

# Capital Adequacy Ratio Modeling

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**Abstracts:** Intends to analyze the determinants of BOPO and its implications for CAR. This is important for banking management guidelines and society in general. The results are expected to find whether BOPO can mediate against CAR. Make a formula to maximize CAR value through BOPO as an indicator of efficiency and intervening variable. The object is a banking company on the Indonesia Stock Exchange (IDX) with a sample of 20 companies, a span of 8 years to form the 160 Observations data panel. There are two research models (Determinants of BOPO and Implications for CAR) which are integrated into one model using Eviews 9 software. In both analysis, a model selection test is required through the Chow Test, Hausman Test, and Lagrange Multiplier Test (LM). The results of the first model, an increase in INF, FS has an impact on a decrease in BOPO (efficient), results that are contrary to theory, LDR is positively correlated, NPL is negatively correlated, KI. The results of the second model, INF, LDR have a significant negative correlation with CAR, while KI, FS, NPL, and BOPO are significant according to theory. Significant BOPO intervening variables described by INFL, FS. It is hoped that it can help bank management in Indonesia to manage efficiency which has implications for CAR, considering that a bank is a place for people to secure their financial assets and trust institutions. Formulate a model for increasing CAR through BOPO efficiency as an intervening variable

**Keywords:** Inflation (INF), Institutional Ownership (KI), Firm Size (FS), Loan to Deposit Ratio (LDR), Non-Performing Loans (NPLs), Bank Efficiency (BOPO), Capital Adequacy Ratio (CAR).

## 1. INTRODUCTION

The banking industry is an institution that has a major role as a driver of the national economy. With this role, the bank is expected to be able to maintain monetary stability. The role of the bank is to regulate the circulation of money circulating in society through its role as a financial intermediary. Therefore the bank also acts as a provider of working capital for business units in carrying out the production function of the business unit. The purpose of this research is to provide education and guidance to the public in general and banking management in particular, that to achieve a good Capital Adequacy Ratio (CAR) efficiency must be carried out, where the smaller the BOPO value, the more efficient the management of bank companies.

Distribution of banking funds in general based on data obtained from the Financial Services Authority (OJK) in 2020 was the largest in the household sector at 24.08%, then in the wholesale and retail trade sector 17.19%, then in the manufacturing industry sector 16.3 % , agriculture and forestry sector 7.03%, construction sector 6.87%, real estate sector 4.74%, transportation, warehousing and communication sector 4.86%, other non-business sector 4.15%, financial intermediary sector 3.95%, the electricity, gas and water sector 3.08 % , the mining and quarrying sector 2.27%, the accommodation and PMM sector 2.12%, the community services sector 1.63%, the rest are other sectors such as the fisheries, government administration sector, education service sector, health sector and social activities, individual service sector, international agency sector.

The large distribution of credit distribution is in the household sector so that this sector will have more impact if there is a failure in banking management, on the other hand this sector dominates the large number of layers of society. For this reason, it is deemed necessary to know the determinants of bank efficiency which have implications for banking health.

The existence of several contradictory research results has encouraged researchers to do this by using different samples and periods as well as the analytical tools they use. Among the results of their research, the Bank Efficiency variable has a significant and positive correlation. Besides that, there are also results that have a significant effect and are negatively correlated, there are also results that are much different, which have an insignificant effect.

Given the trend of increasing demand for funds for the 2013-2020 period by the public from banking institutions in the form of lending, while on the other hand the number of bank company offices has actually decreased, so it is necessary to conduct research on the level at which banking companies are managed in Indonesia. Does this contradiction mean that bank management seeks efficiency by using the BOPO variable in the hope that there will be an increase in the Capital Adequacy Ratio (CAR)?

Referring to Sukmana (2015), the CAR ratio is useful in managing the risk of loss of productive assets, especially those originating from financing risks. Provision of sufficient capital will increase bank reserves so as to guarantee the protection of the banking business from potential risks, in Puspitasari N., Jururi S., Hidayat S.E, (2023). It is considered important to conduct research on CAR.

Apart from CAR, the level of banking operational efficiency is also very important, a study by Kolapo et al., (2012) in Hameed, T. M., Bouabid, A. (2023), the importance of the level of operational efficiency of the Algerian Bay Bank AGB and its management of liquidity risk so that it is necessary to measure it.

## 2. LITERATURE REVIEW

In the Agency Theory, Jensen and Meckling (1976), that financial reports made with accounting numbers are expected to minimize conflicts between interested parties. Based on the financial statements reported by the agent as accountability for their performance, the principal can assess, measure and monitor the extent to which the agent is working to improve his welfare as well as the basis for providing compensation to the agent.

