Sensitivity of Non-Performing Loans to Macroeconomic Variables Malaysia Banking Sector: Panel Evidence

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Abstract: The quality of loans can be one of the factors that limit the banks' loan supply and affect on investment spending. On the other hand according to the Basel committee regulations, banks can calculate their capital charge to cover their internal credit risk. Although banks have a significant role in transmission of monetary policy, in the meantime their performance is strongly influenced by monetary and fiscal policies. These policies are effective in recession and prosperity and thereby affect bank performance; in other words, macroeconomic variables can effect in/directly on banks loans quality and their transitional role. Thus policy makers and bankers are always looking for tools to better manage banks' credit risk. Hence the main objective of this study is to analyze relationship between Non-Performing Loans (NPL) and macroeconomic variables by using a dynamic panel data model in Malaysian commercial banking system for period 1997-2012. The results show that there is a strong evidence cyclical sensitivity of loan quality in Malaysia commercial banking system. Lending interest rate and foreign direct investment outflow are the most effective factors on NPL ratio with simultaneous positive effects and a reverse effect with one-year delay. It can be said that the impact of external shocks on the domestic banking system is more than internal shocks.

Key words: Non-performing loan · Macroeconomics · Credit risk · Dynamic model · Panel

INTRODUCTION

Credit risk is one of the most important kinds of risk in banking sector. Particularly the relationship between business cycle and banks' loan losses was one of the hot debates in recent economic literature especially in related to financial stability analysis. The quality of loans can be one of the factors that limit the banks' loan supply and effect on investment spending. Although banks have a significant role in transmission of monetary policy, in the meantime their performance is strongly influenced by monetary and fiscal policies. Thus, a sensitivity analysis of the credit risk of the loan portfolio is in great importance [1]. The financial crisis in recent decades and their considerable costs to the real economy and the financial institutions have highlighted the importance of this position. Malaysia is among the countries where the banking system was affected by the financial crisis of

1997. Following the crisis, many banks have failed and the Malaysian government was incurring considerable costs to revive the banking sector.

According to some studies such as [2] the most important reason of this crisis was the lack of enough supervisory and regulatory rules in banking system beside noticeable increase in foreign private capital inflow (short-time debts).

However, given the relative stability of the banking system created in recent years, another form of competition between the banks providing credit to households and small businesses has been created. By growing share of bank loans in these sections, banks are exposed to the risks of shocks on macroeconomic variables. Macroeconomic variables can effect in/directly on banks loans quality and their transitional role. Thus policy makers and bankers are always concerned with the financial stability and looking for tools to better

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manage banks' credit risk. One of the risk indicators that are used in literature of banks' credit risk is Non-Performing Loans (NPL). Hence the main objective of this study is to analyze relationship between banks loans quality and macroeconomic variables by using a dynamic panel data model in Malaysian commercial banking system for period 1997-2012. The result of this study can be helpful to bank supervisory and economists to adjust banking system stability and economic policies.

Theoretical Background and Literature: In recent years researches about the credit qualities pay more to the influence of macroeconomic variables and have found same empirical results. The earlier studies about standard credit risk models have been studies by [3], [4], [5] and [6-8]. They fallow each others' studies in this area and at list Wilson [9,10] constructed a model that include the macroeconomic variables such as GDP, interest rate, government spending, housing price index etc. that influence a firm's probability of default. He used a pooled logit regression and confirmed more relationship between macroeconomics factors and the Probability of Default. After this study many different surveys have used macro stress test approach to explain the behavior of banking systems against adverse macroeconomic shocks.

In order to assess different features for banks loans in different situation, most of studies by using bank-level data, have used bottom-up approach and applied panel data methods to investigate banks' credit behavior (See [11], [12-14, [15] and [16]). Since in these studies, Non-Performing Loan ratio is used as a risk indicator; so it is tried to gather a summary of the literature, focusing on studies that examine the macroeconomics determinants of this variable in banking system.

