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Pengaruh Variabel Makroekonomi terhadap Non-Performing Loan (NPL) PT Bank Mandiri (Persero) Tbk

The Influence of Macroeconomic Variables on Non-Performing Loan (NPL) at PT Bank Mandiri (Persero) Tbk

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Abstrak

Dalam beberapa tahun terakhir, rasio *non-performing loan* (NPL) Bank Mandiri relatif menurun stabil hingga pandemi COVID-19 pada tahun 2020 kuartal I menekan perekonomian indonesia. Sejak saat itu, rasio *NPL* Bank Mandiri meningkat signifikan akibat resesi ekonomi global yang juga terjadi di indonesia pada tahun 2020 kuartal III. Penelitian ini bertujuan untuk menganalisis pengaruh variabel makroekonomi seperti produk domestik bruto, inflasi, suku bunga, dan nilai tukar terhadap *non-performing loan (NPL)* secara spesifik pada Bank Mandiri. Penelitian ini menggunakan data sekunder berupa data historis variabel terkait dan *Vector Error Correction Model (VECM)* untuk mengestimasi dinamika hubungan jangka panjang maupun jangka pendek antara variabel. Hasil dari penelitian ini menunjukan bahwa variabel makroekonomi seperti BIRATE, INF, dan LNPDB secara signifikan mempengaruhi *NPL* Bank Mandiri dalam dinamika jangka panjang, sedangkan LNKURS secara statistik signifikan dalam dinamika jangka pendek.

Abstract

In recent years, Bank Mandiri's non-performing loan (NPL) ratio has been on a relatively stable decline until the COVID-19 pandemic in 2020 quarter I put pressure on the Indonesian economy. Since then, Bank Mandiri's NPL ratio has increased significantly due to the global economic recession that also occurred in Indonesia in 2020 quarter III. This study aims to analyse the effect of macroeconomic variables such as gross domestic product, inflation, interest rates, and exchange rates on non-performing loans (NPL) specifically at Bank Mandiri. This study uses secondary data in the form of historical data of related variables and Vector Error Correction Model (VECM) to estimate the dynamics of long-term and short-term relationships between variables. The results of this study indicate that macroeconomic variables such as BIRATE, INF, and LNPDB significantly affect Bank Mandiri's NPLs in the long-run dynamics, while LNKURS is statistically significant in the short-run dynamics.

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1. Introduction

Law No. 10 of 1998 Article 1 states that a bank is a business entity that collects funds from the public in the form of deposits and distributes them to the public in the form of credit and or other forms in order to improve the lives of many people. The role of the financial sector such as banking in both developed and developing countries cannot be underestimated, bank activities direct surplus

funds to productive investments have an important role in moving the wheels of the economy and increasing the productivity of the real sector (Hussain *et al*. 2013). The good performance of this financial sector is a symbol of the prosperity and economic growth of a country or region (Pujianto et al., 2023). On the other hand, poor performance of this sector not only hampers the economic growth of a particular region, but also affects the economic order of the entire world (Khan and Senhadji 2000). In its business activities of lending to debtors, banks are faced with the risk of non-performing loans (NPL). Credit risk is the risk of loss associated with the possibility of counterparty failure to fulfil its obligations or the risk experienced by the bank if the debtor fails to repay the loan (Blaschke *et al*. 2001).

Non-performing loans (NPLs) have indeed been a focal point of research globally over the past few decades, with empirical studies indicating their significant role in banking failures and crises. Research has shown that NPLs can have a substantial impact on the profitability of banks, as evidenced by studies on Greek banks revealing a negative effect of NPLs on net profit before tax (Diakomihalis and Economakou 2023). Furthermore, a systematic literature review spanning from 1987 to 2022 highlights the attention policymakers have given to NPLs due to their determinants, including macroeconomic, bank-specific, and industry factors (Alnabulsi *et al*. 2023**)].** Additionally, studies on Indonesian banks have demonstrated that changes in macroeconomic conditions asymmetrically affect NPLs, with Islamic banks showing greater exposure to these variables (Fakhrunnas et al, 2023) . These findings collectively underscore the critical importance of managing NPLs to ensure the stability and resilience of the banking sector.

