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Non-Performing Loans and Macroeconomic Variables in Malaysia: Recent Evidence

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ABSTRACT

Financial institutions like commercial banks play important role in the financial system by helping countries to grow and provide capital and platform for investors. However, banks need to be able to generate income in their lending business and perform efficiently. Non-performing loans (NPLs) is one of the tools to determine the efficiency of lending institutions in which reflect the quality of the credit portfolio as well as the health of the banking sector. High levels of NPLs in the banking system places the banks in risky situation which may lead to limited financial activities and consequently lower investment and growth. Motivated by this scenario, this study examines the determinants of NPLs in the Malaysian banking system. Using annual data from 1988 to 2018, the study estimates the short and long-run dynamics of several determinants using the Auto-Regressive Distribution Lag (ARDL) cointegration approach. The empirical results demonstrate mixed results. In the long-run, exchange rate is positive and significantly related to non-performing loans, while industrial production and money supply are negative and significant. However, inflation does not have significant effect on NPLs in Malaysia. The findings of this study is useful in assisting the banking institutions and policy makers to design macro and fiscal policies.

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INTRODUCTION

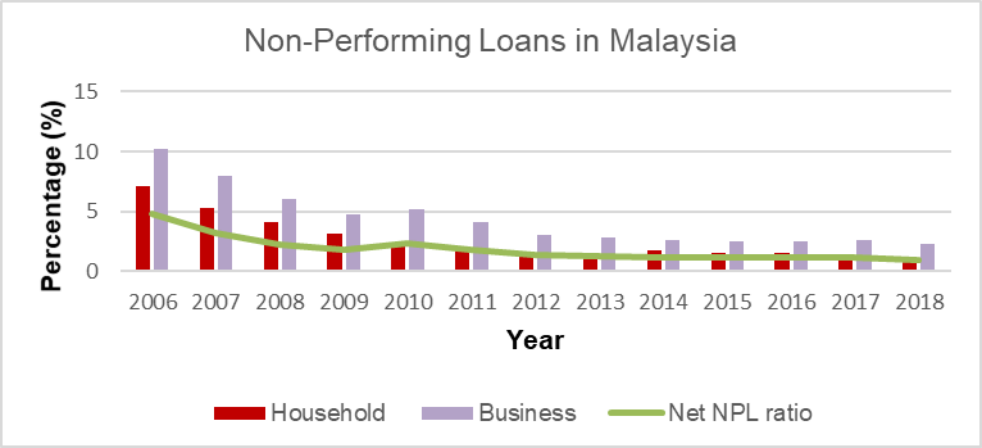
Banking sector plays a significant role in the financial market and economic development. Banks are the main financial intermediaries in Malaysia as bank-based credit is the main source of financing for the economy, particularly among households and Small and Medium Enterprise (SME) (Bank Negara Malaysia (BNM) Annual Report, 2018). Banking institution play an important role in managing the deposits through lending and investment (Kipyego and Wandera, 2013). As a financial intermediary, it provides a wide range of services to the individuals, corporations including government entities. Banks receive deposits and provide loans to their customers in order to gain profits. The quarterly report by BNM indicates that at the end of December 2018, RM398 billion loans were approved where 54% of the loans are for households and the remaining loans are for businesses. The loans for households are mainly for education, health and investment purposes. On the other hand, loans for businesses are largely for the wholesale and retail trade, restaurants and hotels, manufacturing, and financial and insurance sector.

However, in performing the lending business, banks are challenged by risks which are deterrents to the efficiency and stability of the banking system. One of the most important risks associated with banking sector is the credit risk, namely the non-payment of the loans. According to the credit risk circular BNM (2015), credit risk is the risk of counterparty unable to perform the obligation on repayment of principal debt and interest to the bank on a predetermined date. Credit risk is a financial loss to the banks because of the customers' non-compliance on the banks' contractual provisions. A significant volume of credit risk indicates the fragility of the banks is a threat to the financial system and may have adverse impact on the economy.

Credit risk is measured through the Non-performing loans (NPLs) of the banks. The International Monetary Fund (IMF) (2018) defined NPLs as "loans whose repayment in interest and/or principal is past due by 90 days or more, or interest payments equal to 90 days or more have been capitalized, refinanced, or delayed by agreement, or payments which are less than 90 days overdue." The NPLs is important because it will affect the profitability and stability of the banking system. A high NPLs ratio increases provisions for NPLs and lead to the decline in profit and loan portfolio quality. According to the World Bank, globally, the NPLs ratio is 3.85% in 2005 and 3.45% in 2017. In 2009, the NPLs ratio is the highest which is 4.29%. As of 2017, Ukraine, San Marino and Greece are among the highest NPLs countries in the world with 55%, 46% and 40%, respectively.

High NPLs level indicates the vulnerability of the banking system, which reduces banks' capacity to provide new loans and increase the cost of borrowing to the borrower. The interest income from credit business will decrease when borrower does not meet the repayment arrangements. Subsequently, banks need to laid aside extra capital assuming that the borrowers will not pay the loan. Hence, this will reduce the banks net profit. The Malaysian banking sector has experienced banking problems during financial crisis mainly associated with credit risks. Government has taken intervention with the massive restructuring and consolidation of banking institutions with an expenditure of RM12 billion to rescue troubled banks during the 1997 financial crisis. Financial instability is very costly to most countries because of its adverse spill-over effects on economic system as a whole.

