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An Analysis of Non-Performing Loan, Interest Rate and Inflation Rate Using Stata Software

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Abstract: Non-performing loan can be defined as defaulted loan in which banks are unable to profit from. Usually loan falls due if no interest has been paid in 90 days, however this may vary between different countries and actors. The purpose of this paper is to analyze the relationship between the non-performing loan, interest rate and inflation rate by utilizing STATA software. In order to achieve this objective, the Vector Error Correction Model (VECM) is employed to determine whether interest rate and inflation rate may affect the non-performing loan based on a 48 monthly data. The long run relationship shows that interest rate has a significant relationship towards non-performing loan. On the other hand, there is an insignificant relationship between inflation rate and non-performing loans. In the short run relationship, the findings show that both independent variables cannot influence the non-performing loan. Both independent p-values are less than significant interval which means this result will not reject the null hypothesis. As a conclusion, the causal relationship between non-performing loans and inflation rate is nodirectional relationship where similar with the causality relationship between non-performing loans and base lending rate. This research is appertained with commercial banks in Malaysia, thus a restored interpretation in this study will lead to a progressing association in the future.

Key words: STATA • Non-Performing loan • Bad debt • Interest rate • Inflation rate

INTRODUCTION

The problem of non-performing loans (NPLs) has acquired rising awareness in the last few decades. The instant consequence of huge amount of NPLs in the banking system is bank failure. Evaluating NPLs in commercial banks is extremely important as it would cause a huge impact for the bank itself. As indicated by [1], the evaluation of NPLs is of great importance given its association with bank failure and financial crises and it should therefore be of interest to developing countries. NPLs can be defined as defaulted loans in which banks are unable to profit from. Usually loans falls due if no interest has been paid in 90 days, but this may vary between different countries and actors [2]. Many researches on the cause of bank failures found that asset quality is a statistically significant predictor of insolvency [3] and that failing bank institutions have high level of NPLs prior to failure. This can be referred to [4] which focus on a mathematical model for problem of stability of non- performing assets (NPA's) growth in banking sectors. Problems with NPLs are not in any way specific for one particular market since defaulted loans arise all over the world and governments are still struggling to come up with solutions [5].

In the Malaysian context, [6] reported that during the set in of 1997-98 financial crisis, the commercial banks' loans portfolio was stronger and more diversified compared to where it was in 1988. Net NPLs began rising towards the end of 1997 to a high of 7.9% in November 1998 with total net NPLs of RM22.7 billion. A total net non-performing loan has since declined to RM18.1 billion or 6.4% in June 1999 following the sales of commercial banks' loans to Danaharta amounting to RM21.9 billion. According to [8], the magnitude of NPLs is a key element in the initiation and progression of financial and banking

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crises. The analysis of the Malaysian financial system reports a significant relationship between credit risk and financial crises and concludes that credit risk had already started to build-up before the onset of the 1997 Asian Financial crisis and became more serious as NPLs increased.

Given the above discussion, it is not difficult to see why the ability to forecast NPLs is important. The key issue here is how we should go about forecasting NPLs and which approach is the most appropriate. Generally, previous empirical studies have modelled NPLs through the use of various multivariate analyses. Commonly in times of recession, liquid assets decline, collaterals may lose value and suddenly banks may find themselves with large amounts of non-coverage loans [9].

Basically NPLs are due to the refusal of borrowers to reimburse or failed to generate enough income to repay is closely related to credit card. According to [10] and [7], a non-performing loan is a loan that is in default or close to being in default. A default is the failure to pay back a loan. It is argued that the NPLs are one of the major causes of the economic stagnation problems. Each NPL in the financial sector is viewed as an obverse mirror image of an ailing unprofitable enterprise. According to [11], loan losses during the years before the 1997-1998 crises varied widely among the countries. In countries where government had either been directly channelling funds through state-controlled banks (most obviously Indonesia and China) or encouraging such leading (Japan, Korea and India) to preferred industries or companies, NPLs had been significant long before the crisis. [12] Pointed out that local economic conditions and the poor performance of certain industries explained the variation in loan losses. However, commercial banks with greater risk appetite and that are more willing to make loans with a higher probability of default, tend to record higher losses. [13] Shared this general view as well and posited that NPLs reflect realized credit risk for banks arising either from external factors such as depressed economic conditions, or internal factors such as poor lending decisions or both. The study found a significantly positive relationship between the level of loan defaults and high interest rates, excessive lending and volatile funds.