Bank Mandiri is one of the largest and leading state-owned banks in Indonesia. Its wide reach and large customer base make it an important player in the Indonesian banking sector. Bank Mandiri is involved in a wide range of banking services including corporate banking, retail banking, treasury and international banking. This diversity can provide a comprehensive perspective of macroeconomic influences affecting various sectors. Bank Mandiri, like other public companies, tends to have a higher level of transparency and disclosure compared to smaller banks or private banks. The availability of transparent historical data allows researchers to conduct a thorough analysis of the influence of macroeconomic factors on NPLs. As one of the major players in the Indonesian banking sector, Bank Mandiri is influenced by the policies and regulations set by Bank Indonesia as the central bank and the Financial Services Authority. This can provide a clear link between macroeconomic conditions and banking performance. Due to its size and prominence, Bank Mandiri's performance could have wider implications for the stability of Indonesia's financial system as a whole. Studying NPL trends in relation to macroeconomic conditions can provide insights into systemic risk and vulnerability.

Bank Mandiri's non-performing loan (NPL) ratio declined relatively steadily until the COVID-19 pandemic in 2020 quarter I put pressure on the Indonesian economy. Since then, Bank Mandiri's NPL ratio has increased significantly due to the global economic recession that also occurred in Indonesia in 2020 quarter III which can be seen in Figure 1.

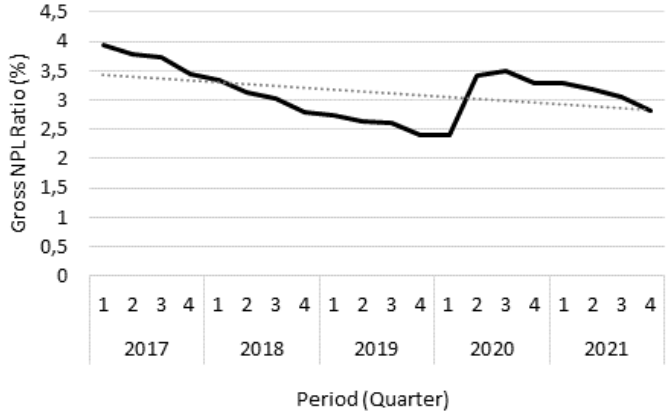

Figure 1. Bank Mandiri Non-Performing Loan (NPL) Chart
Source: Data Processed (2023)

This study aims to analyse the influence of macroeconomics including gross domestic product, inflation, interest rates, and exchange rates on non-performing loans (NPL) specifically at Bank Mandiri. This study uses secondary data in the form of historical data of related variables and Vector Error Correction Model (VECM) to estimate the model of long-term and short-term relationships between related variables. This research is important to conduct because the results of this study can provide in-depth insights that can be used to develop effective risk management strategies to mitigate the risk of non-performing loans. The difference between this research and previous research lies in the data and methods used, previous research focuses more on evaluating the entire issuer in one sector, but not specifically on one company, while in this study reviewing more deeply and specifically about NPLs in one bank, namely Bank Mandiri which was previously able to reduce NPLs.

2. Method

The analysis method used in this research is descriptive and quantitative analysis method using Vector Error Correction Model (VECM) approach. The type of data used in this study is quantitative secondary data in the form of quarterly time series with a range of 2012 quarter I to 2021 quarter IV. The data sources in this study come from the Central Bureau of Statistics, Bank Mandiri, and Bank Indonesia. The data used are Bank Mandiri Non-Performing Loan (NPL), Inflation, BI Rate, Gross Domestic Product, and Exchange Rate (KURS). This research was conducted within 7 months starting in October 2022 to April 2023 at IPB University. The variables and sources.

Table 1. Research Variables and Data Sources

Variable	Symbol	Data Sources
Non-Performing Loan	NPL	Bank Mandiri
BI Rate	BIRATE	Bank Indonesia
Inflation	INF	Badan Pusat Statistik
Gross Domestic Product	PDB	Badan Pusat Statistik
Exchange Rate	KURS	Badan Pusat Statistik

Data processing and analysis were carried out by stationarity test, determining the optimum lag, stability test, and cointegration test to ensure that the data used in the study met the requirements for estimating the vector error correction model (VECM). After all the requirements are met, VECM estimation, granger causality test, impulse response function (IRF), and variance decomposition (VD) are then performed using Eviews 12 Student Version software. Descriptive analysis was conducted to describe how BI Rate, inflation, gross domestic product, and exchange rate affect the short and long term non-performing loan (NPL) of PT Bank Mandiri (Persero) Tbk and the causality relationship between related variables.