Jensen and Warner (1988) argue that the ownership structure (Corporate Ownership) of a corporation will determine the characteristics agency problems (the Agency problems) so that it will map out the division between power and supervision in a corporate entity. La Porta, RF et al. (1999) examined Corporate Ownership in several countries around the world.

Then also Mahadwartha (2004) who examined supervision and engagement based on Internal Institutional Ownership. With the non-effective operation of control mechanisms in various developing countries, the presence of majority owners is expected to act as an alternative governance mechanism in reducing the negative impact caused by agency problems. There are incentives for company owners who control a large number of shares to monitor the investments made intensively, with the assumption that the level of control exercised will increase according to the size of the portion of shares owned.

Research ever conducted by Assaf et al. (2019), they use macroeconomic exogeneous variables, one of which is inflation with the results having a significant effect with a positive correlation to bank efficiency. The results of the same research were also carried out by Christianti (2020). In Diallo (2017) different results are produced that inflation has a significant effect with a positive correlation. The same results were also carried out by Mirzaei & Moore (2017), but there were very different results from the results of Hidayat & Prasetyo's research (2017) with the result that inflation had no significant effect on bank efficiency.

Apart from the exogeneous variables of inflation, Arouri et al (2011) stated that institutional ownership has no significant effect on bank efficiency and Partovi & Matousek (2018). Likewise, in Najoan (2016). In contrast to Sakawa & Watanabel (2020), Institutional Shareholder Ownership has a significant effect with a positive correlation to Bank Efficiency. The same results were carried out by Jamil & Refi (2020). Previously carried out by Eliana & Wahyuni (2019) that Institutional Ownership has a significant effect with a negative correlation to Bank Efficiency.

Regarding Firm Size, Girardone (2004) in his research found that Firm Size has no significant effect on Bank Efficiency. But in Bokpin (2013), Firm Size has a significant effect with a positive correlation to Bank Efficiency and the same results are also in Khalil (2017). In Haryanto (2018) that Firm Size has a significant effect with a negative correlation to Bank Efficiency.

Another exogeneous variable is the Loan to Deposit Ratio. In Odunga, et al (2013) results that the Loan to Deposit Ratio has a significant effect with a positive correlation to Bank Efficiency. The same results were also obtained by Amin & Mohamad (2017) and also by Ramly & Hakim (2017). But conversely by Perwitaningtyas & Pangestuti (2015), also by Lemonakis et al (2018), the Loan to Deposit Ratio has no significant effect on bank efficiency.

The exogeneous variable of Non-Performing Loans (NPL) in Karim, et al. (2010) results that Non-Performing Loans have a significant effect with a negative correlation to Bank Efficiency. The results are the same in Partovi & Matousek (2018), also by Istinfarani & Azmi (2020). There are results with different correlations in Zamore, et al (2021), that Non-Performing Loans have a significant effect with a positive correlation to Bank Efficiency. Besides that, in Subandi & Ghozali (2017) that Non-Performing Loans have no significant effect on bank efficiency.

In the second research model, Exogenous variable Inflation, in Aktas, et al (2015), that inflation has a significant effect with a significant positive correlation to the Capital Adequacy Ratio (CAR). Similar results in Delbariragheb & Zadeh (2015), Kalifa & Bektaş (2017), also in Dao & Nguyen (2020). However, different results occur in Abiodun, et al (2020) that inflation has no significant effect on the Capital Adequacy Ratio, also in Djazuli & Candra (2020).

Another variable besides the Exogenous variable Inflation in the second research model is Institutional Ownership. In Roth & Saporoschenko (2001), Institutional Ownership has a significant and negatively correlated effect on CAR. The results are the same in Chou & Lin (2011), Jamil, et al (2015), but the results are different in Delbariragheb & Zadeh (2015) that Institutional Ownership has a significant and positive correlation with CAR. Another different result is in Shehzad, et al (2010) that Institutional Ownership has no significant effect on CAR.

The next exogenous variable in the second research model is Firm Size. In Shirley et al (2010) that Firm Size has a significant and positive correlation with CAR, as well as the same results in Magdalena, et al (2017). But there are different results in Bateni et al (2014) that Firm Size has a significant effect and has a negative correlation with CAR, as well as in Dewi & Yadnya (2018), Dao & Nguyen, (2020).

Ansary & Hafez (2015) in their research results that the Loan to Deposit Ratio (LDR) has a significant and positive correlation with CAR, also in Andini & Yunita (2015), Yokoyama & Mahardika (2019), Rianto & Salim (2020). But the results are different in Putri & Dana (2018) that the Loan to Deposit Ratio (LDR) has no significant effect on CAR.