Figure 1 shows the NPLs ratio in Malaysia between the year 2006 to 2018. It shows a decreasing trend as a result of restructuring of the banking sector in 1998 and implementation of relevant monetary and fiscal policies by the Central Bank of Malaysia. The NPLs has declined gradually after the Asian financial crisis. In 1999, NPLs is 13% in 1999 but it reduces to 3.2% in 2007. Nevertheless, NPLs increased again to 4.8% in 2008 and further decline constantly to 1% in 2018. At the end of 2018, higher NPLs contributed by working capital and residential loan with total RM7.1 billion and RM5.7 billion of the total NPLs, respectively. The bulk of the NPLs came from the business sector with a proportion of 56% and household sector is 41%.



Source: Central Bank of Malaysia (2019)

Figure **Error! No text of specified style in document.** Non-Performing Loans Ratio in Malaysia Between 2006 – 2018

Government intervention for NPLs recovery strategies also contributed significantly to the decline. During the 1997 Asian financial crisis, several responsive actions for NPL resolution have been implemented by the Malaysian government including the establishment of a special purpose vehicle company. Despite the performance of NPLs ratio in Malaysia, there are certain segments of household and business loans exhibiting high NPLs. NPLs for the personal loans and purchase of properties exhibit an increasing trend since 2014 although after the implementation of responsible financing guidelines in 2010. In addition, oil and gas and construction sector also show increasing trend of NPLs. This may be a concern area as the sectors are inter-related with the development of global growth.

To sustain the resilience of the banks under severe macroeconomic conditions, an assessment risk or Solvency Stress Test is conducted by the banking institutions (Bank Negara Malaysia, 2019). The stress test revealed that credit risk losses comprise about 90% of total banking losses. NPLs are expected to increase with gross NPL ratios rose up to 8.6% in year 2022, under adverse scenarios with a slow and weak recovery. In addition, credit exposures to businesses and household of the total losses are 56% and 34%, respectively. This stress test shows that the macroeconomic exposure is important to the banking system A study by IMF (2015) found that high NPLs leads to slower growth in the affected countries. Many firms which rely on the banking system will be affected. This is because, with higher NPLs, banks have lower ability to lend money to the economy. As a result, banks face lower profit because of higher capital requirements and funding costs.

Several factors are hypothesized be to responsible for NPLs in countries around the world which motivates researches to focus on the determinants of NPLs. Existing studies concluded two strands of literature in analyzing the significant factors or determinants. One strand of literature focuses on bank specific characteristics such as loan size, profit margins and credit policy (see for example: Louzis et al. (2012); Alexandria and Santoso (2015); Viverita et al. (2019)). The other strand of literature focuses on macroeconomic environment which considers the effect of economic growth, inflation and interest rate among others (see for example: Carlos and Bonilla (2012); Beck et al. (2013); Janvisloo and Muhammad (2013)). In addition, there are also studies which consider both internal and external characteristics. Many studies focus on countries that experience financial problems or crisis and some of the studies are motivated by the 2008 global financial crises. Since Malaysia has successfully maintained a conducive environment for NPLs, there is a need to investigate whether this is due to macroeconomics determinants. To complement the existing literature our paper aims to analyze the effect of selected macroeconomic variables on NPLs based on recent annual data. This study complements the existing literature by considering different macroeconomic factors in scrutinizing the contributing factors of NPLs in Malaysia. In addition, it also aims to analyze the possibility of casual relationship between NPLs and each of the macroeconomic variables.

The findings suggest that, industrial production, money supply and exchange rate are significant variables that contribute to the change in NPLs ratio in Malaysia. However, inflation only affect NPLs in the short-run. The rest of the paper is structured as follows: The next section is a brief literature review on NPLs

and its determinants, section 3 presents the empirical model and methodology while section 4 discusses the result. We conclude in section 5.

LITERATURE REVIEW

Over the last decades, the literature on credit risk has expanded with the interest to understand the factors responsible for financial vulnerability. The analysis of the relationship between credit risk particularly on NPLs and the macroeconomic factors mostly deal with the link between credit market imperfection and the wider economy (Mpofu and Nikolaidou, 2018). The basis of literature on credit market imperfection is started by Irving Fisher and other researcher in 1930s as they attempt to understand the adverse linkages between macroeconomic activities and financial markets during the Great Depression crisis. Following that, Bernanke and Gertler (1989) and Bernanke et al. (1999) developed the financial accelerator theory which explain on how a shock to the income of companies and households will affect the capacity to borrow and subsequently its effects to the wider economy. This theory argues that the credit shock occurs via asymmetric information in lending market that was introduced by Akerlof (1970) and developed by Stiglitz and Weiss (1981) directly influences the willingness of the lenders to lend.

