, in [Lawrence \(1995\)](#) model it is shown that in equilibrium, banks demand higher interest rates from riskier clients. In an extension of Lawrence's model, [Rinaldi and Sanchis-Arellano \(2006\)](#) consider the probability that agents can also borrow in order to invest in financial or real assets. The author shows that chance of default hinges on current income, the unemployment rate (which is linked to uncertainty regarding future income) and the lending rate. [Louzis et al \(2010\)](#) posits that the effect of the interest rate should be positive on bank loan loss, especially in the case of floating rate loans. According to [Louzis et al \(2010\)](#), this is mainly due to difficulty in servicing debt.

Clearly from the above literature review, it is obvious that studies (both empirical and theoretical) has identified some peculiar macroeconomic variables as determinants of NPLs. These include GDP, interest rate, inflation rate, unemployment or lending rate (in summary the cost of borrowing as we consider Islamic banks in our case). Moreover, none of the studies considers the scenario in an Islamic banking framework. This is in spite of the rapid growth in Islamic banking industry. Therefore, we examine the impact of some of these macroeconomic variables on NPLs in Malaysia. Before proceeding to the methodology of the study, the trend of NPLs in Malaysia is examined in the next section.

3. ISLAMIC BANKING NPLs IN MALAYSIA

The coverage and classification of impaired loans and provisioning for loan impairment differs across the globe. Countries set guidelines based on some peculiar characteristics, but usually aligned with the provisions of International Accounting Standards Board (IASB) with the sole objective of ensuring the banking system soundness. Most countries without domestic guideline on loan impairment normally follow the provisions of IASB. In Malaysia, Malaysian Accounting Standards Board (MASB), established under the Financial Reporting Act 1997 is responsible for setting out the minimum requirements on loan impairment. MASB issued Financial Reporting Standards (FRS) 139 – Financial Instruments: Recognition and Measurement. FRS 139 serves as a blanket standard for all banking institutions (commercial banks and investment banks) licensed under the Banking and Financial Institutions Act 1989 (BAFIA) and Islamic banks licensed under the Islamic Banking Act 1983 (IBA) ([BNMa, 2011](#)).

In Malaysia financial system, loan (financing in Islamic banking system) is regarded as impaired, where the principal or interest/profit or both is past due for more than 90 days or 3 months. In the case of revolving facilities, the facility becomes impaired, where the outstanding amount has

remained in excess of the approved limit for a period of more than 90 days or 3 months (BNMa, 2011).

Beyond the definition of loan/financing, the methodology of implementing various loan/financing impairment provisions remains a critical issue. Hence, it is stated that functions associated with methodology should be performed by competent and well-trained personnel and properly documented, with clear explanations of the supporting analyses, assumptions used and rationale. Moreover, the procedures used by the banking institution to establish impairment provisions on individually impaired loans/financing are prudent and based on cash flow projections that take into account economic conditions. The framework for establishing collectively assessed impairment provisions is adequate and that the methodology used is reasonable. The banking institution is following policies and practices that are consistent (BNMa, 2011).

Considering the trend of NPLs in Islamic banks of Malaysia, it is noted that it has been fluctuating over the years. From Fig. 1, we observed that NPLs fell from almost RM 3.5 billion in January, 2007 to around RM 2.9 billion in December 2007. This is a period characterised with low interest rate environment, access to credit providing support for households' spending, increased in headline inflation rate (which increased at a slower pace of 2% in 2007) and economic growth of 6.3% (BNM Annual Report, 2007). Therefore, this is an indication that while interest rates positively moves with NPLs, GDP negatively moves with NPLs. The volume of NPLs in Islamic banks further fell to almost RM 2.5 billion at the end of 2008. In the same period, Malaysia economy grew by 4.6% and headline inflation rate averaged 5.4% in 2008 (which is significantly higher than the country's long-term inflation average of 3.0%) lending credence to a negative impact of GDP and inflation on NPLs in Malaysia. Interest rates remained low and accommodative thus partly responsible for fall in the volume NPLs in 2008 (BNM Annual Report 2008). At the end 2009, the economic contracted by 1.7%, while the NPLs jumped to almost RM 3.0 billion, suggesting negative relationship between GDP and the volume of NPLs. Moreover, central banks aggressively eased monetary policy as interest rates were reduced to record lows (BNM Annual Report, 2009). Generally, it is observed that volume of NPLs is negatively associated economic growth and inflation rate, but positively associated with the rate of interest. There are several econometrics methods in which these relationships may be better tested.