Non-Performing Loan (NPL) as an exogenous variable in the second research model, in Romdhane (2012) that NPL has a significant effect with a positive correlation to Capital Adequacy Ratio (CAR). Different results in Septiani & Lestari (2016), Swandewi & Purnawati (2021) that NPL has a significant negative correlation with CAR. Other different results in Murtiyanti, et al. (2015), Nugroho et al (2021) that NPL has no significant effect on CAR.

Chiu et al (2008), Ismaulina et al (2020) have produced research on bank efficiency that has a significant effect with a positive correlation to the Capital Adequacy Ratio (CAR). Different results are produced in Bukian & Sudiarta (2016) that bank efficiency has a significant effect with a negative correlation to CAR. Another result is that in Fitrianto and Mawardi (2006), bank efficiency has no significant effect on CAR.

### 3. HYPOTHESIS

In Assaf et al (2019) it was found that banking companies in the United States where in their research results found that an increase in inflation during the financial crisis caused banks in the United States to increase their efficiency. In line with that, Christianti (2020) found that an increase in inflation has an impact on increasing the efficiency of banking companies in Indonesia. Based on the results of these studies can be formulated in the hypothesis:

**H<sub>1</sub>**: There is a partial effect of inflation on the efficiency of banking companies listed on the Indonesia Stock Exchange.

The results of research by Sakawa & Watanabel (2020) in Japan on banking companies that are included in the TOPIX 500 index, resulted in an increase in Institutional Shareholders which had an impact on increasing Bank Efficiency. Thus the hypothesis can be formulated as follows:

**H<sub>2</sub>**: There is a partial influence of Institutional Ownership on the Efficiency of Banking Companies Banks listed on the Indonesia Stock Exchange.

Research conducted by Bokpin (2013), using the research object of the banking company industry in Ghana with an observation period of 1999 to 2007, resulted that an increase in firm size had an impact on increasing the efficiency of the banking industry industry significantly. Furthermore, it can be formulated in the hypothesis as follows:

**H<sub>3</sub>**: There is a partial effect of Firm Size on Bank Efficiency of Banking Companies listed on the Indonesia Stock Exchange.

Research conducted by Odunga et al (2013) on the effect of Loan to Deposit Ratio on Bank Efficiency using commercial bank research objects in Kenya resulted in a significant influence with a positive correlation. The same results are also in Amin & Mohamad (2017), so that the research hypothesis can be formulated as follows:

**H<sub>4</sub>**: There is a partial influence of the Loan to Deposit Ratio on the Efficiency of Banking Companies Banks listed on the Indonesia Stock Exchange.

Research on the effect of Non-Performing Loans on Bank Efficiency is described in the research of Karim et al (2010), Partovi & Matousek (2018) and research by Zamore et al (2021). The existence of a significant positive effect of Non-Performing Loans on Bank Efficiency is explained in Zamore et al's research (2021) on microfinance banks in 87 countries from 1998 to 2015

**H<sub>5</sub>**: There is a partial influence of Non-Performing Loans on the Efficiency of Banking Companies Banks listed on the Indonesia Stock Exchange.

The research results of Aktas, et al (2015), explained that inflation had a significant positive effect on the Capital Adequacy Ratio (CAR), the same results were also produced by Dao & Nguyen, (2020) also showed the same results, with the research object of Vietnamese commercial banks in 2010 – 2017. Thus the research hypothesis can be formulated:

**H<sub>6</sub>**: There is a partial effect of inflation on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesia Stock Exchange.

The influence of Institutional Ownership on the Capital Adequacy Ratio (CAR) is explained from the results of research by Delbariragheb & Zadeh (2015) with the result that there was a significant influence on the research object of banking companies in Iran during the observation period 2010 - 2013. The following hypothesis can be formulated:

**H<sub>7</sub>**: There is a partial influence of Institutional Ownership on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesia Stock Exchange.

In the research results of Magdalena, et al (2017), concerning the effect of Firm Size on Capital Adequacy Ratio (CAR) using research objects at state-owned banks listed on the Indonesia Stock Exchange (IDX), there has been a significant influence with a positive correlation. Thus the research hypothesis can be formulated as follows:

**H<sub>8</sub>**: There is a partial effect of Firm Size on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesia Stock Exchange.

Research conducted by Ansary & Hafez (2015) on the effect of the Loan to Deposit Ratio (LDR) on the Capital Adequacy Ratio (CAR) with Egyptian Commercial Banks as the object of research for the period of observation 2004 – 2013, resulted in a significant influence with a positive correlation. Furthermore, the research hypothesis can be formulated.

**H<sub>9</sub>**: There is a partial influence of the Loan to Deposit Ratio on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesia Stock Exchange.

