Is the relationship between lending interest rate and non-performing loans nonlinear asymmetric ? Malaysian evidence

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Abstract

This paper addresses the question whether the relationship between lending interest rate and non-performing loans is nonlinear asymmetric or not. Lending interest rate has an inherent implicit cost on the credit issued by banks with implication on loan defaults. In this regard, high level of non-performing loans (NPLs) will depress economic growth owing to many banks refusing to lend. This paper makes the initial attempt to test the non-linear asymmetric relationships between lending interest rate and NPLs by using the NARDL approach and provides a direction of Granger causality between the lending interest rate and NPLs. Malaysia is used as a case study. The finding tends to indicate that lending interest rate and NPLs has an asymmetric relationship in the short-run and symmetric relationship in the long-run. This paper suggests that banks can improve their quality credit management by streamlining their collection process and the quality of customers in order to reduce the number of NPLs in the short-run. Besides, banks can keep their total risk low by diversifying their loan portfolios.

Keywords: Lending interest rates, non-performing loans, ARDL, NARDL, Malaysia

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1.0 INTRODUCTION

Non-performing loans (NPLs) became more important for many researchers after the Asian financial crisis during the 1990s in many countries. This is because it is always correlated with bank failure. The main issue with the NPL is that impaired assets impacting the banking sector vulnerability increased rapidly resulting from the global financial crisis. This NPL will affect the whole banking industry and become a big hurdle in its future development. This is due to the fact that NPLs will tie up bank capital without providing any return and this can reduce bank's profitability as well as threaten business models. NPLs also can erode bank's liquidity and may lead to asset corrosion of banks and capital erosion. Consequently, banking industry becomes weak due to the less capacity to lend and this issue becomes controversial and has been triggered by many politicians, policymakers and investors. Furthermore, as stated by Bonin and Huang, (2001) the probability of financial crisis due to the risk associated by NPLs will increase if it is not eliminated. In this regard, bank's management and financial authorities try to maintain a low level of NPLs to achieve a stable financial system (Badar and Javid, 2013).

Unlike other countries that had serious impacts on many financial sectors after the Asian Financial Crisis 1997 and Subprime Mortgage Crisis 2007, Malaysia was not impacted directly by these crises. This is because there is an intervention from the government regarding the NPL recovery strategies whereby NPL ratio declined from 9.4% in 2005 to 3.6% in 2009 (Loh et al., 2015). The Malaysian government has established the Corporate Debt Restructuring Committee (CDRC), Danamodal, an agency for contributing government funds and Danaharta, an agency for acquiring NPLs that can reduce the level of NPLs. However, Malaysia still cannot provide a radical resolution for the excessive number of NPLs. Considering this, high level of NPLs will depress economic growth due to many banks refusing to increase their lending (Loh et al., 2015). Thus, this paper helps policymakers to develop plans to mitigate the level of NPLs that might obstruct economic growth.

As Malaysian banks are currently experiencing fast growth in banking industry, these NPLs not only reflect the bank-specific factors but also macroeconomic factors such as

GDP growth rate, real exchange rate, lending interest rate, inflation and unemployment (Khemraj and Pasha, 2009; Pullicino, 2016; Farhan et al., 2012; Loh et al., 2015). Based on that, the available literature suggests that the dramatic changes in lending interest rates are associated with the level of NPLs, because high lending interest rates will broaden the debt burden of borrowers eventually causing loan defaults (Pullicino, 2016). The economic rationale behind the lending interest rate is that it has an inherent implicit cost on the credit issued by banks with implications on loan defaults. Simply put, NPLs and lending interest rates have a noteworthy relationship.

On this point, this paper extends the literature concerning non-linearity between lending interest rate and NPLs relationships by using the nonlinear autoregressive distributed lags model (NARDL) introduced by Shin et al. (2014) and provides direction of Granger causality between the lending interest rate, NPLs, real effective exchange rate, inflation rate and unemployment rate. The goal is to capture the short-run and long-run asymmetries through both positive and negative partial sum decompositions of changes in the NPLs and to have a better understanding of the movements of the NPLs in response to changes in the lending rates which helps policymaker maintain a low level of NPLs to achieve a stable financial system. Hence, this paper applies time-series data from the January 2008 to December 2017 to examine five variables whereby two focus variables are lending interest rate and non-performing loan, while the rest are control variables such as, real effective exchange rate, unemployment rate and inflation rate.

The findings tend to indicate that lending interest rate and non-performing loan has an asymmetric relationship in the short-run and symmetric relationship in the long-run. This asymmetric was found due to the impact of Subprime Mortgage Crisis 2007. Hence, either banks increase or decrease their lending interest rates during the economic downturns, the level of non-performing loans always increases in the short-run due to the condition of the economy at that time. It means that, even if the banks offered the lower interest rate during the financial crisis period, the number of NPL always increases. However, in the long-run, the level of NPL is proportionately related to the lending interest rates offered by banks. Bank's management need to maintain a low level of NPLs by hook or by crook to avoid financial crisis to happen.

2.0 THEORETICAL FRAMEWORK

The NPLs ratio will be a concern for many banks in Malaysia as the Central Bank of Malaysia (BNM) recently increased its overnight policy rate (OPR) to 3.25% since January 2018 to catch up with the interest rate in the United States. The changes in OPR will influence other important variables such as, inflation rate, real effective exchange rate, base rate (BR), base lending rate (BLR), fixed deposit and saving deposit accounts and others which have a direct impact to the Malaysian economy. The rise in the inflation rate from 3.7% in August to 4.3% in September 2018 indicates that Malaysia citizens right now cope with a high cost of living as the rise in fuel prices due to the slowdown in the Oil and Gas sector. This can decrease the asset quality of banks in Malaysia. According to S&P Global Ratings, this can be seen as the pool of corporate deposits has fallen and many companies in Malaysia reduced their corporate borrowing. Consequently, this can lead to an increase in NPLs and credit costs that are expected to further stress the banks' profit margin. Conversely, a higher inflation rate might lead to lower delinquency where it can reduce the real value of debt. Besides, inflation makes debt servicing easier and NPLs can be either positively or negatively affected.