3. Results and Discussion

3.1. Stationarity Test

Stationarity test is a statistical test used to determine whether a time series data is stationary or not. The stationarity test method used in this study is the Augmented Dickey-Fuller Test with a 90% confidence level. The results of the Augmented Dickey-Fuller test level can be seen in Table 2.

Table 2. Level Augmented Dickey-Fuller Test Results

Variable	ADF Statistic	MacKinnon Critical Value			Prob.	res.
		1%	5%	10%		
NPL	-1.224013	-3.614045	-2.938987	-2.607932	0.6543	
BIRATE	-1.545861	-3.615588	-2.941145	-2.609066	0.4999	Non-stationary
INF	-0.972878	-3.632900	-2.948404	-2.612874	0.7521	Non-stationary
LNPDB	-1.481919	-3.621023	-2.943427	-2.610263	0.5315	Non-stationary

LNKURS	-2.467804	-3.626784	-2.945842	-2.611531	0.1315	Non-stationary

Based on the Augmented Dickey-Fuller test results at the level in Table 3, it shows that all variables in the study are not stationary at the level. To ensure stationarity, researchers conducted the ADF Test at the First Difference level. The results of the Augmented Dickey-Fuller Test at the First Difference level can be seen in Table 3.

Table 3. First Difference Augmented Dickey-Fuller Test Results

Variable	ADF Statistic	Mac Kinnon Critical Value			Prob.	res.
		1%	5%	10%		
NPL	-4.806471	-3.615588	-2.941145	-2.609066	0.0004	stationary
BIRATE	-2.935684	-3.615588	-2.941145	-2.609066	0.0506	stationary
INF	-6.914965	-3.632900	-2.948404	-2.612874	0.0000	stationary
LNPDB	-10.27913	-3.621023	-2.943427	-2.610263	0.0000	stationary
LNKURS	-3.309947	-3.632900	-2.948404	-2.612874	0.0220	stationary

Based on the Augmented Dickey-Fuller test results at the first difference level in Table 3, it shows that all variables in the study are stationary at the first difference level. Stationarity at the first difference level means that the statistical properties of the data, such as mean and variance, remain constant over time after differencing the data once. This is important for VECM estimation, as VECM assumes that the variables are integrated at the first-order level, denoted as I(1). First-order integration means that differencing the data is required to achieve stationarity.

3.2. Determination of Optimum Lag

The optimal lag will be a reference to the number of lags used in the model to see short-term dynamics. This study uses Akaike's Information Criterion (AIC) to determine the optimal lag. The results of the VAR Lag Order Selection Criteria can be seen in Table 4.

Table 4. VAR Lag Order Selection Criteria Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	452.2427	NA	1.11E-17	-24.84682	-24.62689	-24.77006
1	593.2745	235.05300	1.79E-20	-31.29303	-29.97343	-30.83246
2	649.4537	78.02660	3.46E-21	-33.02521	-30.60594*	-32.18082
3	688.3579	43.22689*	2.01E-21	-33.79766	-30.27873	-32.56946
4	730.2178	34.88328	1.31e-21*	-34.73432*	-30.11573	-33.12231*

Based on the results of the VAR Lag Order Selection Criteria in Table 4, Akaike's Information Criterion (AIC) shows that the optimum lag selected is 4 lags.

3.3. Stability Test

In VECM, the VAR model is transformed into a stationary differences model of the variables. This transformation is done to make the model suitable for long-run analysis. However, this transformation results in unit roots in the model which can cause problems in regression. To overcome this problem, VECM provides restrictions on the parameters in the VAR model. VAR Stability Condition Check is one of the restrictions that shows how the characteristics of the AR lag polynomial and its modulus. Performing a VAR model stability check before estimating a VECM is an important step to ensure that the model can accurately represent the relationship between variables and provide reliable results. The results of the VAR Stability Condition Check can be seen in Table 5.