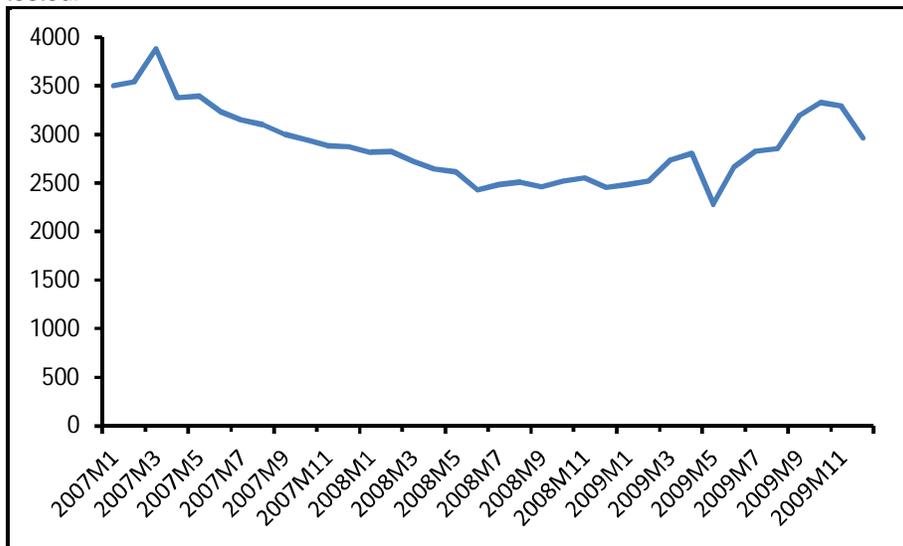


Fig. 1: NPLs in Malaysia Islamic banking system

4. MODEL, DATA AND METHODOLOGY

4.1 Model

The model of the study is fundamentally based on life-cycle hypothesis which assumes that volume of household debt depends on several factors, which include expected path of future income and real interest rates. Lawrence (1995) and Rinaldi and Sanchis-Arellano (2006) have previously adopted the life-cycle framework in investigating the determinants of bank loan losses. In addition, past empirical studies frequently added inflation rate and exchange rate to list of explanatory variables. However, due to concern for degree of freedom, we had to select one of the two macroeconomic variables in addition to proxies for economic activity and interest rates. Hence, we

consider Inflation rate ahead of exchange rate because of the relatively small size of Islamic banks of Malaysia in the global economic context. Thus, in this study, we specify our model as follows:

$$LOS_t = \beta_1 + \beta_2 INT_t + \beta_3 IND_t + \beta_4 PPI_t + \varepsilon_t \quad (1)$$

Where, *LOS* is the proxy for NPLs in Islamic banks in Malaysia *INT* is the interest rate *IND* is industrial production index and *PPI* is the producer price index. β_1 is the constant; and ε is the disturbance term.

4.2 Data

This study employs monthly time series data for the 2007:1 to 2009:12 period, due to data constraint. The period coincides with the occurrence of global financial crisis episode. The dependent variable – average of NPLs in Islamic banks and Islamic Banking Scheme of Commercial banks in Malaysia- is measured by the ratio of 3-month net non-performing financing/ Impaired financing to 3-month net total financing of Islamic banks. Due to non-availability of monthly data on GDP, the study utilises industrial production index to track rate of economic activity. Among the previous studies that adopt industrial production include [Kalirai and Scheicher \(2002\)](#) on Austrian banks. Producer price index is adopted as a measure of inflation, while average lending rate represents interest rate. Lending rate is used because the computation of financing rate in Islamic banks started in 2009. All the data are collected from International Financial Statistics (IFS) of the International Monetary Fund, with the exception of NPL, which is available at Bank Negara Website ([BNMb, 2011](#)). In order to compute the variables' growth rates, we transform the variables into natural logarithm.