Besides, the probability of a higher unemployment rate may result in more loan defaults owing to the less capability to cope with debt payment. In this regard, the loan approval rate for the commercial property drops by almost half. Moreover, economy conditions getting worst when there are higher NPLs due to the higher unemployment rate. In essence, when economic downturns, business cannot perform well and firms might reduce their employees to cut down their operating costs, thus increase in the unemployment rate. This implies that unemployment rate is one of the macroeconomic factors that affect the level of NPLs.

Furthermore, depreciation in the real effective exchange rate is correlated with lower quality of bank assets which contribute to higher NPLs. The real effective exchange rate has a bidirectional causal relationship with NPLs. In other words, the large depreciation of the exchange rate during the crisis contributed to a significant increase in NPLs which linked to the share of foreign currency denominated loans in total loans, especially on

households' balance sheets. Also, when NPLs increase, economic growth turns slowdown and exchange rate tends to depreciate. Nevertheless, this can be seen in the long run relationship. In contrast, NPLs may not be affected by the nominal exchange rate for the countries that can manage to maintain their currency during the crisis. This can be seen in the country such as Latvia where they managed to maintain their exchange rate during the crisis in 2008 to catch up with the economy with fixed exchange rates and a high degree of foreign currency lending.

Simultaneously, as interest rate had to be increased to defend the currency board, even slightly, higher lending interest rate leads to the higher levels of non-performing loans. The case of UK reveals how the reaction of monetary policy to the crisis might result in a decrease in lending interest rate, give a positive impact to the bank loans quality as well as reduced the level of NPLs. Hence, the macroeconomic effect on NPLs could be handled by decreasing in lending interest rate by policymaker. Even though there are many factors that will influence NPLs, however, this paper will focus only on the effective lending rate (ELR), specifically whether ELR can be used to control NPLs in the context of banking in Malaysia. In Malaysia, since OPR increased by 25 points to 3.25% effective in January 2018, it would increase in the base rate (BR). On the one hand, the rise in OPR will lead to higher loan interest rate or profit rate and thus affecting borrowers with variable rate loans as the loans are tagged to base lending rate (BLR). The graph chart 1.1 below shows the bank lending rate increase sharply in January 2018 which reflect to the changes in OPR.

Figure 1.1: Malaysia Bank Lending rate

Based on Ivan Tan, the director of S&P financial institution ratings, the rise in the OPR rate is expected to increase in NPL ratios by around 1.8% up to 2%. Besides, increased in OPR will increase the indebtedness of corporations at 110% of GDP and household debt at 85.6% of GDP in the first half of 2017 and simultaneously increased the national debt services. Simply put, NPLs are very sensitive to the changes in effective lending rate that associated with floating rate loans which determined by the Central Bank of Malaysia (BNM). It means that BR will increase if BNM increases the OPR. This can be seen ELR might have a positive long-run impact on NPLs. On the other hand, the increase in OPR is not always a negative phenomenon. An increased in OPR may be good for depositors with the savings account and fixed deposits which may help them to get more from their saving. Ultimately, Malaysian consumers either borrowers or depositors can get benefit from knowing the OPR. On the borrower side, they have to pay more in terms of instalment or they can increase their loan tenure if they do not want to pay a higher instalment when ELR increased. On the depositor side, they can enjoy better interest rates on their saving accounts when OPR increased.

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There is no clear evidence whether the variations in market floating rate loans which came into effect on January 2, 2015 can affect NPLs as banks performance predominantly depends on the response in both sides of the banks' asset and liability. Since BR is determined by the Statutory Reserve Requirement (SRR) and OPR by BNM in an economy, theoretically, policymakers can influence either the SSR or OPR to control base rate. Not only that, policymaker at the banks can influence ELR to control NPLs. Nonetheless, there is no clear indication whether NPLs has a proportional relationship with the ELR. There are several reasons why banks which provide the same lending interest rate could have different NPLs. Some banks maybe have a higher number of NPLs due to the poor credit management, or maybe they had highly diversified loan portfolios that enabled them to relax their credit standards while keeping their total risk low. Besides, some banks may have been willing to gamble on loans with high default risk because they had a high propensity to take risk. On top of that, they might be asymmetric due to the fact that the margin or "spread rate" between the BR and ELR depends on the borrower's credit risk, liquidity, operating cost and profit margin of the banks. Simply put, each bank has their own ELR depending on their efficiencies in lending. Furthermore, certain banks can offer lower ELR to the customers even have a higher BR in order to remain competitive.

On the other hand, NPLs might be has a proportional relationship with the ELR. Consistent with portfolio theory, each bank intends to maximize returns and minimize loan risks by increasing the optimum ELR. Theoretically, banks will face insolvency resulted from the dropping in asset values when the debtors are unable to pay back their loans because of higher ELR. Considering this, NPLs become a problem for many banks in Malaysia when the principal and interest payments on the loan are overdue by 90 days or more. Furthermore, capital asset pricing theory examine at the systematic risk brought about by the market movements which could affect loan defaults risk. In other words, it measures the loan risks and the optimal ELR to be charged in order to get the higher returns and simultaneously decrease the default risk.

Premised on the above arguments, the changes in ELR that would impact on NPLs are a priori ambiguous. These arguments stand in theory even though empirical evidence yield mixed results. However, this paper will focus only on the effective lending rate (ELR),

specifically whether ELR can be used to control NPLs in the context of banking in Malaysia. In this regard, it will determine whether ELR is the leading or lagging variable and the finding will determine whether it can be used to control NPLs.

3.0 LITERATURE REVIEW

The empirical research on the links between lending interest rate and NPL is voluminous and has been increasingly studied over the last few decades (Khemraj and Pasha, 2009; Pullicino, 2016; Farhan, 2012; Loh Chun Yong et.al., 2015; Beck et al., 2013; Louzis et. al., 2011). The economic rationale behind the lending interest rate is that, it has an inherent implicit cost on the credit issued by banks with preceding implication on loan defaults. Most of these studies provided widespread evidence emphasizing the importance of NPL recovery strategies in reducing the level of NPLs to attain financial stability and to avoid the financial crisis to happen.