Table 5. VAR Stability Condition Check Results

Root	Modulus
0.929466	0.929466
0.096258 + 0.922150i	0.927160
0.096258 - 0.922150i	0.927160
0.836131 - 0.372350i	0.915292
0.836131 + 0.372350i	0.915292
-0.004818 - 0.877295i	0.877309
-0.004818 - 0.877295i	0.877309
0.832694 - 0.130447i	0.842850
0.832694 + 0.130447i	0.842850
-0.627830 + 0.476194i	0.787992
-0.627830 - 0.476194i	0.787992
0.412351 + 0.651989i	0.771442
0.412351 - 0.651989i	0.771442
-0.743653	0.743653
-0.431736 - 0.557593i	0.705200
-0.431736 + 0.557593i	0.705200
-0.187346 + 0.375772i	0.419885
-0.187346 - 0.375772i	0.419885
0.083242 + 0.299043i	0.310412
0.083242 - 0.299043i	0.310412

Based on the results of the VAR Stability Condition Check in Table 5, all roots have a modulus value smaller than 1. So it can be concluded that the VAR system in this study is in stable condition.

3.4. Cointegration Test

The cointegration test aims to determine whether there is a long-run relationship between two or more time series variables. Conducting a cointegration test before estimating VECM is very important because VECM is specifically designed to model and analyse a set of variables that have a long-term relationship with each other. Cointegration testing in this study uses the Johansen Cointegration Test method with a 95% confidence level. The indicators used are Trace Statistic and Maximum Eigenvalue. The results of the Unrestricted Cointegration Rank Test (Trace) can be seen in Table 6.

Table 6. Unrestricted Cointegration Test Results (Trace)

Hypothesized No. of CE(S)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.756434885	119.97259	69.8188875	0.0000
At Most 1*	0.58458466	70.53961	47.8561272	0.0001
At Most 2*	0.504947905	39.792934	29.7970733	0.0026
At Most 3	0.310370332	15.184704	15.4947129	0.0556
At Most 4	0.060350324	2.178686	3.8414655	0.1399

(*) indicates rejection of the hypothesis at the 0.05 level

Based on the Unrestricted Cointegration Rank Test (Trace) results in Table 6, it shows the rejection of the hypothesis of no cointegration equation, at most 1 cointegration equation, and at most 2 cointegration equations. The conclusion is that there are at most 3 cointegrating equations or 4 cointegrating equations. The results of the Johansen Cointegration Test (Maximum Eigenvalue) can be seen in Table 7.

Table 7. Johansen Cointegration Test Results (Maximum Eigenvalue)

Hypothesized No. of CE(S)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.756434885	49.432984	33.8768666	0.0003
At Most 1*	0.58458466	30.746675	27.5843378	0.0190
At Most 2*	0.504947905	24.60823	21.1316163	0.0155
At Most 3	0.310370332	13.006019	14.2646002	0.0783
At Most 4	0.060350324	2.178686	3.8414655	0.1399

(*) indicates rejection of the hypothesis at the 0.05 level

Based on the Unrestricted Cointegration Rank Test (Maximum Eigenvalue) results in Table 7, it shows the rejection of the hypothesis of no cointegration equation, at most 1 cointegration equation, and at most 2 cointegration equations. The conclusion is that there are at most 3 cointegrating equations or 4 cointegrating equations. This ensures the existence of a long-run equilibrium relationship, which is a basic assumption in using VECM.

3.5. Vector Error Correction Model (VECM) Estimation

Vector Error Correction Model (VECM) estimation is conducted to analyse the short-term and long-term dynamics between variables. The results of the Vector Error Correction Model (VECM) estimation can be seen in Table 9.

Table 8. Vector Error Correction Model (VECM) Estimation Results

Cointegrating Equation 1		
Variable	coefficient	t-statistic
NPL(-1)	1.000000	
BIRATE(-1)	3.828809	5.65509
INF(-1)	17.13469	-11.0383
LNPDB(-1)	-0.376052	-2.64739
LNKURS(-1)	-0.246530	-1.21170
C	7.797961	
Error Correction		
Variable	coefficient	t-statistic
CointEq1	0.014611	1.09773
D(NPL(-1))	0.091236	0.41337
D(NPL(-2))	-0.113794	-0.46099
D(NPL(-3))	0.215131473	0.9862
D(BIRATE(-1))	-0.231962	-1.10791
D(BIRATE(-2))	0.339948934	1.45493
D(BIRATE(-3))	-0.326188106	-1.55898
D(INF(-1))	0.187934	1.02749
D(INF(-2))	0.048790023	0.39145
D(INF(-3))	-0.004503006	-0.0652
D(LNPDB(-1))	-0.021874	-0.64334
D(LNPBD(-2))	-0.0379234	-1.26396
D(LNPBD(-3))	0.026263334	0.81373
D(LNKURS(-1))	0.046982	2.18627
D(LNKURS(-2))	0.000466326	0.0823
D(LNKURS(-3))	0.033138082	1.72643
C	9.5E-05	0.09507