4.3 Bound test for cointegration

In testing for cointegration, the study employs the ARDL approach to cointegration introduced by [Pesaran and Shin \(1998\)](#) and [Pesaran et al. \(2001\)](#). Unlike other cointegration techniques, the ARDL does not impose a restrictive assumption that all the variables under study must be integrated of the same order. Therefore, ARDL can be applied irrespective of whether underlying regressors are entirely $I(0)$, entirely $I(1)$ or mutually co-integrated ([Pesaran and Shin, 1999](#)). The ARDL test is suitable even if the sample size is small; in contrast to other cointegration techniques that are sensitive to the size of the sample. Besides, it considers sufficient number of lags to capture the data generating process in a general-to-specific modelling framework. Fourthly, it removes dilemma connected with omitted variables and autocorrelations; provides unbiased and efficient estimates ([Narayan 2004](#)). Procedurally, ARDL entails two distinctive steps. The first step involves the establishment of long run relationship with the following error correction version of the ARDL model.

$$\Delta \ln LOS_t = a_{10} + \sum_{i=1}^p a_{11} \Delta \ln LOS_{t-1} + \sum_{i=0}^p a_{12} \Delta \ln INT_{t-1} + \sum_{i=0}^p a_{13} \Delta \ln IND_{t-1} + \sum_{i=0}^p a_{14} \Delta \ln PPI_{t-1} + \delta_{11} \ln LOS_{t-i} + \delta_{12} \ln INT_{t-1} + \delta_{13} \ln IND_{t-i} + \delta_{14} \ln PPI_{t-i} + \varepsilon_{1t} \quad (2)$$

$$\Delta \ln INT_t = a_{20} + \sum_{i=1}^p a_{21} \Delta \ln INT_{t-1} + \sum_{i=0}^p a_{22} \Delta \ln LOS_{t-1} + \sum_{i=0}^p a_{23} \Delta \ln IND_{t-1} + \sum_{i=0}^p a_{24} \Delta \ln PPI_{t-1} + \delta_{21} \ln INT_{t-i} + \delta_{22} \ln LOS_{t-1} + \delta_{23} \ln IND_{t-i} + \delta_{24} \ln PPI_{t-i} + \varepsilon_{2t} \quad (3)$$

$$\Delta \ln IND_t = a_{30} + \sum_{i=1}^p a_{31} \Delta \ln IND_{t-1} + \sum_{i=0}^p a_{32} \Delta \ln LOS_{t-1} + \sum_{i=0}^p a_{33} \Delta \ln INT_{t-1} + \sum_{i=0}^p a_{34} \Delta \ln PPI_{t-1} + \delta_{31} \ln IND_{t-i} + \delta_{32} \ln LOS_{t-1} + \delta_{33} \ln INT_{t-i} + \delta_{34} \ln PPI_{t-i} + \varepsilon_{3t} \quad (4)$$

$$\Delta \ln PPI_t = a_{40} + \sum_{i=1}^p a_{41} \Delta \ln PPI_{t-1} + \sum_{i=0}^p a_{42} \Delta \ln LOS_{t-1} + \sum_{i=0}^p a_{43} \Delta \ln INT_{t-1} + \sum_{i=0}^p a_{44} \Delta \ln IND_{t-1} + \delta_{41} \ln PPI_{t-i} + \delta_{42} \ln LOS_{t-1} + \delta_{43} \ln INT_{t-i} + \delta_{44} \ln IND_{t-i} + \varepsilon_{4t} \quad (5)$$

In (2) (3) (4) and (5), Δ represents first difference operator. The variables have been defined earlier. To establish long run relationship, joint significance test of cointegration ($\delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0; \delta_{21} = \delta_{22} = \delta_{23} = \delta_{24} = 0; \delta_{31} = \delta_{32} = \delta_{33} = \delta_{34} = 0; \delta_{41} = \delta_{42} = \delta_{43} = \delta_{44} = 0$) is conducted on (2) (3) (4) and (5). The F-test, which has a non-standard distribution, is considered on the lagged levels of the variables in determining whether a long-run relationship exists among the variables. In this regards, two bounds of critical values are generated. The lower bounds critical values serve as benchmark for $I(0)$ variables, while the upper bound critical values serve as

benchmark for I(1) variables. According to the bound test, cointegration exists if the computed F-statistic exceeds the upper critical value. If computed F-statistic falls within the two bounds of critical values, the variables must composed of level and first difference integrated series for possibility of cointegration. Finally, if the F-statistic is below the lower critical value, it implies no cointegration.

The second step simply involves estimating long-run and short-run coefficients of the cointegrated equation, once long run relationship is established through the bound test. The study adopts the small sample size critical values computed by Narayan (2005) for the bound test as against Pesaran and Pesaran (1997) produced critical values, which are for sample sizes of 500 observations and 1000 observations.