Many researchers found that the lending interest rate has a direct positive relationship with NPLs (Khemraj and Pasha, 2009; Farhan et al., 2012). Increase in lending interest rate will increase the number of NPLs. Asari et al., (2011) also found a positive noteworthy relationship between lending interest rate and NPLs. Higher number of NPLs will reduce the banks' assets resulted from the capital erosion. Beck et al., (2013) also found the positive relationship between lending interest rate and NPLs where NPLs can be affected by an increasing price of debt servicing between a borrower and variable rate of contracts. Not only that, but NPL also is likely to be affected by a rise of debt servicing costs of borrowers with variable rate contracts. However, research by Pullicino, (2016) found interest rate has no significant impact to NPLs on the commercial banks in the case of Malta, Italy, France, and UK, but only significant in the case of Spain. Nevertheless, interest rate in Spain has a negatively related to NPLs.

Research by Khemraj and Pasha, (2009) indicates that the real GDP and the real effective exchange rate have a significant impact on the level of NPLs. There has a strong direct relationship between real effective exchange rate and NPLs whereby decrease in the global effectiveness of the national economy transforms into higher NPLs. They also found

a negative relationship between GDP growth rate and NPLs which indicates that the high performance in the real economy due to the lower number of NPLs. This in line with the research by Farhan et al., (2012) where GDP has a significant negative relationship with the NPLs in the case of Pakistani banking sector. However, research by Pullicino, (2016) found exchange rate has no significant impact to NPLs in the case on Malta, Italy, France, and Spain, but only significant in the case of UK. The exchange rate in the UK has found a negatively related to NPLs.

Study by Rizvi and Khan, (2015) stated that inflation has a significantly impact on loan defaults in Pakistan. There are mixed impact of inflation on NPLs. The findings show the negative relationship between inflation and NPLs on the first quarter and have a positive relationship on the second quarter. However, inflation rate is not one of the factors that cause the NPLs in the Guyanese banking system (Khemraj and Pasha, 2009). Not only that, but there is no significant relationship between inflation and NPLs in the Nigerian banking industry (Inekwe, 2010). Based on Farhan et al., (2012) unemployment rate and NPLs has a significant positive relationship in the case of Pakistani banking sector. This result also in line with the case of Malaysia banking system where there is a positive relationship between unemployment rate and NPLs (Loh et al., 2015).

4.0 DATA AND METHODOLOGY

In this section, this paper will present the dataset and the methodological framework. This paper examines five variables whereby two focus variables are lending interest rate (LIR) and non-performing loans (NPL), while the rest are control variables such as, real effective exchange rate (REER), unemployment rate (UNEMP) and inflation rate (INFLR). The time-series data used are monthly data from the January 2008 to December 2017 which provided 120 observations in total. All the data are collected from the DataStream database. Most of the empirical analysis has been done through Microfit 5.0 but, Stata software has been used to estimate NARDL model.

The empirical methodology used in this paper begins with the unit root test to examine whether the variables are either stationary I(0) or first-order difference-stationary (non-

stationary) I(1). To test co-integration, this paper used Phillips-Perron test in order to proceed with Engle and Granger (1987) and Johansen (1991) co-integration tests. However, due to the mixed results found in ADF test, this paper was compelled to move to the ARDL co-integration test that was introduced by Pesaran and Shin (1999) later extended by Pesaran et al., (2001) which can comprise of both I(0) and I(1). To check the non-linearity between lending interest rate and NPLs relationships, this paper used the Non-linear ARDL (NARDL) co-integration test approached by Shin et al., (2014) to capture the short-run and long-run asymmetries through both positive and negative partial sum decompositions of changes in the NPLs. Then the paper proceeds with the Granger-causality testing to examine the causality chain between the lending interest rate, NPLs, real effective exchange rate, inflation rate and unemployment rate.

5.0 EMPIRICAL RESULTS AND DISCUSSIONS

5.1 Unit root test

Unit root test is very important to examine whether the variables are either stationary I(0) or non-stationary I(1) before proceeding to the co-integration tests. This is because most of the finance and economics variables are non-stationary in their original form. To check the stationary of variables separately in the log forms and first differenced, Augmented Dicky-Fuller test (ADF) and Phillips-Perron tests (PP) has been used. ADF test was introduced in 1981 in order to handle the serial correlation that presence in the residuals of the Dickey-Fuller (DF) test (Dickey and Fuller, 1979) which may cause biased empirical results. The idea behind ADF test is to include enough number of lagged dependent variables to rid average errors as well as to correct for residual autocorrelation problem (Dickey and Fuller, 1981). Furthermore, the ADF test can handle the ARMA errors in the variables as well as the characteristic of time-series data such as trends or breaks. Basically, both ADF and PP tests (Phillips and Perron, 1988) are used for testing stationarity of the variables. The difference between ADF and PP tests is that the Phillips-Perron test can be correcting both the autocorrelation and heteroscedasticity problems by using Newey-west adjusted variance method.

Table 5.1.1: ADF test *(Log Form)*

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
LOG FORM	LLIR	ADF(1)=SBC	319.1768	- 3.096	- 3.371	Non-Stationary
		ADF(1)=AIC	324.6492	- 3.096	- 3.371	Non-Stationary
	LNPL	ADF(1)=SBC	250.6697	- 0.704	- 3.371	Non-Stationary
		ADF(1)=AIC	256.1421	- 0.704	- 3.371	Non-Stationary
	LREER	ADF(1)=SBC	315.1133	- 2.097	- 3.371	Non-Stationary
		ADF(1)=AIC	320.5857	- 2.097	- 3.371	Non-Stationary
	LUNEMP	ADF(1)=SBC	160.4117	- 3.003	- 3.371	Non-Stationary
		ADF(1)=AIC	165.8841	- 3.003	- 3.371	Non-Stationary
	LINFLR	ADF(1)=SBC	489.3829	-5.0566	-3.371	Stationary
		ADF(5)=AIC	496.7674	-3.3948	-3.454	Non-Stationary