The main issue related to asymmetric information in credit market is adverse selection (Okuyan, 2014). The problem of adverse selection happens when the lender does not have detailed information of the borrower prior to the decision of the loan. When adverse selection increases, higher average costs will cause the borrower to face more risk in form of mores defaults. Uncertainty related to variability in investment opportunities and the level of performance will cause higher risks to the lender. This occur because of potential bad credit risks for loan advancing (Mishkin, 2012). This indicate the lending institutions are unable to identify good potential borrowers due to difficulties in evaluating the credit worthiness and reliability of the borrower. This also happen due to the uncertainty of project proposed or investment returns, leading to potential increase of NPLs. Pesaran et. al. (2007), develop a framework related to credit portfolio and macroeconomic factors and found that the relationship between the firms and the business cycle is the main factor. When there is an increase in macroeconomic risks, the share of risky loans to aggregate assets reduces, since risks impedes ability of a bank to forecast investment opportunities (Khatib, 2010). Ahmad and Bashir (2013) show the evidence that NPLs is related to the business cycle during expansion and depression. When the economy is prospering, lending activities increases and lenders are capable to pay off the debt thus the NPL is low. During economic recession, banks become stringent and tightens credit availability with shorter terms, higher interest rate and collateral requirements.

Macroeconomic determinants are exogenous factor which influences banks' balance sheets and the debt service capacity of borrowers. Some of the factors includes GDP, currency rates, interest rates and inflation (Mpofu and Nikolaidou, 2018; Zainol et al., 2018; Beck et al., 2015; Ali and Daly, 2010). The other determinants are bank specific factors or internal factor within the banking institution which varies across banks. The factors include the bank size, return on assets, management risk and operation cost. Some existing literature used both macroeconomic and bank specific factors to analyze the root causes of NPLs; for example: Koju et al. (2018) and Chaibi and Ftiti (2015). According to Mensah and Adjei (2015) and Nkusu (2011), some of the factors that contributes to NPLs includes growth volatility, macroeconomic environment, deterioration of terms of trade and higher lending rate.

A substantial amount of literature has been published on the relationship between NPLs and macroeconomics variables and concluded that macroeconomics environment are significant factors influencing the level of NPLs of a country. Different studies have considered different determinants. Among the popular macroeconomics determinants includes GDP, inflation rate, exchange rate, interest rate and unemployment rate. Some studies consider quarterly data while the rest uses annual data. However, most studies are time series analysis mainly because of the different financial environment and characteristics between the countries. Zainol et al. (2018) examine the case for Malaysia. Although similar in nature, out study considers different determinants and proxy as well as annual data. The paper uses quarterly data in 2006 to 2015 and considers four macroeconomics variables which are GDP, lending rate, inflation and household income distribution. Another study for Malaysia by Adebola et al. (2011) explores the determinants for Islamic banking system from 2007 to 2009 using monthly data. This study considers the effect of industrial production index, interest rate and

producer production index. They conclude that only interest rate and producer production index significantly affect NPLs for Islamic banks in Malaysia.

Saba et al. (2012) study the determinants of NPLs for United States from 1985 to 2010. The authors concluded that GDP per capita, total loans and inflation are significant factors affecting NPLs. Zeng (2012) examines the topic for China's banking system in 1999 to 2010. The author analyzes both microeconomics and macroeconomics factors using optimal control theory based on previous studies. He concludes that NPLs depends on microeconomics factors while the macroeconomics factors influence the level of NPLs in China. Vouldis and Louzis (2018) analyze some macroeconomic and banking factors of business loans, consumer loans and mortgages in Greek banking system. This study applied Aggregating Individual markets (AIM) approach and use quarterly data from 2003 until 2017. The results show that IPI is the optimal predictor for consumer NPLs only. Similarly, Žiković et al. (2015), tested nine macroeconomic variables, on customer loan and corporate loan in Croatia using quarterly data from 2001 to 2014. The finding concludes that there exists a negative relationship between NPLs and IPI for both loans in the short- run and long-run. Rulyasri et al. (2017) investigated Bank YXZ, Indonesia to study the factors of NPLs in retail segment for the 2010 to 2016. The study reveals that, IPI has negative relationship and significant effect on NPLs on the long run.

Inflation is an important factor in influencing the borrower to pay the debt (Zainol et al., 2018). Although it is considered as one of the important determinants, existing literature find ambiguous relationship between NPLs and inflation. Vardar and Ozguler (2015) shows positive long-run relationship of inflation on NPLs in Turkey over the during first quarter of 2007 to the fourth quarter of 2013.. This study confirms earlier finding by Janvisloo et al., (2013) , which also reveal that the impact of external shocks on domestic banking system is higher than internal shocks. Another study by Skarica (2014) analyses banking institutions in Europe and find that higher inflation will reduce the real value of households' income and directly influence the ability of the borrower to pay back the loans. Recent evidence suggests that inflation has the opposite effect with existing literature as revealed by the Koju et al. (2018). The study examines the determinants of NPLs for 30 Nepalese commercial banks during the period of 2003 until 2015. Inflation appears to be negative and significant, which shows that higher inflation leads to reduction in NPLs. On the other hand, some studies find that inflation is not a significant determinant of NPLs (Zainol et al, 2018; Isa and Mohamed, 2017).

