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Macroeconomic Determinants of Non-Performing Loans in Malaysia

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Abstract

This study re-examines the effect of a set of macroeconomic variables on the outstanding balance of non-performing loans (NPL) in Malaysia, namely interest rate, unemployment rate, output, and price level. It covers the overall NPL, and both commercial and Islamic banks including their 11 financing sectors (i.e. primary agriculture, electricity, gas and water supply, manufacturing, household sectors, and so on). The data covers monthly observations between 2019M1 and 2021M12. This study finds that higher output growth reduces overall NPL including Islamic banks. The past NPL does explain the recent outstanding balance. The macroeconomic variables also explain the most for the primary agriculture, construction, mining & quarrying, transport, storage & communication, and other sector. This study has relevant policy implications.

Keywords: Banking Sector; Interest rate; Non-performing Loan; Malaysia

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1. Introduction

This study re-examines the effect of macroeconomic determinants viz. interest rate, unemployment rate, output, and price level on non-performing loans (NPL) outstanding balance in Malaysia for the period 2019M1-2021M12. It considers both commercial banks and Islamic banks as well as their 11 financing sectors, for example, primary agriculture, mining and quarrying, manufacturing, household sector, and so on. The previous studies focus on only Islamic banks (Shamsudheen and Masih, 2015; Isaev and Masih, 2017) while Isaev and Masih (2017) extend to the Islamic banks and their mortgage, business, and consumer financing. The overall NPL is the study by Kepli et al. (2021).

The banking sector engages in the business of dealing with financial and monetary transactions in an economy such as investments, deposits, and loans (Hayes, 2022). It becomes '*a middleman*' in collecting deposits from parties with excess savings (depositors) by paying them interest, and channelling it to the parties who demand funds (borrowers) to receive interest payment. Indeed, the banking sector has played a vital role in ensuring that financial resources are allocated efficiently toward promoting economic growth and development (Bank Negara Malaysia, 2022). However, the banking institutions in Malaysia cannot be exempted from NPL outstanding balance when the borrowers may not be able to repay the loans in the period given agreed upon with the bank. That is, the default of a loan is unable to be recovered within the timeframe prescribed by applicable laws (Islam et al., 2005). According to Bank Negara Malaysia (BNM), NPL is the borrower's debt (principal or interest) that has been outstanding for six months or more from the first day of default.

A substantial unmanageable NPL poses a significant economic concern – it is a burden for both the banking sector and borrowers as it contracts credit supply, distorts the allocation of credit, worsens market confidence and slows economic growth (Balgova, et al., 2016). NPL contributed to the vulnerable banking sector, for example in the Asian financial crisis (1997-1998), and the global financial crisis (2007–2008). Among others, the NPL ratio is regarded as an indicator of the onset of the banking crisis as a higher NPL ratio would reduce credit growth and, consequently threaten financial stability (Reinhart and Rogoff, 2010; Ivanović, 2016). Conventionally speaking, a rise of NPL signifies a susceptible financial market, while a low (manageable) NPL is a signal

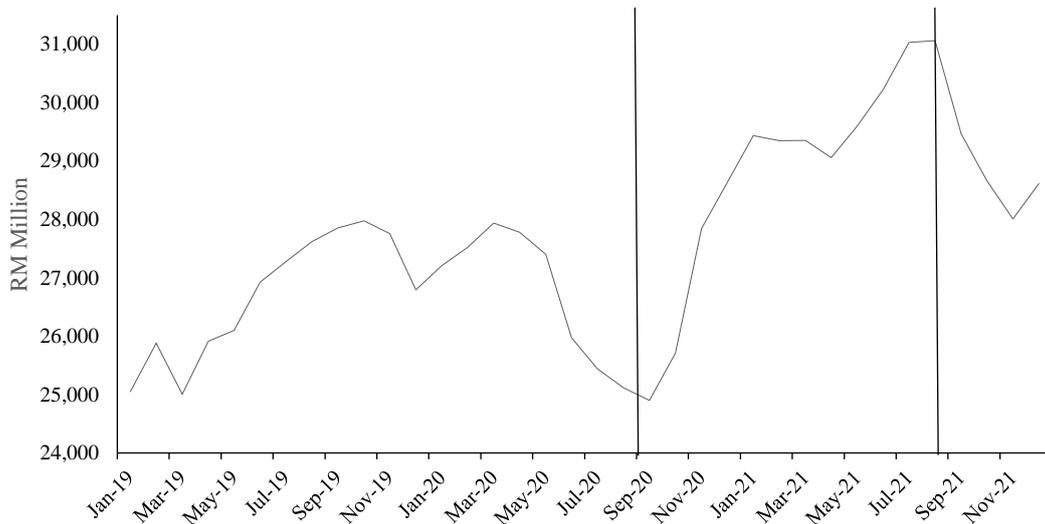
of financial soundness. It reflects the health of the banking system in a country – with a high NPL, the banks have difficulty in collecting interest payments and principal on their loans released. That may lead to less profits (or losses) for the respective banks and possibly, bank closures (Huljak et al., 2020). According to Khoo Siew Kiat, Deloitte Malaysia's restructuring services leader, NPL in Malaysian banks will skyrocket once the moratorium and targeted repayment assistance to borrowers expire (Jalil, 2021). The S&P Global Ratings also stated that the gross NPL ratio could rise to 3% to 4% by the end of 2022 when the loan-repayment moratorium expires (Ong, 2021).

Figure 2 depicts the monthly observations of NPL in Malaysia for the period 2019 (January) - 2021 (December). What can be observed here is that NPL has been steadily increasing, i.e. from RM25,051 million in January 2021 to RM28,616 million in December 2021. There is an upward trend of NPL with an average of RM3.56 million per month over the observed period (based on its trend line estimate). The rise of NPL from January 2019 to October 2019 is mainly due to the weaker demand for exports in 2019, which decreased marginally by 1.7% from the preceding year in tandem with softer global demand amid trade tensions and unfavourable external economic conditions.¹ In this relation, the borrowers would have found it difficult to repay their loans and interest payments causing higher NPL. As the economy improved in the later months of 2019, NPL declined to RM26,794 million in December 2019. This could have resulted from several measures taken by the government to boost the economy such as tax cuts and the easing of monetary policy (Bank Negara Malaysia, 2019). The emergence of the COVID-19 pandemic in early 2020 could have again risen the NPL as businesses faced disruptions and cash flows (profit) were affected. The government's lockdown measures associated with the movement restrictions have impacted the ability of borrowers to repay their debts resulting in higher instances of default. The NPL plummeted to RM24,901 million in September 2020. The September 2020 slump is associated with the BNM's announcement in April 2020 about the automatic six-month moratorium on all bank loans to ease the financial burden of eligible borrowers (Annuar, 2020). Following the end of loan repayment assistance, the NPL has risen peaking at RM31,063 million in August 2021. The NPL is beginning to fall, to RM28,007 million in November 2021