Table 5.1.2: ADF test *(First Differenced Form)*

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
1ST DIFF. FORM	DLIR	ADF(1)=SBC	312.1221	- 6.317	- 2.920	Stationary
		ADF(1)=AIC	316.2132	- 6.317	- 2.920	Stationary
	DNPL	ADF(1)=SBC	248.5813	- 7.259	- 2.920	Stationary
		ADF(2)=AIC	252.8756	- 5.076	- 2.938	Stationary
	DREER	ADF(1)=SBC	311.9638	- 6.732	- 2.920	Stationary
		ADF(1)=AIC	316.0549	- 6.732	- 2.920	Stationary
	DUNEMP	ADF(1)=SBC	157.6141	- 9.782	- 2.920	Stationary
		ADF(3)=AIC	162.6647	- 7.118	- 2.966	Stationary
	DINFLR	ADF(4)=SBC	477.925	- 7.964	- 2.894	Stationary
		ADF(4)=AIC	486.108	- 7.964	- 2.894	Stationary

Table5.1.3: PP test *(Log Form)*

	VARIABLE	T-STAT.	C.V.	RESULT PP
LOG FORM	LLIR	-2.3831	-3.4273	Non-Stationary
	LNPL	-0.8073	-3.4273	Non-Stationary
	LREER	-1.7771	-3.4273	Non-Stationary
	LUNEMP	-3.0949	-3.4273	Non-Stationary
	LINFLR	-2.5603	-3.4273	Non-Stationary

Table 5.1.4: PP test *(First Differenced Form)*

	VARIABLE	T-STAT.	C.V.	RESULT PP
1ST DIFF FORM	LLIR	-9.3910	-2.8641	Stationary
	LNPL	-11.0892	-2.8641	Stationary
	LREER	-8.6001	-2.8641	Stationary
	LUNEMP	-21.9781	-2.8641	Stationary
	LINFLR	-6.8274	-2.8641	Stationary

Table 5.1.1 shows that all variables are non-stationary in their log level form except inflation rate where AIC and SBC give a mixed result. This is because AIC more focus on predicting best of the order of lags and less concerned on over-parameter, while SBC tends to choose lower order of lags and more concerned on over-parameter. However, all variables are stationary after their first differenced as shown in Table 5.1.2. Phillips-Perron tests as shown in Table 5.1.3 shows that all variables are non-stationary in their log level form as null hypothesis of unit root cannot be rejected and become stationary in their first differenced level form as null hypothesis are rejected as stated in Table 5.1.4. Based on ADF test, this study cannot proceed to Engle-Granger or Johansen co-integration tests as they require all variables to be non-stationary. Hence, later this paper compelled to move to the ARDL co-integration test which can deal with variables that are integrated of different order I(0) and I(1). Nonetheless, this paper will use PP test in order to proceed with Engle-Granger or Johansen co-integration tests.

5.2 VAR order selection

Table 5.2.1: Order (lags) of vector autoregressive (VAR)

Order	AIC	SBC	P-Value	C.V.
1	1545.1	1504	[.242]	5%

Before going to co-integration tests, this paper tries to find the order (lags) of vector autoregressive (VAR). Table 5.2.1 shows that both Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) give one lag with the P-value 0.242. Therefore, this paper will used one lag to continue for the next step.

5.3 Cointegration tests

5.3.1 Cointegration tests: Engle-Granger

Basically, Engle Granger tests the co-integration by examining the error term. In this test, the null hypothesis attempts to show that there is no co-integration between the variables, while the alternative hypothesis shows the co-integration between the variables in the long-run.

Table 5.3.1: *Engle-Granger Statistical Test*

VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT	CONCLUSION
LLIR	ADF(1)=AIC	312.0896	-3.0598	-4.5398	Non-Stationary	No Co-integration
	ADF(1)=SBC	308.3618	-3.0598	-4.5398	Non-Stationary	No Co-integration

Based on Table 5.3.1, this paper found that there is no co-integration between the variables as the null hypothesis of unit root fail to be rejected due to low value of test statistic which is lower than critical value. Nevertheless, there are several limitations by using Engle Granger co-integration tests. Engle Granger approach assumes only one co-integration as a maximum and does not give the number of co-integrating vectors.

5.3.2 Cointegration tests: Johansen

To handle the limitations of Engle Granger co-integration tests previously, this paper attempts Johansen co-integration test. This is due to the fact that, Johansen approach can give the possible co-integrated vectors in the model. In other words, if the model has more than two variables, there is a possibility of having more than one co-integrating vector. There may be sub-groups among the variables which are moving together in the long-run. Similarly to the Engle Granger co-integration tests, the null hypothesis in this Johansen co-integration test attempts to show that there is no co-integration between the variables, while the alternative hypothesis shows the co-integration between the variables in the long-run.

Table 5.3.2 (a): Lag order 1, Co-integration with unrestricted intercepts and unrestricted trends in the VAR.

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r = 1	59.479	37.070	34.160	1 cointegration
r<= 1	r = 2	21.974	31.000	28.320	
Cointegration LR Test Based on Trace of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r>= 1	97.846	82.230	77.550	1 cointegration
r<= 1	r>= 2	38.367	58.930	55.010	

Table 5.3.2 (b): Lag order 1, Co-integration with unrestricted intercepts and restricted trends in the VAR.

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r = 1	59.798	37.860	35.040	1 cointegration
r<= 1	r = 2	23.571	31.790	29.130	
Cointegration LR Test Based on Trace of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r>= 1	105.596	87.170	82.880	1 cointegration
r<= 1	r>= 2	45.798	63.000	59.160	

From the Table 5.3.2 (a), Johansen co-integration test shows that there is one co-integration between the variables based on both Maximal Eigenvalue and Trace as the null hypothesis is rejected at 5% significant level. This paper repeated the test by restricted the trends in the VAR as stated in Table 5.3.2 (b) which also gives the similar result of one co-integration between the variables. Notwithstanding, Johansen approach

also has several limitations. It assumes all variables are non-stationary, I(1). Besides, it is very sensitive to the number of lags or constant term or trend. The result may be change when changing the number of lags. Not only that, pre-test is biased in accepting the null as the test tends to accept the null at 95% of the time. Since the ADF test previously gives the mixed result, this paper proceed to the ARDL co-integration test which can accommodate with the variables that are integrated of both stationary I(0) and non-stationary I(1).