Apart from time series analysis, studies on macroeconomic determinants of NPLs have also been conducted on a sample of countries. There are many studies which focus on European Union (EU) countries which mostly have high level of NPLs. Moinescu (2012) and Klein (2013) for example, analyze the relationship for CESEE and CEE countries. Moinescu (2012) applies the Credit Portfolio View model to see if different patterns occur if the model is applied on countries rather than regions. The author states that GDP growth is significant in explaining NPLs although there is no major difference in credit performance across the countries. Another study conducted by Scarika (2014) on CEE countries concludes that the main determinant of NPLs is economic slowdown which is proxied by low GDP and high unemployment and inflation rates.

Using dynamic panel analysis, Klein (2013) examines the determinants and the impact of NPLs on macroeconomic environment in CESEE countries. According to him, NPLs are affected by banks' characteristics and macroeconomic condition for the countries, in which he agreed with existing studies that GDP, unemployment and inflation rate are significant contributors of high NPLs. Esinoza and Prasad (2010) analyze the determinants of NPLs for the Gulf Cooperation Council (GCC) banks. Using dynamic panel method, the authors find evidence of negative relationship between real GDP and NPLs. Fofack (2005) examines the relationship for Sub-Saharan Africa countries in the 1990s. Considering similar sets of macroeconomic variables, the author finds that GDP, exchange rate, real interest rates and bank specific factors significantly affect NPLs. Likewise, Nkusu (2011) conducted the analysis on a panel of 26 advanced countries. In line with existing studies, economic slowdown contributes to higher debt which is a leading cause for high NPLs. Other sample countries analyzed includes Southern Mediterranean (Ouhibi and Hammami, 2015) and developing countries (Beck et al., 2013). The two studies find that inflation, exchange rate and gross capital formation are among the macroeconomic factors which influences NPLs in the sample countries.

In conclusion, the studies explain briefly above has indicated that the macroeconomic variables have either positive or negative impact on the level of NPLs, depending on the nature of the economy of each sample country. The existing literature show that improvements in macroeconomic conditions such as sustainable economic growth, low levels of inflation, manageable money supply circulation and exchange rate are linked with high level of loan quality. Good conditions of macroeconomic variables enhance the ability of borrower in

serving their debt obligations which reduces the level of default loans. Since the literature on Malaysia is still limited and indecisive on the significant factors, this study is filling the gap by considering different determinants and use recent annual data.

EMPIRICAL MODEL AND METHODOLOGY

To achieve the main objective of the study, the following empirical model adopted from Janvisloo and Muhammad (2013), Amtiran et al. (2017) and Zainol et. al. (2018), among others is formulated. The empirical model presents four different macroeconomic variables which may affect the level of NPLs in Malaysia. Even though the topic of interest is different, our study is similar to Ridzuan et al. (2018) where we consider macroeconomic determinants as our main objective, hence we do not include bank characteristics. In addition, the inclusion of internal factors is not possible due to the unavailability of annual data for the time period considered. The empirical model is as stated in equation (1) below:

$$NPL_t = \beta_0 + \beta_1 IPI_t + \beta_2 CPI_t + \beta_3 LNM2_t + \beta_4 LNEX_t + \mu_t \quad (1)$$

where,

NPL	=	Non-performing loans
IPI	=	Industrial Production Index
CPI	=	Consumer Price Index
M2	=	Money Supply
EX	=	Exchange Rate
μ_t	=	Error Term

We use annual data over the period of 1988 to 2018. Data are primarily gathered from the Central Bank of Malaysia (BNM) publication and Department of Statistics Malaysia (DOSM). NPLs is measured as the ratio of net non- performing loans to total loans. Real production output is proxied by the IPI covering the physical output of all stages of production in the manufacturing, mining, gas, and electric utility industries and displays strong co-movements with GDP (OECD, 2012). In Malaysia, IPI covers three major sectors, namely mining, manufacturing and electricity. This variable has been used in the studies by Vouldis and Louzis (2018) and Žiković et al. (2015) and IPI is hypothesized to be negatively correlated with NPLs.

We use CPI as a proxy of inflation, which is an average of prices for different goods. The CPI index provides information about average price changes reflecting values of the Ringgit on purchasing power which represents the expenditure pattern of all households in Malaysia with 2010 as the base year (DOSM, 2018). As prices increase, the purchasing power will decline. Thus, an increase in the CPI would lead price of the goods to increase and subsequently, will burden the borrower to repay their debt with the assumption the income is constant. Vardar and Ozguler (2015) and Janvisloo et. al. (2013) use this variable as a proxy for inflation. The expected sign of this variable is positive.