¹ Malaysia External Trade Development Corporation. (2019). Trade performance 2019. Retrieved from <https://www.matrade.gov.my/en/malaysia-trade-performance/179-malaysian-exporters/trade-performance-2019#:~:text=For%20the%20first%208%20months>

owing to MCO relaxation and the reopening of the economy (Sunil, 2021). Although NPL has been observed to be well-controlled, close monitoring must be paid because it has a devastating impact on the financial sector and the Malaysian economy.

Figure 2: NPL in Malaysia, from January 2019 to December 2021



Source: BNM, <https://www.bnm.gov.my>

Given the banks' income (profit) is primarily from the interest they charge on loans, therefore an increasing drift of NPL may harm the bank's financial performance (Berger and DeYoung, 1997). When banks fail to collect back their loans released, they must bear the losses and consequently lowering their profit (or loss), especially for the smaller local banks would suffer, leading to bank closure because they are unable to sustain the losses. Also, when banks fail to collect their interest payments because of NPL, they have fewer reserves available to create new loans.² As noted by Vouldis and Louzis (2017), NPL obstructs interest revenue, reduces investment opportunities, and causes liquidity crises in the financial system, resulting in bankruptcy and a weak economic system. Also, a rising NPL may lead to a credit crunch, reduce economic activity and ultimately slow down economic development (Ghosh, 2015).

The next section reviews the existing studies on the macroeconomic determinants of NPL in Malaysia. Section 3 is about the research method which documents the

² CFI Team. (2022, December 12). Non-performing loan (NPL). Retrieved from: <https://corporatefinanceinstitute.com/resources/commercial-lending/non-performing-loan-npl/>

empirical framework, data (variables), and testing method. Section 4 reports and discusses the empirical results. Section 5 concludes this study.

2. Literature Review

Of the literature search, there are three studies available investigating the effect of macroeconomic factors on NPL in Malaysian banking institutions. They are Shamsudheen and Masih (2015), Isaev and Masih (2017) and Kepli et al. (2021). Another eight studies are looking at the same topic, but they are from predatory publishers (or discontinued by Scopus), hence excluded (see, **Appendix A**). Shamsudheen and Masih (2015) estimate the effect of interest rate (KLIBOR, Kuala Lumpur Interbank Offered Rate), unemployment rate, industrial production index, and total loan growth on the NPL of Islamic banks in Malaysia. They consider quarterly data for the period 2005-2014. The autoregressive distributed lag (ARDL) models show that NPL and the macroeconomic variables are cointegrated. In the long run, the industrial production index has a positive effect on NPL. Other variables - Interest rates, unemployment rate, and growth rate of total loans, do not affect NPL. Interest rate is the only factor worsening NPL in the short run. The global financial crisis (2007Q3-2009Q2) is no effect in both the short and long run on NPL of Islamic banks in Malaysia.

Isaev and Masih (2017) examine the both macroeconomic and bank-specific factors on NPL categories (viz. mortgage, business and consumer financing) of Islamic banks in Malaysia for the period 2010Q4 - 2016Q3. The macroeconomic variables to be considered are the unemployment rate, GDP growth, and lending rates, while the bank-specific variables are the solvency ratio, inefficiency, and leverage ratio. They find the presence of at most two cointegrating vectors among the variables. The dynamic ordinary least squares (DOLS) estimator shows that the unemployment rate has a positive sign, while economic growth, and inefficiency ratio are negatively association with all financing categories. The lending rates only worsened the consumer loans, whereas the leverage ratio has a negative impact [improve] on business financing. The solvency ratio has no impact on all categories of NPL.

The last study by Kepli et al. (2021), investigate the impact of macroeconomic variables on the overall NPL in Malaysia for the period 1988-2018. The macroeconomic variables are the industrial production index, consumer price index, money supply (M2),

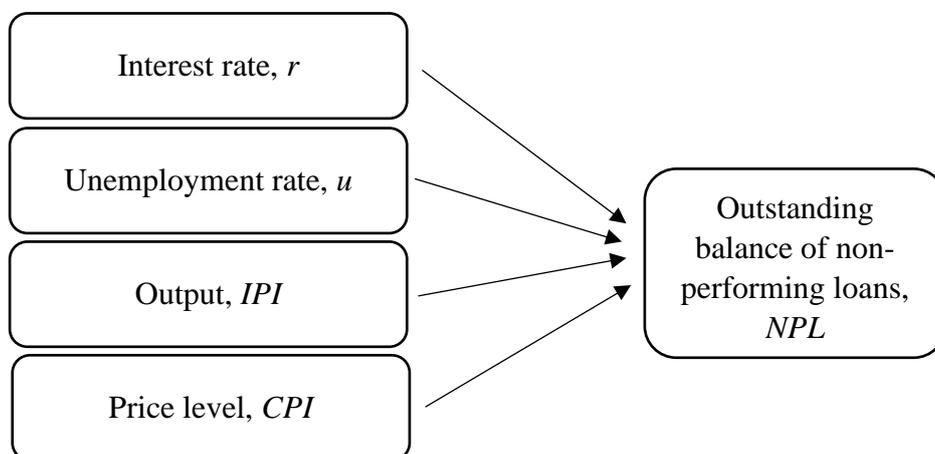
and exchange rate. Using annual data, the ARDL approach confirms that the variables are cointegrated. The NPL is positively explained by the exchange rate, but negatively influenced by industrial production and money supply in the long run. However, the inflation rate does not affect NPL. In the short run, both industrial production negatively, and inflation positively influence the NPL. They also include the Granger non-causality tests with feasible findings.