By Septiani & Lestari (2016), using research objects at the Pasar Raya Kuta-Bali People's Credit Bank company during the period 2010 – 2014 with the findings that Non Performing Loans have a significant effect with a negative correlation to Capital Adequacy Ratio (CAR), so research hypothesis can be formulated as follows:

**H<sub>10</sub>** : There is a partial influence of non-performing loans on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesia Stock Exchange.

The results of his research were explained by Ismaulina et al (2020), with research objects using Mandiri Syariah Bank companies in Indonesia during the observation period 2012 – 2019, that bank efficiency has a significant effect and has a positive correlation to Capital Adequacy Ratio (CAR). Furthermore, the hypothesis can be formulated as follows:

**H<sub>11</sub>** : There is a partial effect of Bank Efficiency on the Capital Adequacy Ratio (CAR) of banking companies listed on the Indonesian Stock Exchange.

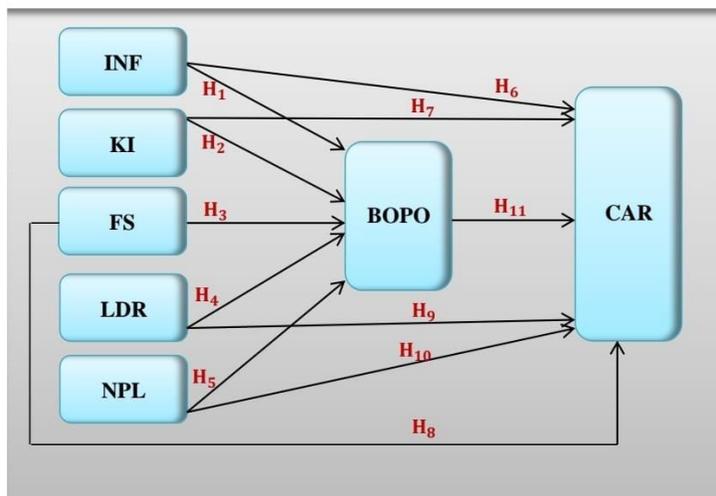


Figure 1. Research Drawing Framework Model

#### 4. RESEARCH METHODS

In this study, the approach used is descriptive qualitative and quantitative using time series and cross-section data. The analytical method used is panel data regression which uses a combination of time series data for the period 2013 to 2020 or for 8 years and cross-section data of public banking companies on the Indonesia Stock Exchange (IDX) with a population of 47 banking companies. The size of the population will be taken as a research sample using purposive sampling along with the criteria in determining the research sample.

Conceptually, the research variables are used in two research models and seven variables. Variable-1, Inflation which is the trend of rising aggregate national prices. Variable-2, Institutional Ownership which is the ratio between share ownership owned by institutions with total outstanding shares. Variable-3, Firm Size, the size/size of the company as measured by the value of the company's assets. Variable-4, Loan to Deposit Ratio (LDR) which is

liquidity risk. Variable-5, Non-Performing Loan (NPL), which is a credit risk. Variable-6, Bank Efficiency which is the ratio between the operational expenses of banking sector companies to the operating income of banking companies (BOPO). Variable-7, Capital Adequacy Ratio (CAR), which is the ratio as a measurement of the capital of banking sector companies to the distribution of credit / the amount of credit extended by banking companies.

Of the 47 banking companies that constitute the study population, purposive sampling will be used as a sampling method based on certain criteria (Sugiyono, 2013) resulting in a total of 20 banking companies as research samples. The criteria referred to above are:

- [1]. Banking companies listed continuously on the Indonesia Stock Exchange during the 2013-2020 period.
- [2]. Banking companies that have been IPO before 2013 and have never been delisted by the Indonesian Stock Exchange
- [3]. Banking companies that have complete financial reports and publish complete stock price data for 4 years during the 2013-2020 period.
- [4]. Conventional Banking Company.
- [5]. Banking companies are not owned by the local government

Operational variables in this study are:

Rate of Inflation ( $X_1$ ) .....	$\frac{CPI_{(t)} - CPI_{(t-1)}}{CPI_{(t-1)}} \times 100\%$
Institutional Ownership ( $X_2$ ).....	$\frac{\text{Number Of Institutional Shares}}{\text{Total Shares}} \times 100\%$
Firm Size ( $X_3$ ).....	$L_n$ Total Assets
Loan to Deposit Ratio/LDR ( $X_4$ ).....	$\frac{\text{Total Credit Distribution}}{\text{Total Third Party Funds}} \times 100\%$
Non Performing Loan/NPL ( $X_5$ ).....	$\frac{\text{Non - Performing Loans}}{\text{Total Portfolio}} \times 100\%$
Efisiensi Bank/BOPO (Y).....	$\frac{\text{Operating Expenses}}{\text{Operating Income}} \times 100\%$
Capital Adequacy Ratio/CAR (Z).....	$\frac{\text{Tier 1 Capital} + \text{Tier 2 Capital}}{\text{Risk Weighted Assets}} \times 100\%$

#### 4.1. Panel Data Regression Estimation

The analysis of this study uses multiple regression panel data which is a combination of time series data and cross section data. Approaches that can be taken in conducting multiple regression analysis of panel data are:

#### 4.2. Common Effects Model

This model is a combination of time series data and cross section data which then uses the OLS method for the panel data. This approach can be said to be the simplest approach compared to the other two approaches. In this approach, you cannot see differences between individuals and differences between time because the intercept and slope of the model are the same.