Some studies investigated the NPLs changing with focusing on bank specific factors and combination them with macroeconomic variables (See [17], [18] and [19]). They have shown that bank specific factors have important roles in NPLs future behaviors. According to a panel data study on some counties in Europe monetary policies, unemployment and income impact effectively on NPLs [20]. In other different studies on Nordik [21] and Ustralian banks [22], the connection between loan quality and some macroeconomics variables such as unemployment, interest rate and business cycles has been indicated that. By a panel data model for Greek banking system in [23] significant relationship between NPLs changes and macroceonomic variables especily intrest

rate, GPD, public dept and unemployment has shown. They categorised loans in three groups including consumers, business and mortgages. Reference [24] by means of a panel data model and dividing the bank loans to 21 granular parts investigated the effects of GDP growth with different quarterly lags on LNPs for Brazilian banks.

Some other studies focus on bank specific factors effects on NPLs such as [25], [26], [27] and [28]. Results from these studies indicate that efficincy indexes from different aspects such as management, skiming, cust, moral hazard can affect the NPLs. Also after recent financial crisis many studies pay to explain linkage between the debt crisis and banking fraglity such as [29].

Few studies have been conducted on credit risk in Malaysian banking system. Refrence [30] found some key determinants of credit risk of commercial banks in emerging economy (including Malaysia) banking systems. They used a combination of three theory including capital asset pricing, Hamada's risk and leverage theory and Markowitz's Portfolio theory to create a theoretical relationship between credit risk and eight bank specific factors. NPL implied as a credit risk factor and their main result is that, credit risk in emerging countries related to several bank specific factors. Also [31] indicates a significant negative relationship between credit risk and GDP in OECD and Asian countries.

NPL and Macroeconomic Variables in Malaysia: According to the literatures there is not a standard framework to analyze effective factors influencing on loans quality. Following the models on the studies mentioned above, in this paper some important macroeconomic variables were selected as factors affecting credit risk. GDP growth (GDG), lending interest rates (LR), Consumer Price Index or Inflation (CPI) and Domestic total Credit growth[1] (DCg) are used to explain an economic boom and stagnation situation. Borrowers ability to repay the debt in boom and recession will be affected the NPL ration (net Non-Performing Loans to total loans ratio) in banking system. NPL ratio is used as a proxy for loan quality. The bank balance sheet data set (loans, assets and NPLs) have been collected from Bank Scope data base from 1997 to 2011. And data for macroeconomic variables are collected from World Bank's data bank. As there is not homogeneity between the banks based on the date of creating so our data make an unbalanced panel. There are 23 commercial banks that we

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[1] Initially the Loan growth for each bank as a bank specific variables insert to the model but its coefficient was always insignificant. Hence the domestic total credit to privet sector selected as alternative variable.
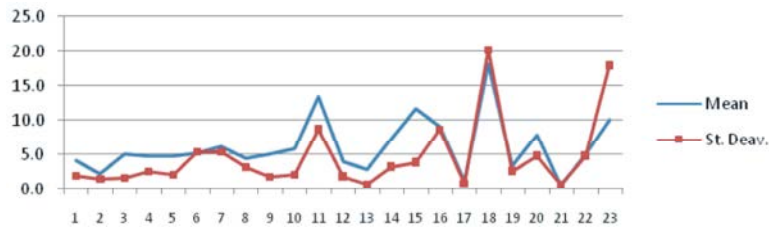
Fig. 1: Selected statistics of NPLs across 23 banks 1997–2011 in percentage
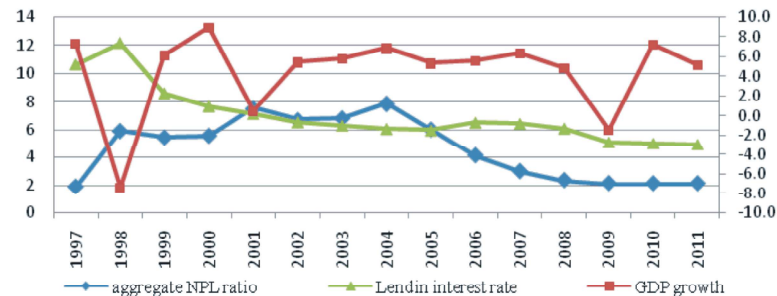   Source: Extracted based on banks' information from annual reports and Bankscope