Interest rate is among the most closely watched variables in the economy. This can be referred to journal of [14] as their paper consists of an empirical study to demonstrate how the average interest rate and non-performing rate are connected.These affect personal decisions such as whether to purchase bonds or place funds into a savings account, as might as decisions of businesses and households. As mentioned by [15], the sharp increase and high level of interest rates placed intense pressure on the financial system and contributed to the failure of a large number of institutions. A study by [16] found that high interest rates increase costs of borrowing, debt burden grows which leads borrowers to default. Consequently, as loan default becomes persistent, the banks lose income and become undercapitalized. [17] Found that a high interest rate was one of the contributing factors to loan default in the industrial sector, particularly in the manufacturing sector in Bangladesh. [18] Suggested that real rate of interest must be lower than real return on capital. It means that as the financial market becomes more and more efficient with the process of development, lending rates should be lowered than before. This may contribute towards reduced level of loan defaults. Many researchers believe that most of the developing countries are suffering from this non-payment loans problem. This can be assured from [19]. Persistent industrial loan defaults and massive loan loss have become a regular feature in developing countries.

In term of inflation, [20] argued that inflation is a rise or increase in the prices of goods and services that is not offset by intensification in their quality. Because of the difficulty in measuring changes in 'quality', a more operational definition of inflation is a 'counting rise in prices'. Inflation discourages investment by increasing the uncertainty about future returns. According to [21], inflation is responsible for the rapid erosion of commercial banks' equity and consequently higher credit risk in the banking sectors of these African countries. [22, 23] added that high inflation has a negative impact on financial deepening. Macroeconomic uncertainty and financial instability which are usually commonplace in economies that suffer from high inflation rates, also contribute to the shallowness of financial systems as they can raise monitoring costs for banks and limit financing of investment projects not just risky ones. This is agreed by [24] who stated that inflation causes misperception of the relative price levels and leads to inefficient investment plans and therefore affects productivity inversely.

Therefore, the aim of this study is to analyze the sensitivity of NPLs to macroeconomic and bank specific factors in Malaysia. The economic indicators used for this study are base Non-Performing Loan (NPL), Interest rate based on Base Lending Rate (BLR) and Inflation Rate (INF).

Methodology: STATA software has been used in this study to test the time series data. STATA is a complete package where time series data, growth, or change over time can be observed and recorded in all their biological and non biological aspects. In this research, the Malaysian NPLS, BLR and INF are the prime concern. The monthly time-series data ranging from January 2006 to December 2009 for the variables were obtained from the Central Bank of Malaysia (BNM) website. Subsequently, all of the series are transformed into a log form which can reduce the problem of heteroscedasticity because it compresses the scale in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference [25].

The following model is a three-variable model which hypothesizes non-performing loan as a function of interest rate and inflation rate:

$$NPLt = f\ (IRt, INFt,) \quad (1)$$

Where;

NPL = Non-performing

IR = Interest rate / (Base lending rate -BLR)

INF = Inflation rate

The sign above the variables demonstrated the anticipated relationship between each explanatory variable with the dependent variable while t-sign is the time trend. In order to avoid spurious registration, we need to discern the stationary of the series. Stationary could be achieved by appropriate number of differencing or called as the order of integration. We use Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests to check the stationary of variables.

Augmented Dickey Fuller (ADF): Any of the forms of this test presumes the existence of white noise errors in the regression. If that is implausible, the test will lose significant power. To cope with this issue, an ADF test is employed in which a number of lags of the dependent variable are added to the regression to whiten the errors. The ADF test is based on the regression equation with the inclusion of a constant and a trend of the form:

$$\Delta xt = \beta 0 + \mu t + \delta\ Xt\text{-}1 + \Sigma\alpha i\ \Delta Xt\text{-}i + \varepsilon t \quad (2)$$

Where Xt = Variables of interest in the logarithm forms at time trend t, ?Xt-i expresses the first differences with k lags, ε is the white noise residual of zero mean and constant variance. The coefficients $\{\beta 0, \delta, \mu t, \alpha 1, \ldots, \alpha k\}$ are parameters being estimated. The null and the alternative hypothesis for unit root in variable Xt is;

H0: $\delta = 0$ (Xt is non stationary or contains a unit root)

H1: $\delta \neq 0$ (Xt is stationary or non unit root)

The unit root hypothesis can be rejected if the t-test statistic from these tests is negatively less than the crucial value tabulated. In other words, by the Augmented Dickey Fuller (ADF) test, a unit root exist in the series Yô (implies non stationary) if the null hypothesis of $\delta = 0$ is not rejected [26].