3. Research Method

Empirical Framework

Four macroeconomic variables have been identified those potentially influence NPL in Malaysian banking institutions viz. interest rate, unemployment rate, output (economic activities), and price level. Figure 3 illustrates the conceptual framework of this study based on Kepli et al. (2021). Kepli et al. (2021) consider four macroeconomic variables, namely industrial production index, consumer price index, money supply, and exchange rate. This study replaces both money supply and exchange rate with interest rate and unemployment rate which are more conventional and have direct implications on NPL. The money supply (M2) that includes demand deposits, fixed deposits, foreign currency deposits and other deposits, is to be converted partially to reserves for making new loans. Hence, the money supply is equivalent to a loan which has no association with NPL in nature. Second, the exchange rate variable applies only to the firms' foreign borrowing that involves foreign businesses. It is assumed that the banks conventionally finance domestic activities.

Figure 3: Conceptual Framework



The interest rate (r) captures the cost of borrowing. It has a positive implication for NPL (Isaev and Masih, 2017). A higher interest rate increases the cost of borrowing (i.e. total interest payments to be paid monthly) consequently higher the cost of repayment. Assuming a fixed income (revenue), both individuals and firms face an increasing fixed cost, and intended to delay their payment or even loan default. The association between unemployment rate (u) and NPL is straightforward i.e. a positive sign that an increase in unemployment rate reduces households' reimbursing capacity as they lose income sources, causing loan default. The empirical evidence remains unclear as Isaev and Masih (2017) found a positive relationship between them. The output (IP) which is measured by the industrial production index, is expected to have a negative sign on NPL. A growing economy (more outputs) typically results in increased employment, and higher wages (income) leading to a decrease in NPL since households are managed to repay their debts. The empirical evidence of such a relationship is ambiguous since Shamsudheen and Masih (2015) find a positive relationship, while Isaev and Masih (2017) and Kepli et al. (2021) find a negative effect. Lastly, the consumer price index (CPI) is a proxy for cost of living - a higher CPI indicates a broad rise in prices for goods and services in an economy. It eventually reduces the households' repayment ability and delays repayments if they want to maintain their current utility (or standard of living). The high cost of living reduces households' purchasing power, resulting in the demand for goods and services decreasing. This may further reduce the revenue (profit) generated by the firms, which results in resource misallocation to those neediest, and ultimately result in loan defaults.

Data and Variables

The data are monthly observations between 2019 (January) and 2021 (December) when this study is conducted. A brief description of the variables is shown in Table 1. It is to note that the overall NPL includes commercial banks, Islamic banks and merchant or investment banks that are obtained directly from BNM. The NPL variable is further disaggregated into NPL in commercial banks (NPL_{CB}) and NPL in Islamic banks (NPL_{ISB}) for comparison purposes. The NPL in merchant or investment banks is excluded given its low percentage share of overall NPL and its sectoral NPL i.e. merely 1.40% in January 2019 or even 0% for the PA and EGW sectors to NPL in merchant or

investment banks. For the sectoral financings to be considered are primary agriculture (*PA*), mining and quarrying (*MQ*), manufacturing (*M*), electricity, gas and water supply (*EGW*), wholesale & retail trade and restaurants & hotels (*WRH*), construction (*Cs*), transport, storage and communication (*TSC*), finance, insurance and business activities (*FIB*), education, health & others (*EH*), household sector (*H*), as well as other sector (*O*). the data source is Table 1.23b, Monthly Highlights and Statistics, BNM. The definitions of the economic sectors/industries are based on the Malaysian Standard Industrial Classification (MSIC) 2000.

Table 1: Description of Variables

	Description	Source
Non-performing loans, <i>NPL</i>	The overall NPL (RM million) is aggregated data from all banking institutions (i.e. commercial, Islamic, and merchant or investment banks) with arrears for at least six months. The data are deflated by CPI deflator (2015=100).	Table 1.23b, Monthly Highlights and Statistics, BNM.
Interest rate, <i>r</i>	It is base lending rate (%) which measures the cost of borrowing. It is minus by inflation rate.	Table 2.1, Highlights and Statistics, BNM.
Unemployment rate, <i>u</i>	The percentage of unemployed workers in the total labour force.	Table C, Department of Statistic Malaysia.
Output, <i>IPI</i>	The industrial production index is used to capture economic output which is based on manufacturing, mining, electric, and gas industry (2015=100).	Table 3.5.1, Monthly Highlights and Statistics, BNM.
Price level, <i>CPI</i>	It is proxied by the consumer price index (2015=100). It captures the cost of living.	Table 3.5.8, Consumer Price Index, Monthly Highlights and Statistics, BNM.

Table 2 depicts the summary statistics of NPL and by types (i.e. commercial banks and Islamic banks) as well as their respective 11 sectors. The overall NPL is about RM25,717 on average (median) in which household sector (*H*) is the largest (RM10,045 million), while electricity, gas and water supply (*EGW*) is the lowest (RM147 million). The average in commercial banks is about double that of Islamic banks, with RM16,217 million versus RM8,836 million. The household sector (*H*) remains the highest average NPL among other sectors with RM6,700 million in NPL in commercial banks and RM3,323 million in NPL in Islamic banks. The electricity, gas and water supply (*EGW*), the lowest average NPL with merely RM52 million in commercial banks, and RM103

million in Islamic banks. Of the standard deviation, it can reveal that commercial banks have a higher default rate than Islamic banks, with RM1163 million and RM553 million, respectively. For the macroeconomic variables, on average, CPI is about 108, IPI is 115.6, the unemployment rate is 4.4%, and the interest rate is 5.7% (Table 3).

Table 2: Summary Statistics of NPL (in RM Million)