4.4 Granger Causality Test

According to Engle and Granger (1987), upon the establishment of the existence of cointegration among variables, causality relationship should be investigated within a dynamic error correction framework. This is because an error correction model affords the opportunity to differentiate between the long run and short run Granger causality. The short run dynamics are encapsulated in the individual coefficients of the lagged terms; while the error correction term contains information of long run causality. Hence, significance of each explanatory variable lags depict short run causation. On the other hand, a negative and statistical significant error correction term is assumed to signify long run causality. The equations are stated below:

$$\Delta \ln LOS_t = \alpha_{50} + \sum_{i=1}^q \alpha_{51} \Delta \ln LOS_{t-1} + \sum_{i=1}^q \alpha_{52} \Delta \ln INT_{t-1} + \sum_{i=1}^q \alpha_{53} \Delta \ln IND_{t-1} + \sum_{i=1}^q \alpha_{54} \Delta \ln PPI_{t-1} + \varphi_1 ECT_{t-1} + \varepsilon_{5t} \quad (6)$$

$$\Delta \ln INT_t = \alpha_{60} + \sum_{i=1}^q \alpha_{61} \Delta \ln INT_{t-1} + \sum_{i=1}^q \alpha_{62} \Delta \ln LOS_{t-1} + \sum_{i=1}^q \alpha_{63} \Delta \ln IND_{t-1} + \sum_{i=1}^q \alpha_{64} \Delta \ln PPI_{t-1} + \varphi_2 ECT_{t-1} + \varepsilon_{6t} \quad (7)$$

$$\Delta \ln IND_t = \alpha_{70} + \sum_{i=1}^q \alpha_{71} \Delta \ln IND_{t-1} + \sum_{i=1}^q \alpha_{72} \Delta \ln LOS_{t-1} + \sum_{i=1}^q \alpha_{73} \Delta \ln INT_{t-1} + \sum_{i=1}^q \alpha_{74} \Delta \ln PPI_{t-1} + \varphi_3 ECT_{t-1} + \varepsilon_{7t} \quad (8)$$

$$\Delta \ln PPI_t = \alpha_{80} + \sum_{i=1}^q \alpha_{81} \Delta \ln PPI_{t-1} + \sum_{i=1}^q \alpha_{82} \Delta \ln LOS_{t-1} + \sum_{i=1}^q \alpha_{83} \Delta \ln INT_{t-1} + \sum_{i=1}^q \alpha_{84} \Delta \ln IND_{t-1} + \varphi_4 ECT_{t-1} + \varepsilon_{8t} \quad (9)$$

where ECT stands for the error correction term, which is derived from the long run equation. In each function, φ must produce a negative and significant sign for causality to exist in long run. Armed with all the foregoing methods, the study provides the empirical findings in the following section.

5. EMPIRICAL FINDINGS

Table 1
Unit root test

| Variables | Levels | | First differences | |
|-----------|--------|----------|-------------------|-------|
| | DF-GLS | KPSS | DF-GLS | KPSS |
| LOS | -1.463 | 0.124 | -4.707*** | |
| INT | -1.178 | 0.453*** | -3.099* | 0.066 |
| IND | -2.795 | 0.086 | -7.510*** | |
| PPI | -1.053 | 1.186 | -3.270** | |

DF-GLS is based on AIC, while KPSS test is estimated based on quadratic Spectral kernel with Andrews bandwidth.

In theory, the bound test for cointegration does not require testing series stationarity. However, it becomes invalid once any of the variables is I(2) or beyond. Moreover, decision at the point of acceptance or rejection depends on knowing whether the variables are I(0) or I(1), especially

when the F-statistics falls between the two bounds. It is for these reasons that we start the empirical analysis with tests to determine the integration properties of the variables. We apply [Elliott, Rothenberg and Stock \(DF-GLS\)](#) to determine the integration properties of the variables. DF-GLS is a two-step process, in which the series is de-trended via a generalized least squares (GLS) regression in the first step before a normal Dickey-Fuller test is applied on the series in the second step. The DF-GLS is augmented with the commonly used [Kwiatkowski, Phillips, Schmidt and Shin \(KPSS\)](#). The results for the DF-GLS and KPSS unit root tests for LOS, INT, IND and PPI are reported in Table 1. While the null of DF-GLS is non-stationarity, the null of KPSS is stationarity. The DF-GLS and KPSS tests produce different results. This is because for DF-GLS, the null hypothesis that the series contain a unit root cannot be rejected for any of the series in levels at the 10% level, but when the data are first differenced, the null of nonstationarity can be rejected for all series at the 5% level. On the other hand, for KPSS, the null of stationarity cannot be rejected for any of the series in levels at the 10% level, with the exception of INT. Generally, this is an indication that the variables are I(0) and I(1).