Phillips-Perron (PP) Tests: The augmentation of the original D-F regression with lags of the dependent variable is motivated by the need to generate errors in that model, since an Ordinary Least Square (OLS) estimator of the covariance matrix is being employed. An alternative strategy for allowing errors is known as the Phillips-Perron (PP) unit root test. The PP test deals with potential serial correlation in the errors by employing a correction factor that estimates the long-run variance of the error process with a variant of the Newey-West formula. Similar to ADF, PP test requires specification of a lag order; in the latter case, the lag order designates the number of lags to be included in the long-run variance estimate.

Cointegration Test: For the cointegration test, the most common used methods are the [27-29] method. The Johansen and Juselius test is a method of cointegration testing based on the maximum likelihood estimation of the Vector Autoregression (VAR) model to determine the number of cointegrating vectors in the analysis. According to [30] there are two test statistics that can be used in identifying the number *(r)* of cointegrating vectors, namely the trace and the maximum eigenvalue test statistics. In this study, we employ the Johansen and Juselius method to test for the long run relationship between variables in a multivariate model. using Johansen's full information maximum likelihood procedure. The analysis is based on the following equation:

$$Y_t = A_1\ Y_{t-1} + A_2\ Y_{t-1} + \ldots.. + A_{ñ}\ Y_{t-ñ} + \varepsilon_{t-p} \quad (3)$$

Where Y_t is a *k*- vector of non stationary 1(1) variables, A with i=1,…, ñ is a lag operator and ε_t is a the white noise residual of zero mean and constant variance. The lag order ñ must be determined using Schwarz's Bayesian Information Criterion (SBIC). Then, as described by [31] we can test the null hypothesis that are *r* power or fewer cointegrating vectors using the following two likelihood ratio tests statistics.

Trace Test:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \log(1 - \lambda_i), \quad r = 0, 1, \ldots, n - 1 \tag{4}$$

Where N is the total number of observations The tests the null hypothesis that the number of distinct cointegrating vector is less than or equal to r against a general alternative. T trace has a chi square distribution with M-r degrees of freedom. Large values of T trace give evidence against the hypothesis of r or fewer cointegration vectors [32].

Maximal Eigenvalue Test: The test is for estimating r cointegrating vectors against the alternative of r+1 cointegrating vectors. It evaluates the null hypothesis:

Ho: r = r0 (Cointegration)
H1: r = r0 +1 (No cointegration)

$$\lambda_{max} = -T \log(1 - \lambda_{r+1}),\ r = 0, 1, \ldots, n - 1 \tag{5}$$

Where is the estimated values of the characteristic roots (eigenvalues) obtained from the estimated matrix, r is the number of cointegrating vectors and T is the number of usable observations. The λ_{max} statistics uses the null that there are less than or equal to r versus exactly r+1 cointegrating vectors. Nevertheless, [30] suggest that the maximal eigenvalue test is more powerful than the trace test [32].

Vector Error Correction Model (VECM): If cointegration has been detected between series we know that there exists a long-term equilibrium relationship between them. In accordance to that, Vector Error Correction Model (VECM) is applied in order to evaluate the short run properties of the cointegrated series. In case of no cointegration VECM is no longer required and we directly continue to Granger causality tests to establish causal links between variables.

The Regression Equation Form for Vecm Is as Follows:

$$\Delta \ln NPL = \delta_0 + \delta_1 \sum_{i=1}^{p} \delta_{1i}\ \Delta \ln NPL_{-1} + \delta_2 \sum_{i=1}^{p} \delta_{2i}\ \Delta \ln BLR_1 + \delta_3 \sum_{i=1}^{p} \delta_{3i} \Delta \ln INF_{-i} + \delta_4\ ect_{t-1} + \mu_t \tag{6}$$

$$\Delta \ln INF = \delta_0 + \delta_1 \sum_{i=1}^{p} \delta_{1i}\ \Delta \ln INF_{-1} + \delta_2 \sum_{i=1}^{p} \delta_{2i}\ \Delta \ln NPL_{-1} + d_3 \sum_{i=1}^{p} \delta_{3i} \Delta \ln BLR_{-i} + d_4\ ect_{t-1} + \mu_t \tag{7}$$

$$\Delta \ln BLR = \delta_0 + \delta_1 \sum_{i=1}^{p} \delta_{1i}\ \Delta \ln BLR_{-1} + \delta_2 \sum_{i=1}^{p} \delta_{2i}\ \Delta \ln NPL_{-1} + d_3 \sum_{i=1}^{p} \delta_{3i} \Delta \ln NPL_{-i} + d_4\ ect_{t-1} + \mu_t \tag{8}$$

In VECM, the cointegration rank shows the number of cointegrating vectors. For instance a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary. A negative and significant coefficient of the ECM indicates that any short-term fluctuations between the independent variables and the dependant variable will give rise to a stable long run relationship between the variables. If both coefficients are significant it implies bi-directional causality from X to Y and Y to X conditional on the presence of Z. Moreover, the magnitude of the error term coefficient indicates the speed of adjustment with which the variables converge overtime. In order to evaluate the short-term behaviour between the two series we look at the coefficients of the lagged terms of ?Yt and ?Xt.