		Mean	Median	Maximum	Minimum	St. Dev.
Overall	Total	25,652.57	25,717.92	28,600.59	23,287.89	1,416.834
	Sector: PA	1,083.605	1,150.087	1,326.518	222.754	274.477
	MQ	323.881	252.186	1,362.481	113.017	230.414
	M	3,278.287	3,508.723	4,037.017	2,236.278	507.307
	EGW	138.901	147.225	177.141	90.513	29.721
	WRH	2,190.087	2,186.018	2,502.539	1,959.549	139.378
	CS	2,352.064	2,328.313	2,788.96	2,121.115	156.512
	TSC	1,933.149	2,001.565	2,172.646	1,656.041	154.516
	FIB	3,172.011	3,124.029	3,566.325	2,902.508	187.807
	EH	536.435	480.922	849.884	338.036	175.526
	H	10,175.01	10,045.06	12,011.2	8,068.71	1,032.765
	O	469.133	386.578	684.384	288.941	134.249
	Commercial Banks (CB)	Total	16,669.2	16,217.24	18,872.81	14,894.86
Sector: PA		178.55	174.564	244.5	126.7	28.51
MQ		135.926	101.322	1,046.194	80.738	158.122
M		2,132.778	2,169.471	2,661.8	1,745.237	207.697
EGW		45.923	52.154	55.907	23.22	11.198
WRH		1,572.273	1,581.71	1,773.984	1,395.697	110.495
CS		1,512.996	1,509.207	1,728.968	1,312.579	129.11
TSC		1,610.457	1,598.56	1,873.76	1,313.583	155.725
FIB		2,035.944	2,037.565	2,267.518	1,756.564	135.556
EH		402.294	329.658	698.016	198.106	185.937
H		6,774.047	6,699.903	8,055.024	5,343.153	711.261
O		268.006	225.4	382	173.5	60.499
Islamic banks, (ISB)		Total	8,704.825	8,836.271	9,540.832	7,245.768
	Sector: PA	905.053	928.05	1,132.8	94.7	260.665
	MQ	182.569	148.35	352.3	30.2	131.801
	M	1,063.547	1,217.95	1,346.8	418.8	324.842
	EGW	92.978	102.65	124.1	36.7	28.873
	WRH	601.206	594.65	723.5	546.2	40.855
	CS	805.064	779.55	1,268.5	650.8	103.752
	TSC	315.211	261	522	168.8	139.926
	FIB	1,083.906	1,101.35	1,352.5	776.4	160.708
	EH	121.725	120.85	137.8	107.1	8.451
	H	3,360.806	3,323.1	3,959.2	2,683.3	334.681
	O	172.761	152.95	258.8	113.5	48.725

Table 3: Summary Statistics of Macroeconomic Variables

	Mean	Median	Maximum	Minimum	Std. Dev.
<i>r</i>	5.4%	5.7%	9.2%	0.8%	2.1%
<i>u</i>	4.1%	4.4%	5.3%	3.2%	0.7%
<i>IPI</i>	114.361	115.6	126.5	77	8.695
<i>CPI</i>	107.769	108	110.4	104.3	1.382

Table 4: Correlation Coefficients between NPL and Macroeconomic Variables

		<i>r</i>	<i>u</i>	<i>IPI</i>	<i>CPI</i>
Overall	Total	-0.527	0.453	-0.096	0.382
	Sector: <i>PA</i>	-0.199	0.541	-0.02	0.011
	<i>MQ</i>	0.031	-0.518	0.131	0.157
	<i>M</i>	0.054	0.538	-0.281	-0.276
	<i>EGW</i>	-0.558	0.288	0.277	0.516
	<i>WRH</i>	-0.608	0.23	0.169	0.545
	<i>CS</i>	-0.124	-0.041	-0.267	0.195
	<i>TSC</i>	-0.204	-0.482	0.044	0.299
	<i>FIB</i>	0.48	-0.165	-0.413	-0.527
	<i>EH</i>	-0.528	0.751	0.205	0.365
	<i>H</i>	-0.615	0.369	0.069	0.534
<i>O</i>	0.473	-0.755	-0.332	-0.321	
Commercial banks, <i>CB</i>	Total	-0.606	0.527	0.024	0.476
	Sector: <i>PA</i>	0.293	-0.04	-0.376	-0.425
	<i>MQ</i>	-0.246	-0.027	0.22	0.326
	<i>M</i>	0.023	0.748	-0.339	-0.307
	<i>EGW</i>	0.141	0.417	-0.263	-0.273
	<i>WRH</i>	-0.568	0.142	0.226	0.558
	<i>CS</i>	-0.111	-0.006	-0.299	0.143
	<i>TSC</i>	-0.499	0.318	0.219	0.392
	<i>FIB</i>	0.049	0.37	-0.211	-0.176
	<i>EH</i>	-0.572	0.726	0.232	0.412
	<i>H</i>	-0.644	0.344	0.108	0.58
<i>O</i>	0.518	-0.588	-0.584	-0.419	
Islamic banks, <i>ISB</i>	Total	-0.114	0.094	-0.273	0.011
	Sector: <i>PA</i>	-0.242	0.574	0.02	0.058
	<i>MQ</i>	0.338	-0.844	-0.034	-0.111
	<i>M</i>	0.06	0.362	-0.211	-0.221
	<i>EGW</i>	-0.629	0.135	0.387	0.637
	<i>WRH</i>	-0.531	0.388	-0.035	0.349
	<i>CS</i>	-0.053	-0.055	-0.029	0.12
	<i>TSC</i>	0.325	-0.882	-0.191	-0.102
	<i>FIB</i>	0.539	-0.594	-0.292	-0.466
	<i>EH</i>	0.772	0.208	-0.462	-0.754
	<i>H</i>	-0.531	0.399	-0.011	0.42
<i>O</i>	0.418	-0.703	-0.168	-0.263	

Table 4 is about the estimated correlation coefficients between the NPL and the four macroeconomic variables. The unemployment rate and overall NPL in the education, health & others sector have a strong positive correlation, 0.751, while a strong negative correlation, -0.755 is observed for other sectors. The interest rate has a negative correlation with NPL in the household sector, -0.615. A positive correlation (0.545) is observed between price level and overall NPL in wholesale & retail trade, and restaurants & hotels. For the NPL in commercial banks, only two macroeconomic variables, namely the interest rate and the unemployment rate have a reasonable correlation with NPL. The interest rate is negatively correlation with total NPL in commercial banks (-0.606), and the household sector, -0.644. There is a positive correlation between the unemployment

rate and NPL in commercial banks, the manufacturing sector, and in the education, health and other sectors. For the NPL in Islamic banks, the unemployment rate is found to have a sizeable negative correlation including mining and quarrying, -0.844, and transport, storage, and communication, -0.882. The coefficient of correlation of the interest rate, and the education, health and other sectors is 0.772. The price level and NPL of Islamic banks in electricity, gas, and water supply are positively correlated, 0.637.