Table 2
Bound test for cointegration

| Dependent Variable | F-Statistics | Critical Values | | | | | |
|--------------------|--------------|-----------------|---------|--------|-------|-------|-------|
| LOS | 3.295** | 10%I(0) | 10%I(1) | 5%I(0) | 5%(1) | 1%(0) | 1%(1) |
| INT | 1.527 | 2.618 | 3.532 | 3.164 | 4.194 | 4.428 | 5.816 |
| IND | 1.869 | | | | | | |
| PPI | 2.728* | | | | | | |

The critical values are extracted from [Narayan \(2005b\)](#) Case II model, which provides for restricted intercept and no trend. The null is no cointegration. *, **, *** imply 10%, and 1% level of significance, respectively.

The results of the bounds test for cointegration are reported in Table 2. The bounds test indicates that cointegration exists when LOS and PPI are the dependent variables. This is because for LOS, the F-statistics (3.295) falls between bound critical values at the 5% level. As the variables are I(0) and I(1), this is an indication that cointegration exist, when LOS is the dependent variable. For PPI, the F-statistics (2.728) falls between bound critical values at the 10% level suggesting cointegration is present, when PPI is the dependent variable. The F-statistics in cases where INT and IND are the dependent variables falls below the critical value, which implies no existence of cointegration, when INT and IND are dependent variable. Summarily, there are two long-run relationships, among the four variables.

Table 3
Granger causality results

| Panel A | | Granger causality | | | | |
|--------------------|--------------|---------------------|--------------|--------------|-----------|--|
| Dependent Variable | Δ LOS | Δ INT | Δ IND | Δ PPI | ECT(-1) | |
| Δ LOS | - | 5.230 | 5.125 | 11.173** | -3.681*** | |
| Δ INT | 18.100*** | - | 13.513*** | 7.774 | - | |
| Δ IND | 47.724*** | 26.625*** | - | 28.228*** | - | |
| Δ PPI | 3.957 | 6.833 | 11.114** | - | -2.710** | |
| Panel B | | Long run estimates | | | | |
| LOS | INT | IND | PPI | | | |
| | 1.386*** | -1.053 | -2.823*** | | | |
| Panel C | | Short run estimates | | | | |
| Δ LOS | Δ INT | Δ IND | Δ PPI | | | |
| | 2.261** | -0.032 | -0.930 | | | |

The variables are expressed in natural logarithmic form. The t-statistic is reported for the ECT, while the chi-square statistics are reported for the variables, *, **, *** imply 10%, 5%, and 1% level of significance respectively.

The results of Granger-causality tests for the model are presented in panel A of Table 3. The short run causality tests are based on estimated values of the Wald F-statistic on lagged dependent variables, and long run causality is inferred by the t-statistic value based on the lagged ECT variable. Based on the bound test results, the long run causality is estimated, when LOS and PPI are the dependent variable. The estimates indicate that INT Granger causes LOS in the short run, while there is a short run feedback from LOS. Long run causality flows from IND to LOS, with short run response from LOS. Unlike the previous findings we observe a bidirectional relationship between PPI and LOS, especially in the long run. Generally, all the evidence points to the fact that NPLs in Malaysia Islamic banking system response to any change in lending rate, industrial production and inflation rate, especially in the long run. However, Granger causality cannot detect whether the macroeconomic variables are positively or negatively related to NPLs in Malaysia Islamic banking system.

The long run estimates are reported in Panel B of Table 3. INT is shown to have a positive long run impact on LOS at 1% level. During the period of high lending rate, NPLs is expected to rise as rate of default among borrowers are likely to rise, even in the Islamic banks in Malaysia, which are affected by the situation in the conventional banking system. On the other hand, IND turns out with a positive but insignificant sign. PPI has negative and significant impact on LOS. The short run results reported in Panel C of Table 3 are generally similar to the long run findings, except that PPI is insignificant. The outcomes of this study are similar to the findings of previous studies including [Bofondi and Ropele \(2011\)](#) work on banks in Italy.