Based on the VECM estimation results in Table 8, the error correction term (long-term model) is obtained:

$$ECT_{t-1} = 1.000NPL_{t-1} + 3.829BIRATE_{t-1} + 17.135INF_{t-1} - 0.376LNPDB_{t-1} - 0.247LNKURS_{t-1} + 7.798 \quad (1)$$

And the VECM estimation equation with NPL as the target variable:

$$\begin{aligned}\Delta NPL_t = {} & 0.0146ECT_{t-1} + 0.091\Delta NPL_{t-1} - 0.114\Delta NPL_{t-2} + 0.215\Delta NPL_{t-3} - 0.232\Delta BIRATE_{t-1} \\ & + 0.340\Delta BIRATE_{t-2} - 0.326\Delta BIRATE_{t-3} + 0.188\Delta INF_{t-1} + 0.049\Delta INF_{t-2} \\ & - 0.022\Delta LNPDB_{t-1} - 0.038\Delta LNPDB_{t-2} + 0.026\Delta LNPDB_{t-3} + 0.047\Delta LNKURS_{t-1} \\ & + 0.0005\Delta LNKURS_{t-2} + 0.033\Delta LNKURS_{t-3} + 0.000095 \quad (2)\end{aligned}$$

In the long-run dynamics, the variables BIRATE(-1), INF(-1), and LNPDB(-1) have a significant effect on NPL as the target variable. The long-run significance means that changes in interest rates, inflation and gross domestic product are expected to have a long-run impact on non-performing loans at Bank Mandiri. This suggests that the relationship is not just a short-term fluctuation, but is likely to persist over time.

In the short-term dynamics, the variables LNKURS(-1) and LNKURS(-3) have a significant effect on NPL as the target variable. This suggests that changes in exchange rates can have a significant and measurable impact on NPLs in a relatively short period of time.

Information on the direction of the relationship is provided by the sign (positive or negative) of the coefficient of the relevant variable. A positive sign (+) of the BIRATE(-1) coefficient indicates that an increase in interest rates is associated with an increase in non-performing loans. A positive sign (+) of the INF(-1) coefficient indicates that an increase in inflation is associated with an increase in non-performing loans. The negative sign (-) of the coefficient LNPDB(-1) indicates that an increase in gross domestic product is associated with a decrease in non-performing loans. The positive sign (+) of the coefficients LNKURS(-1) and LNKURS(-3) indicates that a weakening exchange rate is associated with an increase in non-performing loans.

Overall, these findings provide valuable information for Bank Mandiri in understanding how macroeconomic movements can affect the risk profile of its loan portfolio, and can be taken into consideration in making risk management decisions and strategies.

Furthermore, several diagnostic tests such as serial correlation LM test, residual normality test, and white heteroscedasticity test are conducted to validate the assumptions of the VECM and to assess the reliability of the model estimates. If any of these tests indicate a potential problem, it is important to investigate further and potentially make adjustments to the model or data. To test whether there is an autocorrelation problem in the VECM model estimation, the Autocorrelation LM Test is conducted. The results of the VEC Residual Serial Correlation LM Test can be seen in Table 9.

Table 9. VEC Residual Serial Correlation LM Test Results

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-Stat	df	Prob.
1	26.0766	25	0.40352	1.05434	(25, 38.7)	0.43213
2	30.3085	25	0.21294	1.2833	(25, 38.7)	0.23791
3	21.6448	25	0.65616	0.83441	(25, 38.7)	0.67911
4	22.1359	25	0.62788	0.85783	(25, 38.7)	0.65194

Based on the VEC Residual Serial Correlation LM Test results in Table 9, the null hypothesis that there is no serial correlation at lag h is accepted. So there is no autocorrelation problem in the model.

The Jarque-Bera Test is conducted to see if a normal distribution can be ascertained in the error terms. The results of the VEC Residual Normality Test can be seen in Table 10.

Table 10. VEC Residual Normality Test Results

Component	Jarque-Bera	df	Prob.
1	11.1657	2	0.00376
2	0.05609	2	0.97235
3	1.92304	2	0.38231
4	3.84098	2	0.14653
5	0.13082	2	0.93668
Joint	17.1166	10	0.07182

Based on the results of the VEC Residual Normality Test in Table 10, the combined probability value is more than 5%. Then the normal distribution can be confirmed at the 95% confidence level. Then, the White heteroskedasticity test is conducted for variance problems (White 1980). The results of the White Heteroskedasticity Test (No Cross Term) can be seen in Table 11.