Testing Method

Of the conceptual framework, this study estimates the Ordinary Least Square (OLS) equations (1) – (3). All of the variables have been transformed into natural logarithms, \ln , except for r and u as they are measured in a rate. To avoid the so-called ‘spurious’ OLS regression with non-stationary variables, the first-differenced (Δ) variables are being used to assume stationarity.

$$\Delta \ln NPL_t = \beta_0 + \beta_1 \Delta \ln NPL_{t-1} + \beta_2 \Delta r_t + \beta_3 \Delta u_t + \beta_4 \Delta \ln IPI_t + \beta_5 \Delta \ln CPI_t + \varepsilon_t \quad (1)$$

$$\Delta \ln NPL_{CB_t} = \beta_0 + \beta_1 \Delta \ln NPL_{CB_{t-1}} + \beta_2 \Delta r_t + \beta_3 \Delta u_t + \beta_4 \Delta \ln IPI_t + \beta_5 \Delta \ln CPI_t + \varepsilon_t \quad (2)$$

$$\Delta \ln NPL_{ISB_t} = \beta_0 + \beta_1 \Delta \ln NPL_{ISB_{t-1}} + \beta_2 \Delta r_t + \beta_3 \Delta u_t + \beta_4 \Delta \ln IPI_t + \beta_5 \Delta \ln CPI_t + \varepsilon_t \quad (3)$$

where t is the time dimension (i.e. month). It is to expect that $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 < 0$, and $\beta_5 > 0$. A zero-one dummy variable, D_Break is added to capture a possible structural break due to Covid-19, that is 1= September of 2020 and onward, 0=elsewhere (before).

The Heteroskedasticity and Autocorrelation Consistent Covariances (HAC) estimator has been considered to account for both autocorrelation and heteroskedasticity in the error term of the equations. These equations also apply to the 11 sectors as described early. This study does not follow Kepli et al.’s (2021) method (i.e. cointegration) since none of the economic theories postulates a long-run (or equilibrium) relation between NPL and macroeconomic variables. They are about the empirical concern with *ad hoc* specified equation(s) as this study. Secondly, if the first is false, the available monthly data for an extremely short period of 3 years (2019-2021) does not convince a long-run relation to occur, especially with macroeconomic variables.

4. Empirical Results and Discussion

This section illustrates the empirical results. Table 5 is about the baseline results, changes in output ($\Delta \ln IPI$) are the macroeconomic variable affecting the overall NPL with an estimated coefficient of -0.118. That is, a 1% increase in the output can improve overall NPL by 0.12%. A similar finding is observed for the Islamic banks' NPL with an estimated coefficient of -0.207 which is larger the size than the overall NPL. Meanwhile, the past (i.e. last month) NPL outstanding balance ($\Delta \ln NPL_{t-1}$) does worsen the current outstanding balance of NPL (0.272), and the estimated coefficient for commercial banks is higher than overall that is, 0.398. It is a reversed case for the Islamic banks in which the estimated sign is negative, -0.103 informing that a higher NPL recorded in the previous month can lower the current NPL. This could be attributed to the principles of Shari'ah law, which mandate that borrowers in Islamic finance must repay their loans to fulfil their religious obligation to the creditor.³ Other variables such as interest rate (Δr), unemployment rate (Δu), price level ($\Delta \ln CPI$), and the dummy variable (D_Break) are statistically insignificant for all NPL even at a 10% level.

Table 5: Baseline Results

Variable	Overall	Commercial banks	Islamic banks
$\Delta \ln NPL_{t-1}$	0.272** (0.063)	0.398** (0.047)	-0.103** (0.04)
Δr_t	0.4 (0.298)	0.371 (0.297)	0.418 (0.586)
Δu_t	-0.247 (1.075)	1.186 (0.908)	-4.512 (3.265)
$\Delta \ln IPI_t$	-0.118** (0.055)	-0.049 (0.055)	-0.207* (0.102)
$\Delta \ln CPI_t$	-0.028 (0.614)	-0.173 (0.771)	-0.935 (0.882)
D_Break	0.007 (0.009)	0.013 (0.008)	-0.006 (0.021)
Constant	-0.001 (0.006)	-0.003 (0.004)	0.007 (0.01)
Adjusted. R ²	0.16	0.289	0.001
F-stat (p-value)	2.044 (0.094)	3.231 (0.016)	1.007 (0.441)
Durbin-Watson statistic	1.897	1.77	1.651

Notes: ***, **, and * denote significance level at 1%, 5%, and 10% respectively. The value in (.) is the standard error. D_Break is a zero-one dummy that captures a structural break in September 2020.

³ Loans and debts in the Sharia'h. Financial Islam. Retrieved from: <http://www.financialislam.com/loans-and-debts-in-the-shariah.html>

Table 6 reports the sectoral estimates of overall NPL. Primary agriculture (*PA*), followed by the construction (*Cs*) sector is the sector that is most impacted by macroeconomic variables. For the NPL in primary agriculture, all macroeconomic variables are statistically significant at least at a 10% level, except for, the changes in the price level (cost of living). The estimated coefficients of changes in interest rate and output are 2.397 and -0.809 respectively, and in with their expected sign. However, the unemployment rate is somewhat contrary to expectations, with its estimated coefficient of -19.037. It is partly explained by the Malaysian government's provision of unemployment benefits may help to reduce NPL. During MCO, employees who are let go are qualified for unemployment benefits under EIS's Job Search Allowance, which can equal up to 80% of the employee's salary (Kamil, 2020).

Turning to the construction sector, increasing price level (higher inflation or cost of living) worsens its NPL with its estimated coefficient of 6.959. The estimated coefficients of changes in the interest rate and output on the changes in NPL are 2.189 and -0.313, respectively. For the finance, insurance, and business activities (*FIB*) sector, only changes in the unemployment rate (5.466), and output explain changes (-0.111) in the NPL in this sector. Most of the NPL sector-wise is explained by a single macroeconomic factor. For instance, a higher interest rate worsens the outstanding balance of NPL in the mining and quarrying (*MQ*) sector, 10.91. Similarly, a rise in the unemployment rate accelerates NPL in education, health & others (*EH*) (6.877), and other sector (*O*) (23.041). Also, higher output improves NPL in the transport, storage, and communication (*TSC*) sector, with an estimated coefficient of -0.212. Unexpectedly, an increase in price level decreases NPL growth in the household sector (*H*), -2.209. In the household's (borrowers) perception, inflation enables borrowers to repay lenders with money worth less than when it was initially borrowed, which is advantageous to borrowers. Due to the lowered value of the debt, most households can repay their loans more easily, which reduces the likelihood of loan default.