The structural equation in the Common Effect Model can be formulated as follows

$$Y_{i,t} = \alpha + \beta X_{i,t} + \varepsilon_{i,t}; i = 1,2,\dots,N; t = 1,2,\dots,T$$

#### 4.3. Fixed Effects Model

In this approach, the panel data model has an intercept that may change for each individual and time, where each unit cross section is fixed in time series. Mathematically this model can be formulated as follows:

$$Y_{it} = \alpha + \beta X_{it} + \gamma_2 W_{2t} + \gamma_3 W_{3t} + \dots + \gamma_N W_{Nt} + \sigma_2 Z_{it} + \sigma_3 Z_{i3} + \dots + \sigma_T Z_{iT} + \varepsilon_{it}$$

Where :

$Y_{it}$  : Endogenous variable for individual " i " and time " t ".

$X_{it}$  : Exogenous variable for individual " i " and time " t ".

$W_{it}$  : Is a dummy variable, where  $W_{it} = 1$  for individual " i ",  $i = 1, 2, \dots, N$ , and = 0 for the others.

$Z_{it}$  : is a dummy variable, where  $Z_{it} = 1$  for period " t ",  $t = 1, 2, \dots, T$ , and = 0 for the others.

#### 4.4. Random Effects Model

In this approach, differences between time and between individuals are accommodated through error. This study uses the Generalized Least Square (GLS) method. The advantage of the random effect model compared to the fixed effect model is that in terms of degrees of freedom, it is not necessary to estimate the cross-sectional N intercept.

The structural equation in the random effects approach can be formulated as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}; \varepsilon_{it} = U_i + V_t + W_{it}$$

Where :

$U_i$  : the error of cross section

$V_t$  : the error of time series

$W_{it}$  : combined error

#### 4.5. Model Selection Test

Formally, there are three model suitability testing procedures that will be used to select the best panel data regression model:

#### 4.6. ChowTest

The Chow test (F-statistic) is used to choose between the Common Effect model or the Fixed Effect model. The basis for rejecting the null hypothesis between the two models above is to compare F-statistical calculations with F-tables. If the results of F count > from F table at level  $\alpha = 5\%$  then reject the null hypothesis ( $H_0$ ) and accept the alternative hypothesis ( $H_a$ ), which means that the correct model to use is the Fixed Effect Model, and vice versa.

The formula used in conducting this test is:

$$\text{CHOW} = \frac{(\text{RRSS} - \text{URSS})/N - 1}{\text{URSS}/(\text{NT} - N - K)}$$

Where :

- RRSS : restricted residual sum square  
 URSS : unrestricted residual sum square  
 N : number of cross-sectional data  
 T : amount of time series data  
 K : number of explanatory variables

Test Criteria Fcount < F table accepted  $H_0$

F count > F table is rejected  $H_0$

#### 4.7. Hausman test

The Hausman test is used to choose between the Fixed Effect Model or the Random Effect Model. This Hausman test statistic follows the distribution of the Chi-Square statistic with a degree of freedom of k, where k is the number of independent variables. The Hausman test is a test conducted to find out whether the model used is a Fixed Effect Model or a Random Effect Model. Use the Random Effect Model in the Hausman test if you accept the null hypothesis ( $H_0$ ) and reject the alternative hypothesis ( $H_a$ ), but instead will use the Fixed Effect Model if the statistical hypothesis in the Hausman test rejects the null hypothesis ( $H_0$ ) and accepts the alternative hypothesis ( $H_a$ ).

#### 4.8. Lagrange Multiplier Test (LM)

*Lagrange Multiplier Test (LM)* is used to choose between the Common Effect Model or the Random Effect Model. The LM test is based on the Chi-Squares distribution with a degree of freedom equal to the number of independent variables. If the statistical LM value is greater than the critical value of the Chi-Squares statistic, it will reject the null hypothesis ( $H_0$ ) and accept the alternative hypothesis ( $H_a$ ), this means that the correct estimate for the panel data regression model is to use the Random Effect Model. Conversely, if the statistical LM value is smaller than the critical value of the Chi-Squares statistic, it will accept the null hypothesis ( $H_0$ ) and reject the alternative hypothesis

( $H_a$ ), so that it can be interpreted that the correct estimate for the panel data regression model is to use the Common Effect Model.