Table 11. White Heteroskedasticity Test Results (No Cross Term)

Chi-sq	Df	Prob.
491.008	480	0.35417

Based on the results of the White Heteroskedasticity Test in Table 11, it shows that the probability value is greater than 5%, so there is no variance problem with a 95% confidence level. From the results of the model diagnostics carried out, it can be concluded that the results of the VECM estimation are reliable models and adjustments to the model do not need to be made.

3.6. Granger Causality Test

The Vector Error Correction (VEC) Granger Causality Test is a statistical test used in time series analysis to determine whether one time series can predict another. This test is an extension of the granger causality test, which was originally designed for stationary time series data. Unlike the actual Granger causality test, the VEC Granger Causality Test can identify causality relationships in non-stationary time series that have long-run equilibrium relationships. The results of the VEC Granger Causality Test can be seen in Table 12.

Table 12. VEC Granger Causality Test Results

Dependent Variable : D(NPL)			
Exclude	Chi-sq	df	Prob.
D(BIRATE)	3.09238	3	0.3776
D(INF)	2.46465	3	0.48171
D(LNKURS)	6.34399	3	0.09602
D(LNPDB)	4.08034	3	0.25292
All	14.1266	12	0.2927
Dependent Variable : D(BIRATE)			
Exclude	Chi-sq	df	Prob.
D(NPL)	3.29457	3	0.3484
D(INF)	0.87352	3	0.83181
D(LNKURS)	2.11582	3	0.54872
D(LNPDB)	0.71841	3	0.86886
All	9.61399	12	0.64978
Dependent Variable : D(INF)			
Exclude	Chi-sq	df	Prob.
D(NPL)	14.7867	3	0.00201
D(BIRATE)	3.37172	3	0.33778

D(LNKURS)	10.5299	3	0.01456
D(LNPDB)	1.37614	3	0.71114
All	31.6233	12	0.00158
Dependent Variable : D(LNPDB)			
Exclude	Chi-sq	df	Prob.
D(NPL)	2.13085	3	0.5457
D(BIRATE)	0.59503	3	0.89757
D(INF)	2.3159	3	0.50948
D(LNKURS)	1.60431	3	0.65841
All	8.69144	12	0.72904
Dependent Variable : D(LNKURS)			
Exclude	Chi-sq	df	Prob.
D(NPL)	7.63966	3	0.05408
D(BIRATE)	12.5344	3	0.00576
D(INF)	12.8283	3	0.00502
D(LNPDB)	8.81667	3	0.03183
All	33.7102	12	0.00075

Based on the VEC Granger Causality test results in Table 13, it shows a bilateral relationship between D(LNKURS) and D(NPL), a one-way relationship of D(NPL) to D(INF), a bilateral relationship between D(INF) and D(LNKURS), a one-way relationship of D(BIRATE) to D(LNKURS), and a one-way relationship of D(LNPDB) to D(LNKURS).

This means that the past value of the exchange rate provides useful information to predict the current and future value of NPLs. In other words, there is a cause-and-effect relationship from exchange rates to NPLs in a statistical sense. This result may imply that changes in exchange rates can affect the finances of borrowers, which in turn affects their ability to repay loans. For example, if the currency depreciates, this may lead to higher import costs, affecting their profitability and ability to repay, potentially leading to an increase in bad debts. On the other hand, the variables of inflation, interest rates, and GDP granger cause the exchange rate variable. Inflation, interest rate, and GDP variables do not have a direct relationship to NPL, but have a causal relationship to the exchange rate which has a causal relationship to NPL. This finding can provide a meaningful picture for Bank Mandiri, where Bank Mandiri must pay close attention to exchange rate movements. In addition to the exchange rate having a causal relationship with NPLs, the exchange rate is also the mouth of the causal relationship of other variables.

3.7. Impulse Response Function (IRF)

The Impulse Response Function (IRF) test provides an overview of the dynamic response of a variable to a shock from another variable over time in the system. When a system is in long-run equilibrium (cointegrated), any deviation from this equilibrium is considered a shock. This shock triggers an adjustment process to return the system to equilibrium. The IRF results can be seen in Figure 2.