Money supply (M2) refers to currency in circulation issued by BNM, current and saving deposit, a sum of interest-bearing instruments which include fixed deposit and repo and foreign currency deposit. Higher M2 indicates higher purchasing power and increases level of consumption (Ihsan and Anjum, 2013). This variable has been used in Lleshanaku (2015) and Badar and Javid (2013) and money supply is expected to have a negative sign. Increase in money supply lowers interest rate which means it is now cheaper to borrow. The lower real interest rates lead to higher wealth for borrowers hence, increases the ability to pay back debt and this will contribute to decreasing NPLs.

Another determinant considered in this study is exchange rate. Empirical studies have found mixed results for the relationship between exchange rate and NPLs. Generally, most studies expect exchange rate to have positive effect on NPLs. Increase in nominal exchange rate causes Malaysian Ringgit (MYR) to depreciate. Depreciation of MYR may lead to inflation and higher NPLs. This variable has been used in the studies by Amuakwa-Mensah and Boakye-Adjei (2015) and Atanasijević and Božović (2016).

To analyze our empirical model, we employ the ARDL cointegration approach introduced by Pesaran and Shin (1998) and Pesaran et al. (2001). This method is preferred because of its econometric advantages compared to other contegration method for example the Engle and Granger (1987) and the Johansen and Juselius

(1990). ARDL can be used to analyze the long-run relationship between the variables regardless of the order of integration. In other words, it can be applied irrespective of whether the variables are integrated at level, ($I(0)$), first difference, ($I(1)$) or a combination of both. Since ARDL estimates short-run and long-run coefficients simultaneously along with the lagged dependent and independent variables, endogeneity is not a problem. In addition, ARDL approach is also suitable for small sample analysis. This approach comprises of two distinctive steps. In the first step, the empirical equation in (1) can be written in terms of ARDL model equation as follows:

$$\begin{aligned}\Delta NPL_t = {} & \beta_0 + \beta_1 \Delta NPL_t + \beta_1 \Delta IPI_t + \beta_2 \Delta CPI_t + \beta_3 L\Delta NM2_t + \beta_4 E\Delta X_t \\ & + \sum_{i=1}^{\rho 1} \delta_1 \Delta NPL_{t-i} + \sum_{i=0}^{\rho 2} \delta_2 \Delta IPI_{t-i} + \sum_{i=0}^{\rho 3} \delta_3 \Delta CPI_{t-i} + \sum_{i=0}^{\rho 4} \delta_4 \Delta LNM2_{t-i} \\ & + \sum_{i=0}^{\rho 5} \delta_4 \Delta EX_{t-i} + \mu_t\end{aligned} \tag{2}$$

Δ is first difference operator and μ is the error term. The coefficients of the first differenced variables measure the short-run relationship, while the long-run estimates are obtained from β_1 to β_4. The optimal lags length is selected based on Schawrtz-Bayesian criteria (SBC) and Akaike's information criteria (AIC) and represented by $\rho 1$ to $\rho 5$. In order to determine the cointegrating relationship between NPLs and its macroeconomic determinants, we test the null hypothesis that H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ against the alternative; H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$. The test follows an F distribution and the computed value needs to be compared to the critical values presented in Pesaran et al. (2001) or Narayan (2005). If the computed F-statistic is higher than the upper bound critical values, we reject the null hypothesis, then, the variables are cointegrated, which means that NPLs and the macroeconomics variables are moving together towards a long-run equilibrium. On the other hand, the variables are not cointegrated if the computed F-statistics is lower than the upper bound critical values. If the F-statistic lies between the upper and lower bound critical values, then the test is inconclusive.

If the model passed the Bound test, we proceed to the estimation of a long run and short run relationship between the variables which is as follows:

$$\begin{aligned}NPL_t = {} & \beta_0 + \sum_{i=1}^{\rho 1} \beta_1 NPL_{t-1} + \sum_{i=1}^{\rho 2} \beta_2 IPI_{t-1} + \sum_{i=0}^{\rho 3} \beta_3 CPI_{t_{t-1}} \\ & + \sum_{i=0}^{\rho 4} \beta_4 LNM2_{t_{t-1}} + \sum_{i=0}^{\rho 5} \beta_5 EX_{t_{t-1}} + \varepsilon_t\end{aligned} \tag{3}$$

The final step requires the estimation of an error correction model (ECM) to determine the speed of adjustment, ω. ECT is the residuals from the estimated model in (3).

$$\begin{aligned}\Delta NPL_t = {} & \delta_0 + \sum_{i=1}^{\rho 1} \delta_1 \Delta NPL_{t-i} + \sum_{i=0}^{\rho 2} \delta_2 \Delta IPI_{t-i} + \sum_{i=0}^{\rho 3} \delta_3 \Delta CPI_{t-i} + \sum_{i=0}^{\rho 4} \delta_4 \Delta LNM2_{t-i} \\ & + \sum_{i=0}^{\rho 5} \delta_3 \Delta EX_{t-i} + \omega\, ECT_{t-1} + \varepsilon_t\end{aligned} \tag{4}$$