Statistical LM values can be calculated using the following formula:

$$LM = \frac{nT}{2(T-1)} \left[ \frac{\sum_{i=1}^n (\sum_{t=1}^T \bar{e}_{it})^2}{\sum_{i=1}^n \sum_{t=1}^T e_{it}^2} - 1 \right]^2$$

Where :

$n$  : Number of individuals or companies

$T$  : Number of time periods

$\sum \bar{e}^2$  : Sum of mean squared residuals

$\sum e^2$  : Sum of squared residuals

The LM test is based on chi-squares with a degree of freedom (df) equal to the number of independent variables. If the calculated LM statistic is smaller than the table's chi-squares value, then accept  $H_0$ . So, the model used is the ordinary least square. However, if the calculated LM statistic is greater than the table's chi-squares value, then reject  $H_0$ . This means that the model used is the Random Effect Model.

#### 4.9. Panel Data Regression Model

Structural equation in Model-1, Bank Efficiency Determinants are

$$BOPO_{it} = \alpha + \beta_1 INF_{it} + \beta_2 KI_{it} + \beta_3 FS_{it} + \beta_4 LDR_{it} + \beta_5 NPL_{it} + \epsilon_{it};$$

$$i = 1, 2, \dots, N; \quad t = 1, 2, \dots, T$$

The structural equation in Model-2, the implications for the Capital Adequacy Ratio (CAR) are

$$CAR_{it} = \alpha + \beta_1 INF_{it} + \beta_2 KI_{it} + \beta_3 FS_{it} + \beta_4 LDR_{it} + \beta_5 NPL_{it} + \beta_6 BOPO_{it} + \epsilon_{it};$$

$$i = 1, 2, \dots, N; \quad t = 1, 2, \dots, T$$

Where:

<p>BOPO : Bank Efficiency</p> <p>CAR : Capital Adequacy Ratio (CAR)</p> <p>INF : Inflation</p> <p>KI : Institutional Ownership</p>	<p><math>\epsilon</math> : Error component</p> <p><math>\beta</math> : slopes</p> <p><math>\alpha</math> : Intercepts</p> <p>N : The number of observations</p>
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FS	: Firm Size	Q	: The amount of time
LDR	: Loan to Deposit Ratio	N x T	: Number of panel data
NPLs	: Non-Performing Loans		

## 5. RESEARCH RESULTS AND DISCUSSION

### 5.1. Descriptive Statistics

Statistical data descriptions consist of mean, median, maximum, minimum, standard deviation, skewness, kurtosis and Jarque-Berra statistics as well as p-values. The mean, median, maximum and minimum values for each variable used in the study have different numbers, but the highest score of the four indicators is experienced by BOPO.

The standard deviation as a measure for measuring the dispersion or spread of data shows fluctuating numbers. The biggest standard deviation value is experienced by the Firm Size variable, which is equal to 1.495118, which means that the variable has a higher deviation compared to other variables. Meanwhile, the Non-Performing Loan (NPL) variable has the lowest deviation, which is 0.016752.

Skewness is a measure of the asymmetry in the distribution of statistical data around the mean. The skewness of a symmetric distribution (normal distribution) is zero. Positive skewness indicates that the spread of the data has a long right tail and negative skewness has a long-left tail. Institutional Ownership and Loan to Deposit Ratio variables have negative values, while Inflation, Firm Size, Non-Performing Loans, BOPO and Capital Adequacy Ratio (CAR) variables have positive values.

Kurtosis measures the height of a distribution. The kurtosis of a normally distributed data is 3. If the kurtosis exceeds 3, then the data distribution is said to be leptokurtic to normal. If the kurtosis is less than 3, the data distribution is flat (platykurtic) compared to normally distributed data. For Firm Size, Loan to Deposit Ratio, Non-Performing Loan and BOPO (Bank Efficiency) variables have a kurtosis value of more than 3, while the Inflation, Institutional Ownership and Capital Adequacy Ratio (CAR) variables have a kurtosis value of less than 3.

Jarque-Bera (JB) is a statistical test to find out whether the data used in the study is normally distributed. This test measures the difference in the skewness and kurtosis of the data and is compared to when the data is normal. With  $H_0$  normally distributed data, the JB test is distributed with a degree of freedom of 2. The probability indicates the possibility that the JB value exceeds (in absolute value) the observed value under the null hypothesis. The statistical results show that all variables have a Jarque-Bera value greater than 5% (Jarque-Bera > 5%), these results indicate that the variables used in this study that applied the panel data regression model during the 2013-2020 period concluded that with  $\alpha = 5\%$  which means that  $H_a$  is accepted and the data is not normally distributed. The problem of abnormal distribution is not required in the Regression Data Panel so that data that is not normally distributed can be ignored (Nachrowi, 2006).