Granger-Causality: A stationary variable is said to *Granger-cause* another stationary variable if, after controlling for the past information on the dependent variable, the past information on the independent variable helps predict the present value of the dependent variable [33]. The null of Granger-non causality is rejected either by the joint significance of the coefficients of the lagged differenced hypothesized causal variable or by the significance of the coefficient of the error correction term (adjust parameter) in the equation under study. This test for Granger-causality considers the possibility that the lagged value of the hypothesized causal factor may help explain the current change in the dependent variable, even if the past changes in the dependant variables do not [34]. [35] showed that if previous values of variable X significantly influence current values of Y, then one can say that X causes Y.

Table 1: Result of the Unit Root Tests

	ADF statistic		PP statistic	
Variable	Level	First Difference	Level	First Difference
Non Performing Loan (NPLs)	0.9933	0.0000	0.9947	0.0000
Interest Rate (BLR)	0.9728	0.0001	0.9161	0.0001
Inflation Rate (INF)	0.0006	0.0000	0.0004	0.0000

RESULTS AND DISCUSSION

Augmented Dickey Fuller (ADF) and Phillip Perron (PP) unit root tests are employed to test the stationary of the macroeconomic series at level and then first difference of each series. The result of ADF and PP test at level and first difference are reported in Table 1, by taking into consideration of trend variable and without trend variable in regression. Based on the result, the unit root test on the level and first difference of the series are given in the table. For unit root tests on the level case, the P-value is larger than significant interval, suggesting that the null hypothesis of unit root cannot be rejected and all the series under study are non stationary in their level forms but stationary in their first difference. This implication applied to most variables. Thus, we can proceed to Johansen-Juselius test since we can conclude that the null hypothesis of the series can be rejected at first difference, implying that all these are I (1).

Table 2 shows the result obtained by the application of Johansen cointegration test. The table shows that trace statistics are smaller than critical value at 5% level of significant. This implies that amount of NPLs and other explanatory variables in the model move closely to achieve the long run equilibrium. The researcher rejected the null hypothesis of having rank in the model (r = 1). Therefore, there is cointegration exist between all variables examined at lags (1). Mostly, the model with the smallest Schwarz's Bayesian Information Criterion (SBIC) value is chosen. This method is preferred over AIC as shown in Table 3.

Since a unique cointegrating vector in the three variables VAR used in the cointegration tests, it is best to estimate models with one error correction term included to capture long run relationships shown in Table 4. This implies that the explanatory variables in the model move closely to achieve the long run equilibrium. According to Johansen-Juselius, the first eigenvalue will be more emphasized since it has the highest eigenvalue. Therefore, we would only consider the first equation for future analysis. The estimated cointegrating equation derived is as follow:

Table 2: Johansen Test Statistic Result

Johansen tests for cointegration

Trend: constant — Number of obs = 44

Sample: 2006m5 - 2009m12 — Lags = 4

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	30	220.90319	.	45.6123	29.68
1	35	237.17019	0.52260	13.0783*	15.41
2	38	242.9789	0.23205	1.4609	3.76
3	39	243.70936	0.03266		

Table 3: Lags Order Selection Criteria

Selection-order criteria

Sample: 2006m5 - 2009m12 — Number of obs = 44

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-839.903				8.8e+12	38.3138	38.3589	38.4354
1	-663.223	353.36	9	0.000	4.3e+09	30.692	30.8724*	31.1786*
2	-657.496	11.454	9	0.246	5.0e+09	30.8407	31.1565	31.6923
3	-642.982	29.029	9	0.001	4.0e+09	30.5901	31.0412	31.8066
4	-627.724	30.516*	9	0.000	3.1e+09*	30.3056*	30.8921	31.8871