In addition to the estimation of short-run and long-run relationship between NPLs and its determinants, we also study the possible dependence of the variables. This is because, the significant relationship between the variables does not imply causation or direction of influence. Identification of the causal relationship is conducted using the Granger Causality test which provide the direction of relationship and possibility of causation between NPLs and its determinants. Granger (1988) postulated that the casual relationship between the variables should be analyzed within a dynamic error correction framework once we confirmed the variables are cointegrated. The test involves estimating a pair of regression (Gujarati, 2005). Thus, the following autoregressive time series models are formulated to test for bivariate Granger- causality between NPLs and its determinants:

$$NPL_t = \sum_{i=1}^{n} \alpha_i X_{t-1} + \sum_{i=1}^{n} \beta_i NPL_{t-i} + \mu_{1t} \quad (5)$$

$$X_t = \sum_{i=1}^{n} \gamma_i X_{t-1} + \sum_{i=1}^{n} \delta_i NPL_{t-i} + \mu_{2t} \quad (6)$$

where NPL_t is the rate of NPL and X_t represents the selected determinants while μ_{1t} and μ_{2t} are uncorrelated error terms.

Equation (5) hypothesized that current NPLs is related to the previous NPLs rate as well as other determinants, X. Similarly, equation (6) hypothesized that current determinants of NPL is related to their previous values and the rate of NPLs. The Granger causality test is conducted separately for each determinants, but to simplify, we use X_t to represents the determinants (IPI, INF, M2 and EX). There are four different conclusions that can be inferred from the test. If the estimated coefficient on the lagged X in (5) are jointly significant (i.e. statistically different from zero) and the coefficient on the lagged NPL in (6) is insignificant (not statistically different from zero), then there is a unidirectional causality from X to NPL. In contrast, the unidirectional causality runs from NPL to X if the set of lagged X coefficients in (5) is insignificant and the set of lagged NPL in (6) is significant. If both sets of lagged coefficients are statistically different from zero, we conclude that there is a bidirectional causality. However, we cannot determine the direction of causality if both coefficients are insignificant. In that case, we assume that the variables are independent of each other.

RESULT AND DISCUSSION

Unit Root Test

The unit root tests are conducted to determine the stationarity of the variables. We conduct two different unit root tests, which are the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP). Results are shown in Table 1 below. The results confirm that the variables used in this study are integrated either at level, *I*(0) or first difference, *I*(1). Since there are no *I*(2), we can proceed and apply the ARDL bounds testing approach for our analysis.

Table 1 Unit Root Test

	Augmented Dickey-Fuller (ADF)		**Philips Peron (PP)**	
		Level		
Variable	Constant	Constant With Trend	Constant	Constant With Trend
NPL	-1.04	-4.89***	-3.84***	-3.42*
IPI	-4.60***	-5.79***	-4.60***	-5.89***
CPI	-4.59***	-5.30***	-4.80***	-5.32***
M2	-3.52**	-1.84***	-3.22**	-0.63
EX	-1.52***	-2.06***	-1.55	-0.55
Variable		**First Difference**		
NPL	-2.85*	-2.65	-3.20**	-3.17
IPI	-7.78***	-5.72***	-27.09***	-28.74***
CPI	-6.82***	-6.69***	-10.97***	-10.97***
M2	-3.24**	-4.16**	-3.13**	-4.13**
EX	-5.31***	-5.21***	-5.32***	-5.22***

Notes: The figure is the t-statistic value. * Significant at the 10%; ** Significant at the 5%; *** Significant at the 1%. The lags are selected based on the Schwarz Info Criterion (SC).

Bounds Test

The Bounds test for cointegration is conducted to examine the cointegration between NPLs and the macroeconomics determinants. We choose the Schwarz Info Criterion (SC) lags length selection criteria to determine the optimal lag length. Table 2 reports the Bounds test computed F-value and the Bound critical values from Narayan (2005). The F-statistics is 10.473 which is above the lower and upper bound critical value of 3.74 and 5.06, respectively at the 1% significance level. Thus, we can reject the null hypothesis of no cointegration and conclude that the is a long-run relationship between the variables. This result confirms that the variables are moving together towards a long-run equilibrium.

Table 2 Bound Test

F-statistic:	**10.473*** **	
	Bound critical value	
Significant level	*I*(0)	*I*(1)
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06

Notes: The asterisk (***) denotes that the statistics are significant at 1% level. Critical values are extracted based on Narayan (2005), Case III: unrestricted intercept and no trend with $k = 4$.

Long-Run Result

Since we confirmed the existence of cointegration, the analyses proceed to identify the magnitude of the long-run coefficient. Table 3 presents the empirical result of the estimated model. The result shows that in the long run, industrial production, money supply and exchange rate are significant determinants of NPLs. Exchange rate is positive and significant whilst industrial production and money supply have an adverse effect on NPLs, which are in line with existing literature. The inverse relationship between IPI and NPL is in line with existing literature for example Vouldis and Louzis (2018); Žiković et al. (2015) and Vatansever and Hepsen (2013) among others. The result shows that NPLs is affected by the economic slowdown which is proxied by the industrial production index. This also suggest that if Malaysia's economy is growing, there will be favorable positive economic conditions like lower unemployment, increases in firm's profit and household incomes which then lead to higher ability for debtors to pay back their loans, reducing the number of problematic loans. However, in recession, when the economics environment deteriorates, there will be higher debt repayment problems which causes the NPLs to increase.