Table 4
Diagnostics tests

| Test Statistics | LM test |
|--------------------|-------------------------|
| Serial Correlation | CHSQ(1) = 2.723 [0.114] |
| Functional Form | CHSQ(1) = 0.580 [0.457] |
| Heteroscedasticity | CHSQ(1) = 1.198 [0.282] |

These statistics are distributed as Chi-squared variates. The probability values are reported in the parenthesis.

The study applies a number of diagnostic tests to the ARDL estimates, as shown in Table 4. The tests suggest no existence of serial correlation of the disturbance terms in the ARDL estimators. Besides, Ramsey Reset test shows the model is well specified and heteroscedasticity tests demonstrate independence of the errors from the regressors (homoscedasticity). The ARDL estimates are further shown to be stable as Fig. 2 shows that Cumulative Sum of Recursive Residuals test statistics does not exceed the bounds of the 5% level of significance.

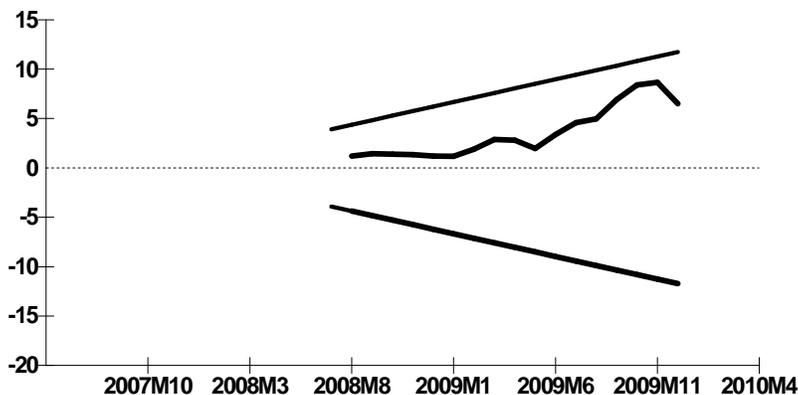


Fig. 2 Plot of Cumulative Sum of Recursive Residuals

6. CONCLUSION

Bank loan losses are described as being pro-cycle because more often, a sizeable volume of NPLs serve as prelude to financial fragility. Arising from such significance of NPLs, past literatures attempted to study the determinants of NPLs, but restricting their scope to mostly developed countries and certainly on conventional banks. However, Islamic banking system provides an alternative outlook as theoretically; it depends more on profit and loss paradigm relative to interest rate. Therefore, Islamic banks should carry the signal of financial crises better. Hence, this paper assesses the macroeconomic determinants of NPLs in Islamic banks in Malaysia for the period covering 2007:1 to 2009:12. We utilised the ratio of NPLs in Islamic banks to total financing in Islamic Banks to measure the extent of NPLs in Malaysia. The study employs ARDL approach to cointegration introduced by Pesaran and Shin (1999), and Pesaran et al. (2001) to examine the effects of some macroeconomic variables which include industrial production index, interest rate and producer price. The findings indicate that two long run relationship among the variables. On the direction of such relationship, we note that interest rate (average lending rate) has significant positive long run impact on NPLs. This is not surprising as in the period of high lending rate, NPLs is expected to increase, which will cause rise in rate of default among borrowers. On the other hand, industrial production index turns out with a positive but insignificant sign. This reinforces the popular believe that Islamic banking system in Malaysia is not motivated by profit and loss mechanism, as the impact of interest rate is better felt compared to productivity. Producer price index appears to have negative and significant impact on NPLs. The short run results generally similar to the long run findings, except that producer price index is insignificant. The outcomes of this study are similar to the findings of previous studies including Bofondi and Ropele (2011) work on conventional banks in Italy. With these findings it is believed that tracking the changes of these macroeconomic variables will serve as a warning system to banks management and financial authorities in Malaysia on the risk of financial crises. The main limitation of this study is that it fails to consider the impact of bank specific effects. Moreover, the sample size and the number of macroeconomic variables in the study are small. This may serve as the basis for future studies.