Findings also show that the previous NPL rises the current NPL in the household sector (0.372). Meanwhile, a negative sign is found between changes in the past NPL and the current NPL in primary agriculture, construction, education, health & others, and other sector. In primary agriculture, it could be related to the harvest seasoning in which the borrowers (or farmers) might not be able to repay the loans in the past month because

of a delayed harvest season or low yields than expected. However, they might be able to pay it back in the current month if the harvest is successful. A similar reason behind the outcome of construction is that construction projects only generate revenue when the projects are completed. The borrowers (developers) who involve in the construction sector may not be able to repay their loans if the projects have not been done in the previous month. They might have the ability to pay back if their handled projects are completed and they receive payment this month. The dummy variable that captures the structural break of Covid-19 improves the current NPL in primary agriculture, with a negative sign (-0.144), while it is a positive sign (0.016) for the NPL in wholesale & retail trade, and restaurants & hotels (*WRH*), given the intuition that businesses in this sector have not yet fully recovered from the severe impact of Covid-19 pandemic despite the end of the automatic six-month moratorium, which has limited their ability to repay their debt and increased the current NPL. Indeed, the estimates show none of the variables has explanatory power on changes in NPL in manufacturing (*M*), as well as electricity, gas, and water supply (*EGW*).

For the NPL in commercial banks, Table 7 presents their sectoral estimates showing that mining and quarrying is the most responsive sector to macroeconomic variables. The estimates indicate that an increase in interest rate, unemployment rate, and price level lead to a rise in NPL in mining and quarrying of commercial banks. For electricity, gas, and water supply, a higher interest rate and unemployment rate improve (decrease) NPL, with the estimated coefficients of -0.27 and -7.681, respectively at a 10% level. These contrasting observations can be attributed to the fact that electricity, gas, and water are necessities for human existence, and demand for these services is consistently high in Malaysia given their oligopoly in nature. It may lower the risk of NPL given that businesses in the *EGW* sector are less impacted by economic fluctuations. This sector may be less vulnerable to the risk of NPL than other sectors when the interest rate and unemployment rate rise. In the construction sector, changes in the output and price level are statistically significant at 1% on changes in NPL in commercial banks, with estimated coefficients of -0.41 and 8.235, respectively.

Table 1: Sectoral Estimates of Overall NPL

Sector:	Primary agriculture	Mining & quarrying	Manufacturing	Electricity, gas & water supply	Wholesale & retail trade and restaurants & hotels	Construction	Transport, storage & communication	Finance, insurance & business activities	Education, health & others	Household sector	Other sector
$\Delta \ln NPL_{t-1}$	-0.172*** (0.033)	-0.024 (0.065)	0.117 (0.071)	0.007 (0.066)	0.162 (0.154)	-0.361** (0.132)	-0.149 (0.123)	0.016 (0.084)	-0.181*** (0.047)	0.372*** (0.085)	-0.204*** (0.045)
Δr_t	2.397* (1.334)	10.91* (5.497)	-2.598 (6.088)	-1.181 (2.673)	0.089 (0.561)	2.189* (1.094)	0.068 (0.406)	0.798 (1.802)	-0.046 (0.687)	0.539 (0.318)	-0.203 (1.225)
Δu_t	-19.037*** (6.741)	5.616 (17.176)	5.447 (3.787)	2.591 (7.351)	4.484 (4.793)	6.865 (5.531)	-3.16 (13.011)	5.466*** (1.046)	6.877*** (1.5)	-3.087 (4.889)	23.041** (8.687)
$\Delta \ln IPI_t$	-0.809*** (0.165)	0.159 (0.349)	-0.092 (0.115)	0 (0.212)	-0.028 (0.049)	-0.313*** (0.089)	-0.212** (0.088)	-0.111** (0.045)	0.056 (0.065)	0.009 (0.046)	-0.281 (0.186)
$\Delta \ln CPI_t$	3.848 (2.314)	12.723 (12.324)	-2.229 (3.627)	-2.73 (2.128)	0.508 (2.273)	6.959*** (2.486)	0.793 (4.544)	1.588 (1.846)	-1.751 (3.384)	-2.209** (0.83)	4.731 (4.903)
D_Break - 09/2020	-0.144** (0.055)	0.149 (0.123)	-0.039 (0.032)	0.047 (0.056)	0.016* (0.009)	0.017 (0.023)	0.01 (0.023)	0.004 (0.006)	0.012 (0.037)	0.018 (0.022)	0.034 (0.023)
Constant	0.123** (0.047)	-0.039 (0.03)	0.018 (0.022)	-0.011 (0.036)	-0.008 (0.007)	-0.017 (0.018)	-0.008 (0.009)	-0.007 (0.004)	0.015 (0.011)	-0.004 (0.012)	-0.054*** (0.017)
Adjusted. R ²	-0.089	-0.164	-0.001	-0.178	0.018	0.314	-0.117	0.048	-0.123	0.086	0.162
F-stat	0.551	0.227	0.994	0.168	1.103	2.062	0.422	1.277	0.398	1.515	2.064
(p-value)	(0.765)	(0.964)	(0.449)	(0.983)	(0.386)	(0.092)	(0.858)	(0.301)	(0.874)	(0.211)	(0.091)
D-W	1.862	1.256	2.058	2.006	2.046	1.627	1.954	1.941	2.03	1.958	1.83

Notes: ***, **, and * denote significance level at 1%, 5%, and 10% respectively. The value in (.) is the standard error. D_Break is a zero-one dummy that captures a structural break in September 2020. D-W stands for Durbin-Watson statistic.