Money supply is negatively related to NPLs in the long run which is in line with Bucur and Dragomirescu (2018) and Lleshanaku (2015). Although many literatures find contradicting result, this study proves that the government's expansionary monetary policy reduces the bad loan in the financial system. Lower interest rate may stimulate higher investment; thus borrowers are able to repay their financial obligations. As a result, NPLs will be reduced by approximately 0.073% if the government increases money supply. The negative relationship between exchange rate and NPLs suggests that when the exchange rate depreciates, the loan's principal amount and the interest that needs to be paid increase. The cost of borrowing is increased because the banks tend to charge high lending rates given the high volatility risk involved. Currency depreciation with high interest rates could push corporate borrowers into bankruptcy and depleting banks' capital buffers (World Bank, 2019). This is in line with existing literature such as Rulyasri et. al. (2017) and Amuakwa-Mensah and Boakye-Adjei (2015). The empirical result also reveals that inflation does not have a significant impact on NPL in the long run. Although the outcome is contrary to the expected result, there are studies which also evidenced the same positive and insignificant relationship of inflation on NPLs. The finding confirms the insignificant relationship found by Zainol et al. (2018) and Isa and Mohamed (2017) in Malaysia and Rifat (2017) in Bangladesh.

Table 3 Long-Run Result

Dependent Variable: NPL			**Lag structure: (2,0,0,0,0)**	
Variable	**Coefficient**	**Standard Error**	**t-Statistic**	**Prob.**
IPI	-0.59**	0.23	-2.49	0.02
CPI	0.52	0.72	0.71	0.48
M2	-7.27***	1.16	-6.25	0.00
EX	15.71**	6.96	2.29	0.03
Constant	22.77***	7.03	3.24	0.00

Notes: Significant at the 10%; ** Significant at the 5%; *** Significant at the 1%.

Short-Run Result

The short-run results is presented in Table 4. In the short-run, only industrial production and inflation are significantly related to NPLs. An increase in IPI leads to decrease in NPLs by 0.15%, while inflation increases NPLs by 0.24%. This suggests that in the short-run, better economic conditions increases households purchasing power and increases consumption. This will give opportunity for higher loans and possibility of burdens in paying back the debts. For inflation, an increase in the cost of goods and services increases operational costs for the firms and decreases consumer demand which will eventually affect financial performance of firms and the ability of paying back the loans (Beck et al., 2013). On the other hand, M2 and exchange rate are insignificant. The ECM is negative and statistically significant which also validates the use of ARDL approach. The ECM

coefficient of -0.29 indicates that the speed of adjustment is approximately 29% towards the stable position in the long run.

Table 4 Short-Run Result

Dependent Variable: NPL			**Lag: (2,0,0,0,0)**	
Variable	**Coefficient**	**Standard Error**	**t-Statistic**	**Prob.**
D(NPL(-1))	0.34**	0.13	2.66	0.01
D(IPI)	-0.15***	0.03	-5.09	0.00
D(CPI)	0.24**	0.12	2.03	0.05
D(M2)	-4.03	3.72	-1.09	0.29
D(EX)	3.58	2.00	1.79	0.09
C	24.94***	4.88	5.11	0.00
ECT(-1)	**-0.29*** **	**0.06**	**-5.11**	**0.00**

Notes: * Significant at the 10%; ** Significant at the 5%; *** Significant at the 1%. Case III: unrestricted intercept and no trend.

Diagnostic Tests

To ensure the efficiency and validity of the findings, we conduct several diagnostic tests. The tests include serial correlation, heteroscedasticity, normality and stability tests. The results in Table 5 shows that the residuals are serially uncorrelated and homoscedastic as the null hypotheses fail to be rejected for all the tests. In addition, the model also passed the normality test, therefore, we can conclude that the results are valid and efficient.

Table 5: Diagnostic Test

Diagnostic Test	**LM Test Serial correlation**	**Heteroscedasticity**	**Jarque-Bera Normality**
Result	0.295 (0.747)	1.241 (0.324)	0.037 (0.982)

Notes: P-values are shown in parentheses.

To ensure that the long-run model is stable, we conducted the cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) tests. Figure 2 and 3 illustrates that the model is stable as both CUSUM and CUSUMSQ move inside the critical bound at 5% significant level. The results imply that the long-run relationships and stability of coefficients are established among variables over the period of 1988 to 2018.