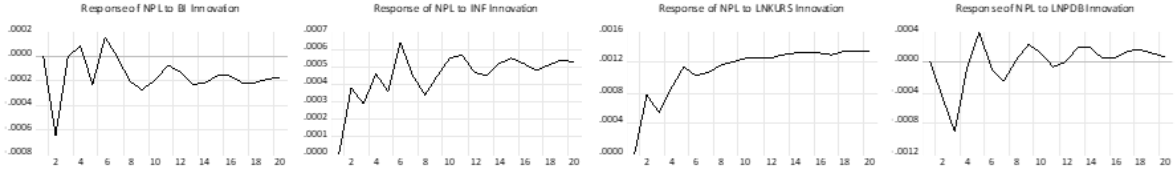

Figure 2. Impulse Response Function of NPLs to Macroeconomic Variables

Based on Figure 5, NPL responds positively (+) to INF and LNKURS shocks in both the short and long run. The positive (+) response of NPL means that when inflation or exchange rate experiences a shock (e.g. unexpected increase), it will lead to an increase in non-performing loans.

High inflation can lead to an increase in interest rates. This can make it harder for borrowers to repay their loans, potentially increasing non-performing loans. Inflation can also reduce the real value of assets, making it difficult for borrowers to recover their investment, potentially increasing default rates. Significant changes in exchange rates can affect borrowers involved in international trade. Currency depreciation can affect the profitability of borrowers, potentially leading to an increase in bad debts

On the other hand, NPLs provide an asymmetric response to BIRATE and LNPDB shocks in both the short and long term. This asymmetric response means that the response of NPLs to shocks on BIRATE and LNPDB is not uniform in both the long and short term.

A shock to BIRATE can be associated with an increase in interest rates. Higher interest rates can increase borrowing costs, potentially causing financial stress for borrowers. This may lead to an increase in bad debts. Higher interest rates may also encourage tighter lending, leading to better credit quality. This may lead to a decrease in NPLs due to a stricter approach to lending

A shock to LNPDB can be associated with economic expansion. This can occur due to various factors such as increased consumption, investment, or government spending. Economic expansion can sometimes lead to increased lending activity, including riskier loans. This may lead to a higher probability of bad debts. On the other hand, economic growth can lead to improved business conditions, higher income levels, and better repayment capacity of borrowers. This may lead to a decrease in non-performing loans.

3.8. Variance Decomposition (VD)

Variance Decomposition analysis is a statistical method used to decompose the total variance in a set of data into different components. This method is used to understand the relative contribution of various factors to the overall variability in a system. In VECM analysis, variance decomposition decomposes the forecast error variance of each variable into the shock of the variable itself and the shock of other variables in the system. This helps to understand how much of the variation in each variable is due to the shock of the variable itself compared to the shock from other variables. By analysing the VD, researchers can gain insight into which variables have a stronger influence on the dynamics of the system. The results of Variance Decomposition of NPL can be seen in Table 13.

Table 13. Variance Decomposition of NPL Results

Variance Decomposition of NPL						
Period	S.E.	NPL	BIRATE	INF	LNPDB	LNKURS
1	0.002849	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.004919	94.39503	1.741997	0.581753	0.902592	2.378629
3	0.006651	94.15994	0.953108	0.501499	2.417034	1.968421
4	0.008464	95.03853	0.596979	0.595149	1.502287	2.267056
5	0.010064	94.91322	0.480402	0.548352	1.211338	2.846689
6	0.011582	95.04994	0.379535	0.716981	1.211338	2.933630
7	0.012977	95.24696	0.302344	0.689473	0.767661	2.993564
8	0.014317	95.37752	0.270062	0.689473	0.631056	3.099700
9	0.015694	95.42452	0.256890	0.596706	0.547829	3.174055
10	0.017018	95.44158	0.234047	0.609691	0.547829	3.244535

Based on Table 13, it shows that the contribution of NPL itself is relatively larger than the other variables (BIRATE, INF, LNPDB, LNKURS) in the system. This could mean that interest rates, inflation, GDP, and exchange rates have a relatively smaller direct impact on NPLs compared to the dynamics of NPLs themselves. This finding suggests the possibility that there are specific factors or characteristics associated with NPLs that are not adequately captured by the variables in the model.