Table 2: Sectoral Estimates of NPL in Commercial Banks

Sector:	Primary agriculture	Mining & quarrying	Manufacturing	Electricity, gas & water supply	Wholesale & retail trade and restaurants & hotels	Construction	Transport, storage & communicatio n	Finance, insurance & business activities	Education, health & others	Household sector	Other sector
$\Delta \ln NPL_{t-1}$	0.067*** (0.013)	-0.039** (0.015)	-0.203 (0.375)	0.054 (0.109)	0.028 (0.178)	-0.221 (0.207)	0.007 (0.279)	0.222 (0.155)	-0.134*** (0.046)	0.432*** (0.053)	-0.025 (0.049)
Δr_t	-2.033 (2.551)	14.538*** (1.542)	-0.635 (2.651)	-0.27* (0.155)	-0.065 (0.506)	1.464 (0.983)	-0.389 (1.223)	1.584 (1.408)	-0.317 (0.868)	0.581* (0.301)	-1.36* (0.781)
Δu_t	2.067 (5.464)	41.255*** (8.978)	8.01 (7.17)	-7.681* (3.837)	7.185 (6.123)	10.776 (7.361)	-0.231 (10.977)	9.174*** (2.833)	10.769*** (3.221)	-1.922 (3.645)	10.888 (11.078)
$\Delta \ln IPI_t$	-0.236*** (0.072)	-0.091 (0.082)	0.155 (0.224)	-0.172 (0.181)	-0.017 (0.071)	-0.41*** (0.1)	0.079** (0.032)	-0.001 (0.103)	0.073 (0.087)	0.03 (0.028)	-0.749** (0.28)
$\Delta \ln CPI_t$	-0.734 (1.039)	32.5*** (4.831)	-3.62** (1.586)	-2.3 (3.568)	1.189 (3.075)	8.235*** (2.836)	-1.816 (6.303)	3.095 (3.712)	-0.66 (5.044)	-1.809*** (0.51)	4.232 (5.967)
D_Break - 09/2020	-0.042** (0.02)	0.17*** (0.02)	-0.008 (0.029)	-0.074 (0.044)	0.023* (0.012)	0 (0.02)	0.008 (0.071)	0.008 (0.012)	0.012 (0.061)	0.019 (0.016)	0.003 (0.021)
Constant	0.02 (0.017)	-0.039*** (0.013)	0.006 (0.017)	0.039 (0.034)	-0.013 (0.009)	-0.009 (0.013)	-0.004 (0.015)	-0.008 (0.009)	0.024*** (0.008)	-0.004 (0.009)	-0.025 (0.024)
Adjusted. R ²	0.108	-0.105	0.051	-0.079	0.005	-0.009	-0.208	0.086	-0.161	0.143	0.111
F-stat (p-value)	0.545 (0.77)	0.479 (0.818)	1.297 (0.292)	0.597 (0.73)	1.027 (0.429)	0.954 (0.474)	0.052 (0.999)	1.515 (0.211)	0.238 (0.96)	1.915 (0.115)	1.686 (0.163)
D-W	2.031	1.16	1.898	1.953	2.132	1.997	2.004	1.94	2.038	1.939	2.275

Notes: ***, **, and * denote significance level at 1%, 5%, and 10% respectively. The value in (.) is the standard error. D_Break is a zero-one dummy that captures a structural break in September 2020. D-W stands for Durbin-Watson statistic.

Table 3: Sectoral Estimates of NPL in Islamic Banks

Sector:	Primary agriculture	Mining & quarrying	Manufacturing	Electricity, gas & water supply	Wholesale & retail trade and restaurants & hotels	Construction	Transport, storage & communicatio n	Finance, insurance & business activities	Education, health & others	Household sector	Other sector
$\Delta \ln NPL_{t-1}$	-0.268*** (0.022)	-0.05 (0.043)	0.046 (0.076)	-0.034 (0.054)	0.354*** (0.044)	-0.375*** (0.019)	-0.15 (0.149)	-0.08 (2.029)	-0.12 (0.153)	0.271** (0.125)	-0.268*** (0.033)
Δr_t	4.519 (2.741)	7.158* (3.669)	-7.28 (15.267)	-0.926 (3.23)	1.338* (0.72)	2.587** (1.176)	3.194*** (1.079)	-0.715 (13.513)	1.492*** (0.427)	0.44 (0.631)	3.008* (1.677)
Δu_t	-33.791*** (10.791)	-61.851*** (19.168)	2.699 (8.649)	10.511 (10.978)	-1.191 (1.517)	-4.644 (4.66)	-34.899** (14.715)	1.264 (53.351)	-2.994 (4.582)	-5.903 (3.487)	32.485* (16.297)
$\Delta \ln IPI_t$	-1.182*** (0.279)	0.377 (1.191)	-0.395* (0.222)	0.119 (0.307)	-0.07** (0.027)	-0.076 (0.15)	-1.467*** (0.437)	-0.255 (4.202)	-0.034 (0.071)	-0.044 (0.084)	0.284* (0.165)
$\Delta \ln CPI_t$	5.837* (2.982)	-18.256 (17.951)	-3.827 (16.079)	-2.479 (5.025)	0.529 (0.77)	1.782 (2.107)	6.499 (5.416)	0.786 (52.944)	-2.488 (1.644)	-3.361*** (0.789)	6.639 (5.524)
D_Break - 09/2020	-0.203*** (0.066)	0.091 (0.125)	-0.113 (0.081)	0.135* (0.079)	0.002 (0.01)	0.044** (0.018)	0.03 (0.027)	-0.012 (0.192)	0 (0.009)	0.015 (0.025)	0.045** (0.017)
Constant	0.182*** (0.052)	-0.009 (0.035)	0.056 (0.064)	-0.051 (0.048)	0.002 (0.003)	-0.026** (0.01)	-0.018 (0.015)	-0.007 (0.054)	0 (0.007)	-0.002 (0.014)	-0.062*** (0.01)
Adjusted. R ²	0.148	0.04	-0.035	-0.128	0.038	0.045	0.187	-0.126	0.134	0.024	0.163
F-stat (p-value)	0.784 (0.59)	0.189 (0.977)	0.812 (0.57)	0.378 (0.887)	1.215 (0.329)	1.259 (0.309)	2.261 (0.068)	0.386 (0.881)	1.852 (0.126)	1.135 (0.369)	2.072 (0.09)
D-W	1.801	1.465	2.01	2.002	1.668	0.94	1.993	1.848	2.09	1.934	1.93

Notes: ***, **, and * denote significance level at 1%, 5%, and 10% respectively. The value in (.) is the standard error. D_Break is a zero-one dummy that captures a structural break in September 2022. D-W stands for Durbin-Watson statistic.