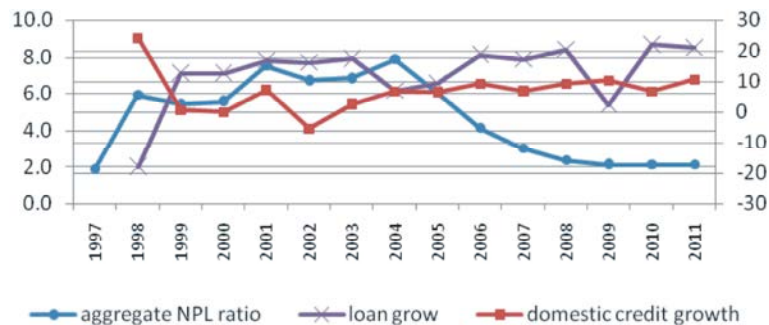Fig. 2: NPL in total bank system in comparison with GDP growth and lending rate in Malaysia.

Fig. 3: NPL in total bank system in comparison with total domestic credit growth and total loans growth in commercial banks
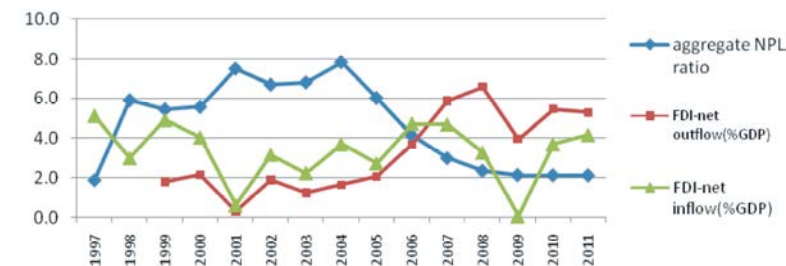

Fig. 4: NPL in total bank system in comparison with net foreign direct outflow and inflow investment

can get and all observations are 252. A look at the banks' loans shows that credit quality is extremely heterogeneous across different size of banks.

Compression of banks' average NPL and their standard deviation in Figure (1) shows this feature. The banks' code numbers are sorted based on asset size of banks from big to small size. This figure shows that the small size banks have more NPL ration in average and also have more NPL ratio deviation. The trend of NPL ratio and

macroeconomic variables are comparable in Figures (2 and 3). According to Figure (2), the negative association between output growth and also lending interest rate with NPL ratio is quite evident. But the relationship of these variables with intervals between these variables is necessary to implement econometric model. As it is shown in Figure (3), there is a positive connection between NPL and loan growth. After 1997 crisis rapid credit growth and the supportive economic environment

led to increase NPL ratio until 2004 with a series of pulses. After 2004 banking system faced a stability and NPLs ratio despite the increasing of loans, had a decreasing trend. This feature continued until 2008 and the negative impact of the global financial crisis on the macroeconomic (decrease in economic growth) and financial environment led to stop NPL downward trend. This figure also shows an inverse relationship between foreign investment and NPL. But linking by interruptions between them is controversial which can be discussed based on econometric model's results.