5.3.3 Cointegration tests: Autoregressive Distributed Lag (ARDL)

From the limitations of the Johansen co-integration test, this paper move to Autoregressive Distributed Lag (ARDL) which can deal with the variables that are stationary I(0) and non-stationary I(1). There is said to be a co-integration between the variables in the long-run when the F-statistics (Wald Test) exceeds the critical value of upper bound. The null hypothesis in this ARDL co-integration test attempts to show that there is no co-integration between the variables, while the alternative hypothesis shows that there is a co-integration between the variables in the long-run.

Table 5.3.3 (a): *ARDL Statistical Test*

Variables	F-stat	P-value	Lower Bound (90%)	Upper bound (90%)	Lower Bound (95%)	Upper bound (95%)	Conclusion	Sig. Level
DLIR	4.2607	[.002]	2.782	3.827	3.189	4.329	Co-integration	10%
DNPL	4.1302	[.002]	2.782	3.827	3.189	4.329	Co-integration	10%
DREER	2.4115	[.042]	2.782	3.827	3.189	4.329	No co-integration	
DUNEMP	4.5554	[.001]	2.782	3.827	3.189	4.329	Co-integration	5%
DINFL	1.2308	[.301]	2.782	3.827	3.189	4.329	No co-integration	

Based on Table 5.3.3 (a), there is co-integration between the lending interest rate (LIR) and non-performing loans (NPL) in the long run at 10% significant level and unemployment rate (UNEMP) at 5% significant level as the F-statistic exceeds the critical value of upper bound. Therefore, this paper rejects the null hypothesis of no co-integration between the variables which indicates that the variables are moving together in the long-run. In other words, co-integration implies that the relationships between the variables are not spurious. There is a long-run equilibrium relationship among the variables whereby each variable contains information for the prediction of other variables. On the other hand, there is no co-integration in real effective exchange rate (REER) and inflation rate (INFLR) as the F-statistic below the critical value of lower bound

Table 5.3.3 (b): *long-run coefficients of ARDL*

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,2,1,1,0) selected based on Akaike Information Criterion

Dependent variable is LLIR
116 observations used for estimation from 2008M5 to 2017M12

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNPL	.29388	.082661	3.5553[.001]
LREER	-.16674	.39117	-.42626[.671]
LUNEMP	-.46927	.23054	-2.0355[.044]
LINFLR	.84836	.59736	1.4202[.158]
INPT	-1.3382	4.4009	-.30408[.762]

For the long-run coefficients of ARDL as stated in Table 5.3.3 (b), this paper estimated using the Akaike Information Criterion (AIC). Based on the AIC, non-performing loans (NPL) has a positive and significant relationship with lending interest rate at 5% significant level. This implies that 1% increases in NPLs will increase the lending interest rate by 0.29%. Intuitively, higher level of NPLs will reduce the banks' assets resulted from the capital erosion and consequently will increase lending interest rate of the banks. Furthermore, 1% increases in the unemployment rate will decrease in lending interest rate by 0.47%. It means that when the unemployment rate increases, more people are not able to borrow money and for the banks to maintain, they need to run their business by offering the lower lending interest rate to remain competitive.

Nevertheless, ARDL co-integration assumes linear and symmetric changes of non-performing loans (NPL) when level of lending interest rate (LIR) increases or decreases. Previous researchers still did not found either the lending interest rate has symmetric or asymmetric relationship with non-performing loans. Hence, this paper will discover whether the lending interest rate has asymmetric relationship with non-performing loans in the short-run and long-run by using NARDL approach.

5.3.4 Cointegration tests: Non-Linear Autoregressive Distributed Lag (NARDL)

As mentioned previously, this paper will focus on two variables, namely lending interest rate and non-performing loans to check the asymmetric relationship between two of them without control the variables. The NARDL approach identifies the relationship LIR and NPL specifically whether there exist the short-run and long-run relationship when these linkages are non-linear and asymmetric. NARDL model test for a long-run co-integration using bounds testing whereby the null hypothesis attempts to show that there is no long-run relationship between the variables (no co-integration), while the alternative hypothesis shows that there is a long-run relationship between the variables in the long-run (co-integration). There is said to be a co-integration between the variables in the long-run when the F-statistics (Wald Test) exceeds the critical value of upper bound.

Table 5.3.4 (a): Non-Linear ARDL (NARDL) Statistical Test

Variables	F-statistics	Critical Lower Bound	Critical Upper bound	Conclusion
NPL	12.6058	3.79	4.85	Co-integration

Table 5.3.4 (a) indicates that there is a co-integration between lending interest rate (LIR) and non-performing loans (NPL) in the long run at 5% significant level as the F-statistic exceeds the critical value of upper bound. In other words, lending interest rate and non-performing loan are moving together in the long-run.

Wald test for long-run and short-run symmetry

This paper introducing the short-run and long-run asymmetries in the standard ARDL model leads to the following general form of NARDL model introduced by Shin et al., (2011).

$$\Delta LIR_t = \beta_0 + \beta_1 LIR_{t-1} + \beta_2 NPL^+_{t-1} + \beta_3 NPL^-_{t-1}$$

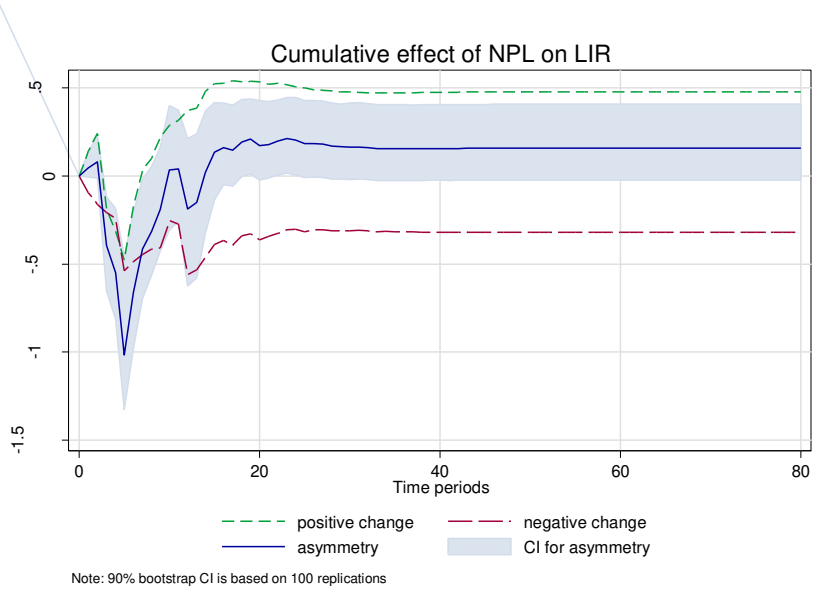
$$+ \sum_{i=1}^{p} \varphi_i \Delta LIR_{t-i} + \sum_{i=0}^{q} (\theta_i^+ \Delta NPL^+_{t-i} + \theta_i^- \Delta NPL^-_{t-i}) + u_t$$