REFERENCES

- Bank Negara Malaysia. Annual Report of Bank Negara Malaysia. Various issues. Kuala Lumpur, Malaysia.
- Bercoff, J.J., Giovanni, J. and Grimard, F. (2002). Argentinean banks, credit growth and the tequila crisis: A Duration Analysis" (Unpublished).
- BNMa. (2011). Classification and impairment provision for loan/financing [Online] Available http://www.bnm.gov.my/guidelines/01_banking/04_prudential_stds/02_gp3_20110613.pdf (July 22, 2011)

- BNM. (2011). Bank Negara Malaysia database [Online] Available: www.bnm.gov.my/index.php?ch=109&pg=294&ac=228&mth=5&yr=2011&eld=box1#ib (July 22, 2011)
- Bofondi, M. and Ropele, T. (2011). Macroeconomic determinants of bad loans: evidence from Italian banks. *Occasional Papers*, 89.
- Dash, M., and Kabra, G. (2010). The determinants of non-performing assets in Indian commercial bank: An econometric study. *Middle Eastern Finance and Economics*, 7, 94-106.
- Elliott, G., and Rothenberg, T., and Stock, J. (1996) Efficient tests for an autoregressive unit root. *Econometrica*, 64, 813-836.
- Engle, R.F., and Granger. C. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, 55, 251-276.
- Gambera, M. (2000). Simple forecasts of bank loan quality in the business cycle. *Emerging Issues Series*, Federal Reserve Bank of Chicago. Available http://www.chicagofed.org/digital_assets/publications/risk_management_papers/sr_2000_3.pdf (July 21, 2011)
- Hoggarth G., Sorensen S. and Zicchino L. (2005). Stress tests of UK banks using a VAR approach. *Bank of England Working Paper*, 282.
- Jimenez G. and Saurina J. (2006). Credit cycles, credit risk, and financial regulation. *International Journal of Central Banking*, 2, 65-98.
- Kalirai H., and Scheicher, M. (2002). Macroeconomic stress testing: Preliminary evidence for Austria. *Austrian National Bank Financial Stability Report*, May, no. 3.
- Keeton, W., and Morris C.S. (1987). Why do banks' loan losses differ? *Federal Reserve Bank of Kansas City, Economic Review*, 3-21.
- Khemraj, T., and Pasha, S. (2009). The determinants of non-performing loans: An econometric case study of Guyana. Paper presented at the Caribbean Centre for Banking and Finance Bi-annual Conference on Banking and Finance, St. Augustine, Trinidad.
- Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics*, 54, 159-178.
- Lawrence, E. C., (1995). Consumer default and the life cycle model. *Journal of Money Credit and Banking*. 27, 939-954.
- Louzis, D. P., Vouldis A. T., and Metaxas V. L. (2010). Macroeconomic and bank-specific determinants of non-performing loans in Greece: a comparative study of mortgage, business and consumer loan portfolios. *Bank of Greece, Working Paper*, 118.
- Narayan, P. K. (2004). Fiji's tourism demand: the ARDL approach to cointegration. *Tourism Economics*, 10(2), 193-206.
- Narayan, P.K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics*, 37, 1979-1990.
- Pesaran, M.H., and Pesaran, B. (1997), *Microfit 4.0*. Oxford University Press: Oxford.
- Pesaran, M.H., and Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis, in Strom, S. (Ed.). Paper presented at *Econometrics and Economics Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Cambridge University Press, Cambridge.

- Pesaran, M.H., Shin, Y., and Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16, 289-326.
- Rajan, R., and Dhal, S.C. (2003). Non-performing loans and terms of credit of public sector banks in India: An empirical assessment. *Reserve Bank of India Occasional Papers*, 24(3), 81-121.
- Rinaldi L. and Sanchis-Arellano A. (2006). Household debt sustainability: What explains household non-performing loans? An Empirical Analysis. *ECB Working Paper*, 570.
- Salas, V. and Saurina, J., (2002). Credit risk in two institutional regimes: Spanish commercial and savings banks. *Journal of Financial Services Research*, 22(3), 203-224.
- Shu, C. (2002). The Impact of macroeconomic environment on the asset quality of Hong Kong's banking sector. *Hong Kong Monetary Authority Research Memorandums*.
- Sinkey, J. F., and Greenwalt, M. (1991). Loan-loss experience and risk-taking behavior at large commercial banks. *Journal of Financial Services Research*, 5, 43-59.