Econometrics Model: To explain relationship between macroeconomic variables and bank quality the ratio of net Non-Performing Loans (NPL) to total loans is used as indicator of credit risk. An econometric model is used to study the behavior of this variable and identify factors affecting on its changes. Following the empirical studies on NPL based on dynamic panel data models, in this study also a dynamic framework is designed to survey the NPL behavior in Malaysian banking system. Since some of the banks have less information so the Dynamic Model Panel Data will be better to analyzes the sensitivity of NLP to macroeconomics factors. The sample is unbalanced because of the exit or merge of some banks and the incorporation of new ones. Based on a general dynamic panel data model the general equation in this study is such as following equation:

$$NPL_{i,t} = \alpha NPL_{i,t-1} + \beta X_t + \mu_i + \upsilon_{i,t} \tag{1}$$

That subscripts t and i show the time dimension and cross sectional of the panel. B is the k×1 vector of coefficients for explanatory variables (X that is a k×1 vector). The bank specific unobserved effect is shown with μ_i and $\upsilon_{i,t}$ is the error term. In this study according to literature the GDP growth, loan growth, net outflow of foreign direct investment and the lending interest rate considered as the most important factors affecting on NPL. Also these factors are used with two years lag in the model. In this regard, it is noteworthy that data limitations prevented the use of variables is delayed for more t*h*an two years.

$$NPL_{i,t} = \alpha NPL_{i,t-1} + \sum_{j=0}^{2} \beta_{1j} GDg_{t-2} \sum_{j=0}^{2} \beta_{2j} Lr_{t-j} + \sum_{j=0}^{2} \beta_{3j} DCg_{t-j}$$

$$+ \sum_{j=0}^{2} \beta_{4j} FDau_{t-j} + \sum_{j=0}^{2} \beta_{5j} CPI_{t-j} +_{i,t}$$

Subjects: $_{i,t} = \mu_i + \upsilon_{i,t}$ and $|\alpha| < 1$

Because of data limitation in some of banks in this study only two lags of explanatory variables are inserted in the model. The coefficient α is expected to be positive but less than one and β_{1j} coefficients are expected to be negative, reflecting deteriorating loan quality during the economic downturn. β_{2j} if j=0 have to be negative because the debtors cannot borrow more to improve their financial situation and solvency. At the same time demand for new funds for new projects is reduced. So in the next few years is likely to be reduced NPLs. Hence it is expected that β_{2j} when j>0 to be negative. β_{3j} is expected to be negative The increase in loans by commercial banks typically have a positive impact on NPL ratio but increase the total domestic credits will have a positive impact on reducing the NPL. When j=0, β_{4j} is expected to be positive because outflow of foreign founds lead to financial limitation for domestic investors. Based on empirical results the β_{5j} can be negative or positive depends on the economic condition. If inflation leads to increase the value of costumers' assets consequently the β_{5j} will be negative.

MATERIALS AND METHODS

The inclusion of the lagged dependent variables in banks non performed loan function means that there is correlation between lag of independent variable and the error term (NPL_{it-1} depends on $\upsilon_{i,t-1}$) which include bank-specific effect and the $NPL_{it,-1}$ is endogenous. Therefore, the dynamic panel data estimation with Ordinary Less Square (OLS) and Fixed Effects methods (FE) will be bias.[2] If the sample be large this problem will be solved but in small samples it needs to use the methods that reduce this bias. Reference [32] suggests GMM estimators to solve the endogeneity problem. To this end we have to remove the firm specific effect (μ_i) from the equation (1). Reference [32] shows that by using first difference method the firm specific effect can be eliminated but a new kind of bias is introduced by means of the correlation between the transformed lagged dependent variable and the transformed error terms by first deference. Also if some of the explanatory variables be predetermined it means

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[2] OLS estimator will be bias upwards because of correlation between error terms and lag depended variable. And Fixed Effects estimator will be bias downward because in this method μ_i that contains the effects of the variables which are constant over time but vary among units, is removed from the model.