Where, *LIR* is a lending interest rate, *NPL* is non-performing loan and p and q are lag orders. NARDL approach will decompose non-performing loans into its positive ΔNPL^+_{t-i} and negative ΔNPL^-_{t-i} partial sums for increases and decreases. The null hypothesis in this NARDL test shows that the relationship between lending interest rate and non-performing loan is symmetry in long and short term, while the alternative hypothesis shows that there is an asymmetry between the variables.

Table 5.3.4 (b): NARDL long run and short run symmetry

Independent: NPL	F-statistics	P-value	Selected specification
Long run	1.083	0.301	Symmetry
Short run	22.62	0.000	Asymmetry

Based on the Wald test as shown in Table 5.3.4 (b) indicates that the relationship between lending interest rate and non-performing loan is symmetry in the long-run at 5% significant level as the P-value is insignificant while asymmetry in the short-run as the P-value is significant.



The graph above portrays the cumulative effect of non-performing loan on lending interest rate and the shaded area is the confidence interval for symmetrical relationship. From this graph, the effect of non-performing loan on lending interest rate are not lies within the confidence interval in the short-run but then slowly lies within the shaded area in the long-run.

Intuitively, this asymmetric relationship in the short-run and symmetric relationship in the long-run between lending interest rate and non-performing loan may be due to the condition of the economic during that time. Hence, this can be seen on the mechanism of credit tightening during the financial crisis in 2008 as the data in this paper was collected from 2008 until 2017. During the financial crisis period in 2008, many Malaysian debtors were unable to pay back their loans. Consequently, non-performing loan becomes a problem for many banks in Malaysia when the principal and interest payments on the loan are overdue by 90 days or more. Simply put, either banks increase of decrease their lending interest rates during the economic downturns, the level of non-performing loans will always increases in a short-run period due to the condition of the economy at that time.

Since this paper used the data from 2008 to 2017, the graph above shows the asymmetric relationship between lending interest rate and non-performing loan in a short-run within 15 months during the financial crisis period happened and then becomes symmetric in the long-run. It means that, even the banks offered the lower interest rate during the financial crisis period, the number of non-performing loan always increases. However, in the long-term, the level of non-performing loan (NPL) is proportionate related to the lending interest rates offered by banks.

5.4 Vector Error Correction Model (VECM)

Vector Error Correction Model (VECM) indicates the direction of Granger causality, which variable is leading and which variable is lagging. In other words, which variable is exogenous and which variable is endogenous. Additionally, VECM also implies that changes in dependent variables are a function of the level of disequilibrium in the co-integrating relationship as well as changes in other variables. The variable is said to be

exogenous if the corresponding dependent variable is insignificant and the variable is said to be endogenous if the corresponding dependent variable is significant which refer to the error correction coefficient. The size of the coefficient of the error correction term indicates that how long it would take to get back to equilibrium if we shock one variable. The null hypothesis in this VECM attempts to show that the variable is exogenous, while the alternative hypothesis shows that the variable is endogenous.

Table 5.4: VECM Statistical Tests

ECM	Coefficient	Standard Error	T-Ratio [P-value]	C.V.	Result
DLIR	-0.124010	0.032470	-3.8193[.000]	5%	Endogenous
DNPL	-0.087081	0.029935	-2.9090[.004]	5%	Endogenous
DREER	-0.087418	0.051272	-1.7050[.091]	5%	Exogenous
DUNEMP	-0.559350	0.081707	-6.8458[.000]	5%	Endogenous
DINFLR	-0.051018	0.027795	-1.8355[.069]	5%	Exogenous

Table 5.4 above shows that, lending interest rate (LIR), non-performing loans (NPL) and unemployment rate (UNEMP) are the variables that are endogenous as the null hypothesis is rejected at 5% significant level. The significant of error-correction coefficient confirms the result of a significant long-run co-integrating relationship between variables. On the other hand, variables such as real effective exchange rate (REER) and inflation rate (INFLR) are exogenous as the null hypothesis is fail to be rejected at 5% significant level. The result in Table 5.4 states that non-performing loans and unemployment rate contain information of lending interest rate and this seems intuitive in general term. This can be concluded that lending interest rate, non-performing loans and unemployment rate are lagging variables while real effective exchange rate and inflation rate are leading variables.

Intuitively, lending interest rate (LIR) is endogenous as it could be influenced by internal factors such as banks' efficiencies in lending. Banks will provide loans depend on the

borrower's credit risk, liquidity, operating cost and profit margin of the banks. Similarly, non-performing loans is endogenous as it depends on banks' credit management. Some banks maybe have a higher number of NPLs due to the poor credit management, or maybe they had highly diversified loan portfolios that enabled them to relax their credit standards while keeping their total risk low. Furthermore, unemployment rate also is an endogenous as it depends on the business operation and performance of a company. Some firms might reduce their employees to cut down their operating costs and this would lead to increase in the level of unemployment rate. In this regards, the probability of a higher unemployment rate may result in more loan defaults owing to the less capability to cope with debt payments.

Intuitively, real effective exchange rate (REER) is exogenous as Malaysia exchange rate is against US-dollar which its supply and demand is determined in a global market. Malaysia, as an oil exporter has certainly reduced the demand for the ringgit due to the lower US-dollar receipts as well as a slowdown in the global economy, has affected Malaysian exports as well as exchange rate. Furthermore, inflation rate (INFLR) is exogenous because a change in inflation rate is an external shock which determined globally and could not be controlled by Malaysian country. This implies that during the high inflation, overall price level of products offered in a market increased. If the borrower's income after taxes does not increase, they must save less, substitute less expensive items, or will incur debt.