For the household sector NPL in commercial banks, an increase in interest rate worsens the NPL with an estimated coefficient of 0.581. A higher price level appears to lower NPL, -1.809. Additionally, for the other sector, a higher interest rate and output worsen (increase) NPL with their estimated coefficients of -1.36 and -0.749, respectively. It is also found that the unemployment rate worsens NPL in finance, insurance, and business activities in commercial banks, 9.174. Meanwhile, higher output improves NPL in primary agriculture, -0.236, while it [output] is associated with an increase in NPL (0.079) for the transport, storage, and communication sector. It is possibly explained that when the output increases, demand for transportation and storage services increases, which can put a strain on the capacity of transport and storage companies to meet demand. Therefore, more debts are required to expand/improve their operations, leading to a higher likelihood of NPL in the event of an economic downturn. In addition, changes in the price level reduce NPL in manufacturing (-3.62). More precisely, changes in the past outstanding balance of NPL have increased the current NPL in primary agriculture, and household sectors. Indeed, past NPL does improve the current NPL in the mining and quarrying and education, health, and other sectors. Also, the dummy variable reduces the changes in NPL in primary agriculture, but worsens the NPL in mining and quarrying, and wholesale & retail trade, and restaurants & hotels.

Table 8 shows the sectoral estimates of NPL in Islamic banks. Primary agriculture, transport storage and communication, and other sector are the financing sectors that are most impacted by macroeconomic variables. For the primary agriculture sector, a higher unemployment rate and output result in a lower NPL, but a lower price level leads to a lower NPL in Islamic banks. The results show that the unemployment rate is found to have the highest estimated coefficient among other variables, -33.791. For the transport, storage, and communication sector, interest rate, unemployment rate, and output are statistically significant at 5%, with their estimated coefficients of 3.194, -34.899, and -1.467, respectively. For other sectors, higher interest rates, unemployment rates, and output result in a higher NPL in Islamic banks, with their estimated coefficients of 3.008, 32.485, and 0.284, respectively. For the mining and quarrying sector, changes in interest rate worsen NPL, 7.158, while a higher unemployment rate improves NPL in this Islamic financing sector (-61.815). In the wholesale & retail trade, and restaurants &

hotels, interest rate worsens in their NPL in Islamic banks, but changes in the output improve the situation.

It also is observed that the construction and education, health and other sectors are affected by changes in interest rates. Meanwhile, higher output lowers NPL in the manufacturing sector, -0.395, and a higher price level decreases NPL in the household sector (-3.361). Meanwhile, changes in the past outstanding balance of NPL increase changes in the current NPL in wholesale & retail trade, and restaurants & hotels, and the household sector. It is the opposite story that a higher past NPL does improve the current NPL in primary agriculture, construction, and other sectors. The Covid-19 dummy variable explains improvement in NPL in primary agriculture, but to increase NPL in electricity, gas, and water supply, construction, and other sectors. Surprisingly, none of the variables can explain changes in NPL in finance, insurance, and business activities in Islamic banks although at a 10% level.

4. Conclusion

This study re-examines the impact of interest rate, unemployment rate, output, and price level on NPL in Malaysia for the period 2019-2021. This study finds that: (1) Higher output improves the overall outstanding balance of NPL including for the NPL in Islamic banks; (2) The past NPL does explain reasonably the recent outstanding balance; (3) The macroeconomic variables explain the most for primary agriculture, construction, mining & quarrying, transport, storage & communication, and other sectors; and (4) The sectoral findings are varying among overall NPL, commercial banks, and Islamic banks.

Given policy implications, BNM is in a feasible position to continuously enact and improve existing or new policies to control NPL growth in Malaysia, regardless of either commercial or Islamic banks. Indeed, BNM had announced several measures to ensure the bank stability and reduce the incidence of NPL in Malaysia including a review of borrowers' creditworthiness before approving a loan. The implementation of a loan marginal policy is a good step forward in reducing the risk of default loans, where financial institutions are required to check the Central Credit Reference Information System (CCRIS) before approving loan applications.⁴ Such policy encourages financial institutions to adopt prudent lending practices and evaluate the creditworthiness of

⁴ Bank Negara Malaysia. (n.d.). CCRIS Report. Retrieved from: <https://www.bnm.gov.my/ccris>

borrowers more carefully and hence lower the default loan with the respective financing sectors. To reduce overall NPL growth across sectors, it is important to explore strategies to increase output. Implementing fiscal-related policies such as increasing government expenditure on economic development can help to reduce NPL growth. By stimulating the economy, these policies would lead to higher total output, resulting in increased firms' and households' income. As such, customers' capability to repay the loans would improve and ultimately reduce the default loans. The Malaysian government should actively implement policies such as the Malaysian Family Work Guarantee initiative (Chau, 2021) to reduce the unemployment rate by providing specific support and opportunities for job seekers.

There are a few drawbacks that could not be avoided in this study. Firstly, other potential [relevant] macroeconomic variables have been omitted in this study as well as considering some bank-specific variables (i.e. bank size, capital adequacy ratio, inefficiency ratio, leverage ratio, and so on). Hence, further study is recommended to include these variables for comprehensiveness. Secondly, for simplicity, this study ignores the micro-foundation in examining the behaviour of NPL at the macroeconomic level (aggregate). They include risk assessment and loan monitoring that worsens the NPL in the commercial banking sector of Pakistan (Khan et al., 2021). It has to consider for future study. Thirdly, instead of solely focusing on Malaysia, the inclusion of other countries' data is recommended for comparison purposes. Lastly, given the available monthly data from the official database (BNM) for three years (2019-2021), a total of small sample (36 observations) may bias the estimates. Further study should consider a longer period, indeed.

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Appendix A: Articles by Predatory Publishers (Beall's List, <https://bealllist.net/>)

Adebola, S. S., Wan Yusoff, W., & Dahalan, J. (2011). An ARDL approach to the determinants of nonperforming loans in Islamic banking system in Malaysia. <i>Kuwait Chapter of Arabian Journal of Business and Management Review</i> , 1(2), 20–30. Publisher: Hilaris Publisher (Hilaris SRL) (connected to OMICS). Data, variables and methods: Aggregate NPL of Islamic banks - 2007- 2009 (monthly) - Interest rates, producer price index, and industrial production index - Auto regressive distribution lag (ARDL) and Granger non-causality tests. Key findings: Long-run: interest rate +ve; Producer price index –ve
Janvisloo, A. M., & Muhammad, J. (2013). Non-performing loans sensitivity to macro variables: Panel evidence from Malaysian commercial banks. <i>American Journal of Economics</i> , 3, 16–21. Publisher: Scientific & Academic Publishing. Data, variables and methods: Aggregate NPL of Commercial banks - 1997-2012 - Interest rate, the net outflow of foreign direct investment (FDI), inflation, economic growth, and domestic credit growth - Dynamic panel data model/GMM estimator. Key findings: Lending interest rate +ve; FDI-net outflow –ve.
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