Table 1: Summary results of exploratory panel regressions

Right hand variables	GMM two step			System GMM two step		
	Coef.	SDev.	P-value	Coef.	SDev.	P-value
L1NPL	0.667	0.048	0	0.761	21.7	0.00
FDau	2.14	.546	0.00	2.2	0.354	0.00
Lag 1 FDau	-3.671	0.778	0.00	-3.087	0.491	0.000
Lag 2 FDua	1.0049	0.356	0.005	1.424	0.126	0.000
DCg	0.52	0.063	0.407	Omitted as it was insignificant		
Lag 1 DCg	-0.31	0.044	0.000	-0.25	0.033	0.000
Lag 2 DCg	-0.43	0.047	0.000	-0.369	0.046	0.000
GDg	-1.64	0.278	0.000	-1.292	0.274	0.000
Lag 1 GDg	-0.374	0.052	0.000	-0.082	0.075	0.276
Lag 2 GDg	-0.999	0.179	0.015	-0.649	0.122	0.000
Lr	dropped because of collinearity			dropped because of collinearity		
Lag 1 Lr	dropped because of collinearity			dropped because of collinearity		
Lag 2 Lr	0.708	0.292	0.015	1	0.211	0.000
CPI	1.026	0.553	0.064	0.652	0.107	0.000
Lag 1 CPI	0.132	0.424	0.230	0.476	0.118	0.000
Lag 2 CPI	dropped because of collinearity			dropped because of collinearity		
sargan			1			1
AR(1)			0.105			0.058
AR(2)			0.302			0.295

that there is correlation between error terms and explanatory variable or $E(X_{it}, \upsilon_{i,ts}) = 0$ for $s < t$ but $E(X_{it}, \upsilon_{i,ts}) \neq 0$ for $s \geq t$.

To solve this problem [33] suggests using the untransformed regressors or lagged level as an instrument for the transformed variable (First differenced GMM method). On the other hand according to [34], if the lagged dependent variables are persistent during the time or tend to be random walk, so lagged levels of these variables will be weak instruments in first difference equation of regression. Therefore, a system GMM approach is suggested by [34] to avoid the probabilistic bias with the differenced estimator. In this proposed regression in differences and regression in levels are combined and the instruments for independent variables in levels are the lagged differences of the corresponding instruments.

Notably, [32] suggests two different One-step and two-step methods to estimate of GMM and System GMM models. In one step method it is assumed that the error terms are independent and homoskedastic between units. But in two steps the error term extracted from first step are used to create a consistent estimate of the variance–covariance matrix in order to relaxing the assumption of independence and homoskedasticity of error term; because on this condition the result will be different.

Estimate Results: To achieve better results and interpretation, different methods have been used to estimate the coefficients and all the models were computed over the entire sample of banks. First of all the GMM and system GMM model estimated with one step method but most of coefficiencies are not significant. Also the Sargan test show that over identifying condition about combination of instrument variables is not correctly specified. Hence the two step method is used in both GMM and system GMM model. The results of these two models are indicated in Table (1).

As it is shown the Sargan test in both models indicates the optimal combination of instrumental variables used in the estimation of the models. Also the autocorrelation test results suggest there is no autocorrelation between error terms. The results of the exploratory regressions were in line with expectations and extremely robust under alternative estimation methods. The coefficient of the lagged dependent variable is 0.66 and 0.76 in GMM and System GMM models, it means NPL is persistence.[3] Since the System GMM models used the comprehensive instrument variables and the correlation between explanatory variables and error term is tested and solved this potential problem; therefore, results based on System GMM model is used to interpret the coefficients.

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[3] If this coefficient equal to 1 it means that the depended variable (NPL) is not stationary and in this situation it is necessary to used first difference GMM model. It means that we have to use first difference of NPL as a depended variables.