**Table 1. Descriptive Statistics**

	INF	KI	FS	LDR	NPLs	BOPO	CAR
Means	0.049729	0.722431	32.55425	0.836339	0.028201	0.818625	0.201140
Median	0.037900	0.711850	32.63045	0.869650	0.027000	0.838423	0.222702
Maximum	0.083800	0.981500	36.50185	1.088600	0.088000	0.870134	0.235009
Minimum	0.030200	0.259100	29.61852	0.506100	0.002400	0.615119	0.172412
std. Dev.	0.021933	0.185498	1.495118	0.122903	0.016752	0.057927	0.122152

Observations	160	160	160	160	160	160	160
Cross sections	20	20	20	20	20	20	20

Source: Secondary data processed by the author

**5.2. Testing the Appropriateness of the Research Model I Bank Efficiency as an Endogeneous Variable**

Structural Equation of Research Model I

$$BOPO_{it} = \alpha + \beta_1 INFit + \beta_2 Klit + \beta_3 FSit + \beta_4 LDRit + \beta_5 NPLit + \epsilon_{it};$$

$i = 1,2,\dots,N ; t = 1,2,\dots,T$

Where:

- BOPO : Bank Efficiency
- INF : Inflation
- KI : Institutional Ownership
- FS : Firm Size
- LDR : Loan to Deposit Ratio
- NPLs : Non-Performing Loans

Chow test:Common Effects vs Fixed Effects

The Chow-test was carried out using the F statistical test with the chi-square test with statistical hypotheses: rejecting the null hypotheses ( $H_0$ ) and accepting the alternative hypotheses ( $H_a$ ) at a level of  $\alpha = 5\%$ , which means that the Fixed Effect Model will be better used than the Common Effect Models, and vice versa.

**Table 2.Chow test: Common Effectsvs Fixed Effects**

Endogenous Variable: Bank Efficiency (BOPO)

Effect Test	Statistics	df	Prob.
Cross-section F	8.07842	(19,135)	0.0037

Source: Secondary data processed by the author

The test results in table-2 will accept alternative hypotheses( $H_a$ ) and reject null hypotheses ( $H_0$ ) so that in the Chow-Test it would be better to use the Fixed Effect Model for use in estimating the panel data regression method.

### 5.3. Hausman Test: Fixed Effect vs Random Effect

Hausman test done using Test cross-section random effects or chi-square test with statistical hypothesis: reject null hypotheses ( $H_0$ ) and accept alternative hypotheses ( $H_a$ ) at the level of  $\alpha = 5\%$ , which means Fixed Effects Model would be better used than Random Effects Model, vice versa.

**Table 3. Hausman Test: Fixed Effects vs Random Effects**

Endogenous Variable: Bank Efficiency (BOPO)

Test Summary	Chi-Sq. Statistics	Chi-Sq. df	Prob.
Random cross-sections	5.707232	5	0.0045

Source: Secondary data processed by the author

The test results in table-3 will accept alternative hypotheses ( $H_a$ ) and reject null hypotheses ( $H_0$ ) so that in the Hausman Test it would be better to use the Fixed Effect Model for use in estimating the panel data regression method.

### 5.4. Lagrange Multiplier (LM-test): Common Effect vs Random Effect

Lagrange Multiplier Test done through the Breusch-pagan Lagrange Multiplier test (LM-test) with statistical hypotheses: reject the null hypotheses ( $H_0$ ) and accept the alternative hypotheses ( $H_a$ ) at the level of  $\alpha = 5\%$ , which can be interpreted Random Effects Model would be better used than Common Effects Model, vice versa.

**Table 4. Lagrange Multiplier (LM-Test) Breusch-Pagan**

Common Effects vs Random Effects

Endogenous Variable: Bank Efficiency (BOPO)

	Test Hypotheses		
	Cross-section	time	Both
Breusch-Pagan	0.547893 (0.4592)	0.952767 (0.3290)	1.500660 (0.2206)
Gourirrioux, et al.*	--	--	0.952767 (>= 0.10)
*Mixed chi-square asymptotic critical values:			
	1%	7,289	
	5%	4,321	
	10%	2,952	

Source: Secondary data processed by the author

The LM test Breusch-pagan (BP) of 1.500660 is a smaller value than the Chi-Square table with  $\alpha = 0.05 = 4.321$ , or the probability value of the LM-test Breusch-pagan (0.2206) is greater than  $\alpha = 0.05$  or accept the null hypothesis ( $H_0$ ) and reject the alternative hypothesis ( $H_a$ ). So, it can be interpreted that the Common Effect Model is better than the Random Effect Model in estimating the panel data regression method.