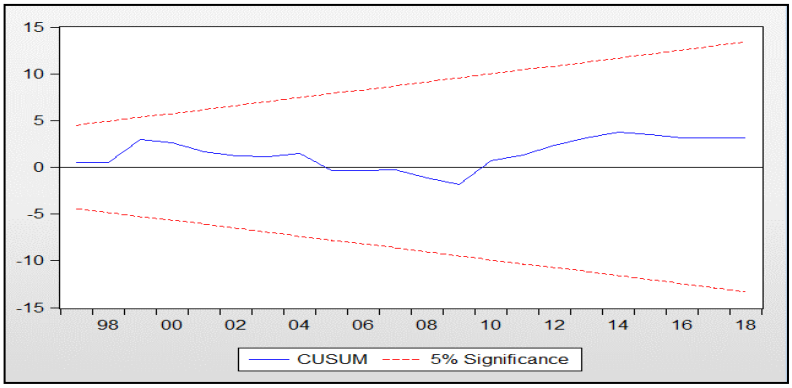


Figure 2 CUSUM

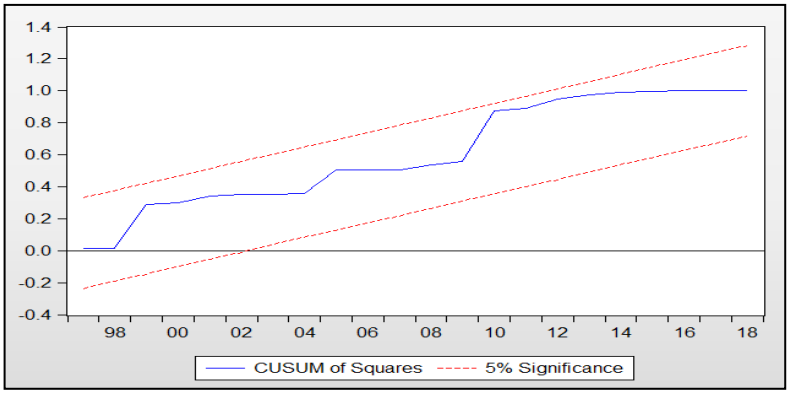


Figure 3 CUSUMSQ

Granger Causality Tests

To investigate the relationship further, we conduct the Granger Causality test to examine the possible causal relationship between the dependent variable, NPLs and each of the independent variables chosen in the analysis. Based on the result on Table 6, we can conclude that there exists a bi-directional relationship between Industrial Production Index and NPLs since both variables granger cause each other. This suggests that IPI will have great impact on NPLs and any changes in NPLs ratio will also affect IPI. There exists uni-directional causal relationship between exchange rate and NPLs, IPI, CPI and M2. This uni-directional causal relationship runs from exchange rate to all the variables stated above. This indicates that changes in exchange rate will affect NPLs and macroeconomics conditions proxied by the determinants. In addition, changes in NPLs and the macroeconomics variables do not affect exchange rate. Additionally, there is also a uni-directional causal relationship runs from money supply to IPI which suggest that increases in money supply will affect the growth of the economy while growth does not affect money supply.

Table 6: Granger Causality Tests

Null Hypothesis	**F-Statistic**	**Decision**
IPI does not Granger Cause NPL	3.401 (0.050)**	Reject H_0
NPL does not Granger Cause IPI	4.549 (0.021)**	Reject H_0
EX does not Granger Cause NPL	7.199 (0.004)***	Reject H_0
M2 does not Granger Cause IPI	6.089 (0.007) ***	Reject H_0
EX does not Granger Cause IPI	3.492 (0.047)**	Reject H_0
EX does not Granger Cause CPI	3.627 (0.042) **	Reject H_0
EX does not Granger Cause M2	7.700 (0.003) ***	Reject H_0

Notes: ** Significant at the 5%; *** Significant at the 1%. P-values are shown in parentheses.

CONCLUSION

This paper attempts to study the determinants of the NPLs in Malaysia by examining the relationship between selected macroeconomic indicator and NPLs over the period of 1988 to 2018. In the short run, industrial production and inflation are significantly related to NPLs. A deviation caused by an external shock from the NPLs in current period will be corrected approximately in 3 years. In the long run, all determinants are significant except for inflation. The result also shows that 80% of the NPLs can be explained by the independent variable in the model. The result from the Granger causality test found that IPI has bi-directional effect on NPLs and exchange rate has unidirectional causality against all other variables. The empirical result suggests that the macroeconomic environment is very important for NPLs in Malaysia. The exogenous macroeconomic factor arising partly from the global trade tensions influences the economic growth, thus effecting business and household income. Furthermore, exchange rate flexibility and sufficient level of money supply further enhance the capability to withstand external shocks. According to Bank Negara Malaysia Annual Report (2019), global trade developments will remain a key factor affecting the 2019 economic outlook. Hence, establishing and a clear understanding of the factors that affect NPLs would provide policy authorities in Malaysia the important information to formulate appropriate and effective policy particularly in the banking sector.

The results may assist the management of banking institutions to manage their lending policy and credit risk assessment to prevent an excessive build-up of debt in the banking system. Among others, the implementation of macro prudential measures to encourage more responsible lending amid an increasingly challenging global economic environment. In addition, economic growth, money supply and exchange rate are crucial to lower the NPLs level and continues to be a key source of strength for the Malaysian economy in managing more volatile capital flows and their effects on NPLs of domestic banking conditions. Thus, BNM needs to continue to monitor and provide effective macroeconomic measures and guidelines to mitigate excessive money supply and exchange rate fluctuations. As a buffer against external shocks, the flexibility of the exchange rate remains an important shock absorber.

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