Table 2:

npl	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
npl						
L1.	.6765929	.0452783	14.94	0.000	.587849	.7653367
dcg	-.184455	.0270981	-6.81	0.000	-.2375663	-.1313437
l1dcg	.3026575	.045198	6.70	0.000	.214071	.391244
l2dcg	-.4317835	.0299135	-14.43	0.000	-.4904129	-.3731542
gdg	-.9806483	.1024696	-9.57	0.000	-1.181485	-.7798115
l1gdg	-.409498	.0403896	-10.14	0.000	-.4886603	-.3303358
l2gdg	-.6240283	.0820625	-7.60	0.000	-.784868	-.4631887
lr	5.246138	.4979886	10.53	0.000	4.270098	6.222178
l1lr	-5.379163	.4486088	-11.99	0.000	-6.25842	-4.499906
l2lr	2.101479	.0915313	22.96	0.000	1.922081	2.280877
p	.4210601	.0699181	6.02	0.000	.2840231	.5580972

As it is shown in the Table (1), both of GDP growth and domestic credit growth have negative effects and both lending rate and inflation have positive effects on NPL ratio. The share of FDI-net outflow from GDP has positive effects on NPL ratio in level due to reduced access to financial resources by domestic investors to pay their debts. But after one year it leads to decrease NPL. It means that outflow of foreign investments causes to less domestic investment and consequently less NPL in the future. If the percentage of FDI outflows from GDP, increase 1unit (for example if shift from 4% to 5%) NPL ration in commercial banks will be increase 2.2 units (for example will shift from 2% to 4.2%). But the next year it will decrease 3 units. GDP growth has negative effects on NPL ratio under any circumstances. But its contemporaneous effect is more than one-and two-year interval effects. According to the results one unit increasing in GDP growth lead to 1.3 units decreasing in NPL ratio simultaneous and 0.6 units after two years.

About growth of lending by commercial banks it is noteworthy that the effect of this variable was significant, but its amount is very small. Therefore, the growth rate of total domestic credit to private sector (DCg) as an alternative variable was used.

The estimated results show that any increase in total domestic credit with two year delay has a positive effect on NPL ratio. It is noteworthy that the level variable of DCg was dropped because of collinearity. Also the Level and one-year lag variables of lending rate have been removed for the same reason. But because of important role of this factor in banks' operation and loans quality it was necessary to investigate the correlation between the explanatory variables. According to correlation matrix the lending interest rate are strongly correlated with FDI-net outflow (%GDP). Thus the model was re-estimated by replacement FDI with lending interest rate and its intervals. The results of this model are shown in Table (2).

As it is indicated the lending interest rate has strongly contemporaneous and positive effect on NPL ratio and after one year it caused to decrease this ratio. When the interest rate grows at short time access to new funds to replace existing debt will be lower and consequently the NPL ratio will be increased. On the other hand demand for loans by new customers will be decreased and over the coming year the NPL ration gradually will be less. According to results one unit increase in landing rate lead to increase 5 units the NLP ratio and after one year it has exactly the negative effects.

It is worth mentioning that most of different estimated models, the coefficients of one and two-year lag price were not significant. And the price level variable has had a positive impact on NPL ratio.

CONCLUSION

The econometric estimation results show that there is a strong evidence cyclical sensitivity of loan quality in Malaysia commercial banking system. Based on the results lending interest rate and FDI-net outflow (%GDP) are the most effective factors on NPL ratio with simultaneous positive effects and a reverse effect with one-year delay. This situation is an evidence of the extreme sensitivity of the commercial banking system in Malaysia as open economy to FDI. Also there is a robust negative relationship between NPL and GDP growth with the effects operating with up to two year lags. Inflation and domestic credit growth have positive and negative effects respectively and their effects last for up to two years, but a mild.

So it can be said that the impact of external shocks on the domestic banking system is more than internal shocks. Mean while effects of monetary policy shocks is greater than demand and supply shocks. These results can influence in decisions and policy outcomes by economists and also in prediction effects of monetary and fiscal policy and above all in order to combat the negative effects of external shocks. On the other hand banks can forecast the effects of economics shocks on their loans' quality. And start to implement actions required to adjust their capital adequacy to deal with potential risks.

Also these results can be merged with vector autoregressive (VAR) model that extract the relationship between some macroeconomics variables systematically. This model can indicate the mechanism effects of any shock and can be used in estimation an out-of- sample simulation of NLP for banking system under different scenarios.

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