Endogenous: npl blr inf

Exogenous: _cons

Table 4: Vector Error Correction Model (VECM) Estimation

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	2	45.25184	0.0000

Identification: beta is exactly identified
Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf. In	
_ce1						
lnnpl	1	.	.	.	.	
lnblr	-2.310094	.396484	-5.83	0.000	-3.087188	-1
lninf	.4388231	.078573	5.58	0.000	.2848228	.
_cons	-13.84394	.	.	.	.	

$$NPLs = -13.8439 - 2.3101BLR + 0.4388INF \quad (9)$$

The results show a negative relationship between the BLR and NPLs, nonetheless there is a positive association between INF and NPLs. The magnitude of this

Table 5: Granger Causality Test Results based on Vector Error Correction Model VECM)

	Independent Variable		
Dependent Variable	NPL	BLR	INF
NPL	-	0.8627	0.1974
BLR	0.7433	-	0.0050
INF	0.4587	0.0655	-

relationship is fairly strong suggesting that banks with a greater penchant for risk taking incurred higher NPLs.

The Equation 9 consists of a trend value at -13.8439. The BLR is consistent with the theory. Hence, in the long run, 1% increase in BLR, will decrease 2.3101% in NPLs. P-value is also significant in this research where is 0.0000 less than 0.05 percent. It fulfills the economic theory where increment in BLR will decrease in NPLs. It also will reduce the percentage of NPLs in the country. Together with the BLR manipulation, it is recommended that the commercial banks pay attention to several factors when providing loans in order to restrict the level of impaired loans to the borrower. Specifically, commercial banks need to consider the international competitiveness of the domestic economy since this may impair the ability of borrowers from the key export oriented sectors to repay their loans which in turn would result in higher NPLs. The banks should also constantly review the interest rates on loans since loan delinquencies are higher for banks which increase their real interest rates [36].

In contrast, 1% increases in INF, will increase the NPLs by 0.4388%. [21], for instance, shows that inflationary pressures contribute to the high level of impaired loans in a number of Sub-Saharan African countries with flexible exchange rate regimes. The analysis reveals a fairly strong positive relationship between NPLs and INF. The INF and the weighted average loan rate, have an impact on the level of NPLs and should therefore be included in the forecasting models as suggested by [37]. It follows therefore that our results are contrary to the argument by [38] that macroeconomic variables have limited predictive power in explaining loan defaults. Evidence to support the view of [39] that forecasts employing data only on past loans which are usually more accurate than less parsimonious models, is not found in our study. This suggests that international competitiveness had a less pronounced impact on NPLs when compared to the slowdown in the real economy during our sample period.

Beyond the analysis of the long run relationships among the three variables in the system, the short run dynamics is also explored by performing multivariate Granger Causality test for the VECM. Probability values for Granger Causality tests from the VECM specification are presented in Table 5. Apparently, NPL and BLR have no relationship in the short run. For the causality of NPL and INF, the p-values are still insignificant at 10% significance level. As a conclusion, there is no causal relationship between these two variables.

The causality of INF and BLR provides evidence in support of the pure expectation hypothesis that bidirectional causality exists between the INF and BLR. The null hypotheses are well-rejected for both cases, implying that there are bi-directional relationships between the variables This implies that changes in BLR precede changes in INF, vice versa. This is consistent to the standard economic theories since inflation is an autonomous occurrence that is impacted by money supply in an economy. Even though there is no relationship between NPL and BLR in the short run, the government through its central bank can use the interest rate to control money supply and, consequently, the INF. When interest rates are high, it becomes more expensive to borrow money and savings become attractive. When interest rates are low, banks are able to lend more, resulting in an increased supply of money. Alteration in the rate of interest can be used to control inflation by controlling the supply of money in the following ways which a high interest rate influences spending patterns and shifts consumers and businesses from borrowing to saving mode[1].

CONCLUSION

The finding in the long run relationship demonstrates that not all the independent variables are consistent with the economy theory. This indicates that both economic indicators are important factors, which will influence the fluctuations and performance of the NPLs of commercial banks in our country (Malaysia). In the short run relationship, the finding shows that both independent variables do not influence the NPLs. Both of independent p-value is more than significant interval which means this result will not reject the null hypothesis. The reason is the movement for both independent variables is influenced by time. For a short duration, the fluctuation of interest rate and inflation rate is not really affected.

[1]Economy Watch, 2009. Inflation and Interest Rate. Retrieved March 13, 2011 from http://www.economywatch.com/inflation/economy/interest-rates.html

As such, the results exhibit that the variable is insignificant in the short run relationship. For recommendation, commercial banks should be perceptive with the fluctuation of the inflation rate and interest rate as they will affect the NPLs. A resonant discernment in this study will lead to a better loan-management ahead.

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