These factors may contribute significantly to NPLs. This result may have implications for policy intervention. If the level of NPLs is largely driven by its own dynamics, it may suggest that targeted actions to address NPLs directly would be more effective than focusing on broader economic variables.

3.9. Managerial Implications

Based on the results of this study, managerial implications can be formulated using the POAC (Planning, Organising, Actuating, and Controlling) management function approach in the context of risk management.

Planning, planning managerial implications can begin with the identification of problems from the findings obtained from the research results. The findings in this study can be seen in Table 14.

Table 14. Key Findings from the research

Method	Key Findings
VECM	Interest rate has a positive (+) long-run relationship with NPLs
	Inflation has a directional positive (+) effect in the long-run relationship on NPLs
	Gross domestic product has a negative effect (-) in the long-run relationship on NPLs
	Exchange rate has a directional effect (+) in the short-run relationship on NPLs
Granger Causality Test	The exchange rate has a causal relationship with NPLs and is the mouth of the causal relationship of other macroeconomic factors.
IRF	NPL gives positive response direction (+) to the shock on inflation
	NPL gives positive response direction (+) to the shock on the exchange rate
VD	As the contribution of NPLs themselves is relatively larger than other variables, targeted actions to address NPLs directly will be more effective than focusing on broader economic variables.

Based on Table 14, in general the findings in this study indicate credit risk. Credit risk is the risk due to the failure of other parties to fulfil obligations to the Bank, in this finding other parties are distracted by external macroeconomic conditions. Therefore, in accordance with OJK's mandate, Bank Mandiri is expected to have adequate policies and strategies in mitigating the risks identified in this study.

Organizing, Bank Mandiri has organised its Risk Management Framework in the Bank Mandiri Risk Governance Structure which includes three main parts, namely Risk Oversight, Risk Policy and Management, and Risk Identification, Measurement, Mitigation, and Control. The three main parts are supported by the Audit Work Unit and Independent Assurer to ensure the effectiveness of their implementation. Risk management at Bank Mandiri within the scope of the findings of this research can be the function, duties, and responsibilities of the Credit Portfolio Risk Group work unit.

Actuating, the model and results used in this study can be used by Bank Mandiri as an approach to estimate Basel II risk parameters for the application of the Internal Rating Based Approach (Probability of Default/PD, Loss Given Default/LGD, Exposure at Default/EAD). The estimation of these parameters will affect the amount of capital that Bank Mandiri must hold to cover potential losses. Ultimately, the results of this research will assist the Enterprise Risk Management (ERM) framework by mitigating risk through capital reserves. The results of this research can also assist the Credit Portfolio Risk Group in carrying out portfolio management, where the Credit Portfolio Risk Group can provide recommendations on which business segments are less affected by changes in external macroeconomic conditions in order to optimise Bank Mandiri's portfolio.

Controlling, Bank Mandiri may supervise model validation and advise on model development/modification to ensure the quality and reliability of the research is academically and business-acceptable. Bank Mandiri may periodically calibrate and revalidate the risk model by an independent Model Risk Validator unit to maintain the reliability and validity of the model and fulfil the requirements of the supervisory regulations.

4. Conclusion

The results of this study indicate that based on the results of VECM estimation, in the long term BI Rate and Inflation have a significant positive effect on Bank Mandiri's NPL, GDP has a significant negative effect on NPL, while the Exchange Rate has no significant effect on Bank Mandiri's NPL. In the short term, the exchange rate has a significant positive effect on Bank Mandiri's NPL, while BI Rate, Inflation, and GDP have no significant effect on Bank Mandiri's NPL.

Based on the results of the VEC Granger Causality Test shows a bilateral relationship between the exchange rate and NPL, a one-way relationship of NPL to Inflation, a bilateral relationship between Inflation and the exchange rate, a one-way relationship of BI Rate to the exchange rate, and a one-way relationship of GDP to the exchange rate.

Based on the results of the Impulse Response Function (IRF) analysis shows that Bank Mandiri's NPL responds positively to shocks to Inflation and Exchange Rates, while Bank Mandiri's NPL responds fluctuatingly to shocks to GDP and BI Rate.

Based on the results of the Variance Decomposition (VD) analysis, the contribution to the diversity of NPLs is dominated by the contribution of the NPL variable itself. This suggests that the variability in Bank Mandiri's NPLs is largely due to internal factors or factors specific to the loans themselves, rather than external macroeconomic conditions.

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