Table 5.4 also shows the sign of the coefficients of error correction terms all are negative indicate that all variables will return to their long-run equilibrium value. The size of the absolute coefficient as shown in Table 5.4 implies that lending interest rate speed of short-run adjustment to long-run equilibrium is relatively faster compared to non-performing loans once there is a shock. With this understanding of the causality testing, VECM allows data to determine the absolute exogeneity or absolute endogeneity without gives the information about the relative exogeneity or relative endogeneity. Thus, this paper will proceed to Variance Decomposition (VDC) to further enhance the analysis.

5.5 Variance Decomposition (VDC)

As mention earlier, Variance Decomposition (VDC) can provide the relative degree of exogeneity and endogeneity of the variables. In other words, VDC identifies which variable is most exogenous and which variable is most endogenous. Since generalised variance decomposition gives more strength compared to the orthogonalised variance decomposition, this paper applies generalised VDC to examine the proportion of the variance of a variable explained by its own past. A variable which can explain mostly by its own shocks is the most exogenous.

Table 5.5: *Generalised Variance Decomposition*

GENERALISED FORECAST ERROR VARIANCE								
	HORIZON	**DLIR**	**DNPL**	**DREER**	**DUNEMP**	**DINFLR**	**SELF-DEP**	**RANKING**
DLIR	15	76.12%	2.11%	14.04%	3.07%	4.67%	76.12%	5
DNPL	15	5.15%	77.67%	5.96%	10.02%	1.20%	77.67%	4
DREER	15	3.70%	2.75%	82.80%	3.27%	7.49%	82.80%	2
DUNEMP	15	2.25%	3.93%	11.87%	79.06%	2.89%	79.06%	3
DINFLR	15	1.49%	3.06%	3.58%	4.94%	86.929%	86.93%	1
	HORIZON	**DLIR**	**DNPL**	**DREER**	**DUNEMP**	**DINFLR**	**SELF-DEP**	**RANKING**
DLIR	25	76.10%	2.12%	14.03%	3.08%	4.68%	76.10%	5
DNPL	25	5.15%	77.66%	5.96%	10.02%	1.20%	77.66%	4
DREER	25	3.70%	2.75%	82.79%	3.27%	7.49%	82.79%	2
DUNEMP	25	2.25%	3.94%	11.87%	79.06%	2.89%	79.06%	3
DINFLR	25	1.50%	3.06%	3.58%	4.94%	86.91%	86.91%	1
	HORIZON	**DLIR**	**DNPL**	**DREER**	**DUNEMP**	**DINFLR**	**SELF-DEP**	**RANKING**
DLIR	50	76.10%	2.12%	14.03%	3.08%	4.68%	76.10%	5
DNPL	50	5.15%	77.66%	5.96%	10.02%	1.20%	77.66%	4
DREER	50	3.70%	2.75%	82.79%	3.27%	7.49%	82.79%	2
DUNEMP	50	2.25%	3.94%	11.87%	79.06%	2.89%	79.06%	3
DINFLR	50	1.50%	3.06%	3.58%	4.94%	86.91%	86.91%	1

As shown in Table 5.5, the ranking for the generalised forecast error variance are consistent for the horizon of 15, 25 and 50 months. The results state that inflation rate is the most exogenous intuitively because it is determined globally and could not be

controlled by Malaysian country. Then it followed by real effective exchange rate, unemployment rate and non-performing loans. Lending interest rate is seen to be the most endogenous. Figure 5.5 indicates the casual chain from exogenous (right) to endogenous (left).

Figure 5.5: Casual chain from exogenous (right) to endogenous (left)

Based on Figure 5.5, the causal chain shows that lending interest rate is the most endogenous. Although the NPL is the second rank of endogenous, but still lending interest can be used to control non-performing loans because NPL is a follower variable. The dramatic changes in lending interest rates are associated with the level of NPLs, because of high lending interest rates will broaden the debt burden of borrower eventually causing loan default. This is aligned with the theory where higher lending interest rate would leads to the higher levels of NPLs. Intuitively, decrease in lending interest rate due to the reaction of monetary policy to the crisis would give a positive impact to the bank loans quality that leads to the decreases in NPLs. Hence, policymaker at the banks can control the level of NPLs by decreasing the lending interest rate in the context of banking in Malaysia.

Besides, as the NPL is endogenous, it could be influenced by internal factors such as banks' quality credit management. Therefore, banks can improve their quality credit management by reflecting their efficient collection process and quality of customers to reduce the number of NPLs. Other than that, banks can keep their total risk low by diversifying their loan portfolios. In addition, policymaker such as the Monetary Policy Committee at BNM also can influence either the SSR or OPR to control base rate.

However, as the NPL is place at the second rank of endogenous variable, it would not just be affected by lending interest rate, but also others macroeconomic factors such as

unemployment rate, exchange rate and inflation rate. The higher unemployment rate may result in more loan defaults owing to the less capability to cope with debt payment. Even though policymaker can control lending interest rate in the context of Malaysia, lending interest rate will be influenced by the level of unemployment rate. This is due to the fact that, when the level of unemployment rate increases, more debtors are unable to pay back their loans and banks might be turning to insolvency due to the decreases in asset values. Hence, banks will increase or decrease their lending interest rate due to the level of unemployment rate.

Real effective exchange rate as stated in Figure 5.5 shows the second rank of exogenous which indicates that Malaysia exchange rate is determined globally which depends on exports and imports. Malaysia as an oil exporter will then have influence on the exchange rate. Intuitively, the large depreciation of the exchange rate during the crisis will increase in NPLs which connected to the share of foreign currency denominated loans in total loans. Nonetheless, real effective exchange rate is not the most exogenous variable maybe because of the intervention by the Central Bank of Malaysia (BNM) to maintain a stable exchange rate and a high degree of foreign currency lending to catch up the current economy. Moreover, stabilising the exchange rate is among some of the immediate measures the Malaysia government could implement to cushion the impact of global economic slowdown. This can be seen during the financial crisis of 2007-2008 whereby Malaysian Prime Minister Tun Dr Mahathir Mohamad imposed strict capital controls and pegged the ringgit to the US dollar at 3.8 ringgit to maintain a stable exchange rate.

Also, Figure 5.5 shows the inflation rate is the most exogenous as it place at the first rank of casual chain. This is because Malaysian inflation rate is determines globally and could not be controlled by one country. Malaysia highly depends on imports and exports which government cannot control the inflation rate by using monetary policy. This can be seen as Malaysia is a country that relies on demand for export from foreigners which could influence the inflation rate.

5.6 Impulse Response Functions (IRF)

Essentially, Impulse Response Function (IRF) produces the same information as Variance Decomposition (VDC), but in graphical format where both use a variable-specific shock to see the impact on other variables in the system. Simply put, IRF determines the effect of a shock on one variable on a host of other variables. In this regard, it helps to see the variables with the most influence by replicating shocks in tandem.

Figure 5.6: Generalized impulse responses to one SE shock in the equation of DLIR and DNPL

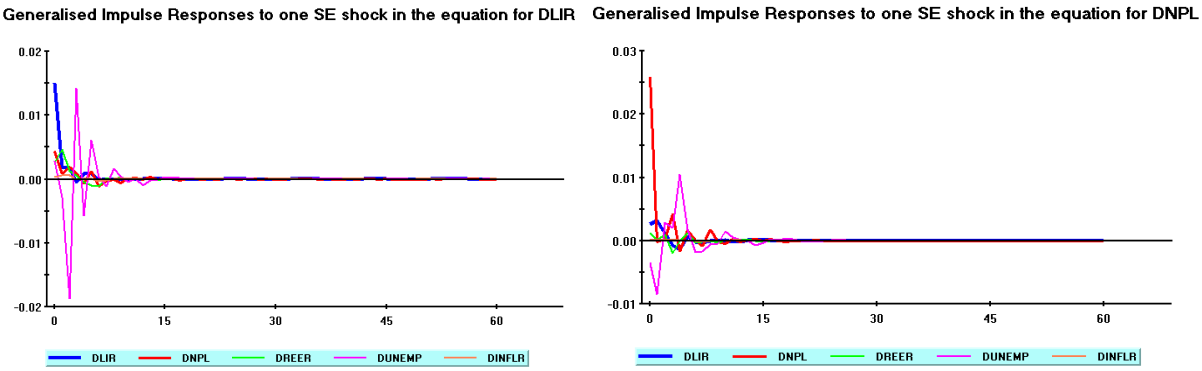


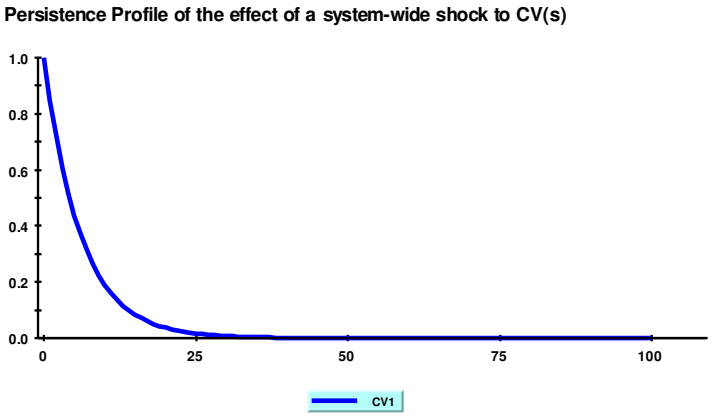
Figure 5.6 shows the impact of a shock in lending interest rate (DLIR) to other variables. Since Malaysia government can use lending interest rate to control NPLs, it can be seen that a shock in lending interest rate yield the huge response in non-performing loans and employment rate. This is due to the fact that, there is a theoretical relationship between the NPLs, lending interest rate and unemployment rate which each variable contains information for the prediction of other variables. Similarly, when non-performing loans is being shocked, there also gives the huge response in the lending interest rate and unemployment rate while least response in real effective exchange rate and inflation rate. Overall, all variables return to their equilibrium within the 15 months period.

5.7 Persistence Profile (PP)

Unlike Impulse Response Function (IRF) which use a variable-specific shock to see the impact on other variables in the system, Persistence Profile (PP) use a system-wide

shock on the long-run relations between the variables to estimate how long it would take to get back to equilibrium if the entire co-integrating equation is shocked.

Figure 5.7: Persistence profile of the effect of a system-wide shock



From the Figure 5.7, if the entire co-integrating equation is shocked, persistence profile indicates that it will take within 25 months (around 2 years) to get back to equilibrium.

6.0 CONCLUSIONS AND POLICY IMPLICATIONS

There have been many empirical studies on the links between lending interest rate and non-performing loans. However, this study takes into account the non-linear relationships between lending interest rate and NPLs by using the NARDL approach and provides a direction of Granger causality between the lending interest rate, NPLs, real effective exchange rate, inflation rate and unemployment rate. This paper tries to examine a better understanding of the movements of the NPLs in response to changes in the lending interest rate which helps policymaker maintain a low level of NPLs. The findings indicate that policymakers in Malaysia can control lending interest rate, NPLs and unemployment rate as these variables could be influenced by internal factors. However, they cannot control real effective exchange rate and inflation rate as these variables are determined globally.

As lending interest rate has a significant and positive relationship with NPLs, policymaker at the banks can control the level of NPLs by decreasing the lending interest rate in the case of banking in Malaysia. Banks can improve their quality credit management by streamlining their collection process and quality of customers to reduce the number of NPLs. Besides, banks can keep their total risk low by diversifying their loan portfolios. In addition, policymaker such as the Monetary Policy Committee at BNM also can influence either the SSR or OPR to control base rate.

The result also shows the lending interest rate and non-performing loan has an asymmetric relationship in the short-run and symmetric relationship in the long-run. This asymmetric was found due to the impact of Subprime Mortgage Crisis 2007. Hence, either banks increase or decrease their lending interest rates during the economic downturns, the level of non-performing loans will always increase in the short-run due to the condition of the economy at that time. It means that, even if the banks offered the lower interest rate during the financial crisis period, the number of NPL always increases. However, in the long-run, the level of NPL is proportionately related to the lending interest rates offered by banks. By hook or by crook, bank's management need to maintain a low level of NPLs to avoid financial crisis to happen.

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