**Results of Paired Conformity Test of Research Model I**

**Table 5**

No	Method	Testing	Results
1	Chow-Test	Common Effects vs Fixed Effect	Fixed Effect
2	Hausman test	Fixed Effects vs Random Effect	Fixed Effect
3	Lagrange Multiplier	Common Effect vs Random Effect	Common Effect

Table 5 is a recapitulation of tables 2, 3, and 4 from the results of the suitability test of the research model I, which concludes using the Fixed Effect Model.

**Endogeneous Variable Bank Efficiency in Research Model I**

**Table 6. Model Fixed Effect White Cross-Sections (No-Heteroscedasticity)**

Variables	coefficient	std. Error	t-Statistics	Prob.
Inflation	-0.072435	0.030255	-2.394128	0.0180
Institutional Ownership	0.031837	0.029844	1.066776	0.2880
Firm Size	-0.705358	0.231544	-3.046322	0.0027
Loan to Deposit Ratio	0.128736	0.042843	3.004869	0.0032
Non-Performing Loans	-0.758026	0.268113	-2.827258	0.0054
C	0.229971	0.133728	1.719688	0.0878
Weighted Statistics				
R-squared	0.832343	Mean dependent var		-0.012490
Adjusted R-squared	0.813649	SD dependent var		0.064073
SE of regression	0.056469	Sum squared residue		0.430485
F-statistics	18.79998	Durbin-Watson stat		2.369772
Prob(F-statistic)	0.000095			
Unweighted Statistics				
R-squared	0.774550	Mean dependent var		-0.008625
Sum squared residue	0.440397	Durbin-Watson stat		2.379284

Source: Secondary data processed by the author

**Research Results Model I, Indirect Effect on CAR and Discussion (Table 6)**

[1] The results of testing the first hypothesis partially using the t-test show that the inflation variable has a significant effect with a negative correlation to BOPO of banking companies in Indonesia. Theoretically, the trend of rising inflation will have an impact on rising interest rates which in turn will reduce BOPO and increase the level of efficiency of banking companies. These results support the results of Assaf et al. (2019), Christianti (2020).

[2] Partial testing of the second hypothesis using the t-test shows that the institutional ownership variable has no significant effect on the BOPO of banking companies in Indonesia. Theoretically, this variable plays a

role in the occurrence of efficiency in banking companies, but this is not the case in the results of this study. This result differs from Jamil & Refi (2020), Eliana & Wahyuni (2019) that Institutional Ownership has a significant effect on Bank Efficiency.

[3] The results of testing the third hypothesis on the Firm Size variable partially using the t-test show that this variable has a significant effect with a negative correlation to BOPO of banking companies in Indonesia. This shows that the larger the Firm Size in banking companies will reduce the BOPO rate and increase the efficiency level, which means eliminating unproductive banking assets. These results support the results of Bokpin (2013), Khalil (2017).

[4] Partial testing of the fourth hypothesis based on the t-test shows that the Loan to Deposit Ratio (LDR) variable has a significant positive correlation to the BOPO of banking companies in Indonesia. Thus when there is an increase in credit distribution, the financial management of the banking sector in Indonesia will increase the BOPO rate which means it will be increasingly inefficient. These results differ from the results of Amin & Mohamad (2017), Ramly & Hakim (2017), Perwitaningtyas & Pangestuti (2015), Lemonakis et al (2018).

[5] In testing the fifth hypothesis partially based on the t-test, it shows that the Non Performing Loan (NPL) variable has a significant negative correlation with the BOPO of banking companies in Indonesia. This result shows that there is an anomaly which can be interpreted that the high level of NPL will reduce BOPO, which means more efficient management in managing the banking business. This is different in Karim, et al. (2010), Partovi & Matousek (2018), Istifarani & Azmi (2020).

**Testing the Suitability of the Research Model II Capital Adequacy Ratio (CAR) as an Endogeneous Variable**

Structural Equation of Research Model II

$$CAR_{it} = \alpha + \beta_1 INF_{it} + \beta_2 KI_{it} + \beta_3 FS_{it} + \beta_4 LDR_{it} + \beta_5 NPL_{it} + \beta_6 BOPO_{it} + \epsilon_{it};$$

$i = 1,2,\dots,N ; t = 1,2,\dots,T$ . Where:

- CAR : Capital Adequacy Ratio
- INF : Inflation
- KI : Institutional Ownership
- FS : Firm Size
- LDR : Loan to Deposit Ratio
- NPLs : Non-Performing Loans
- BOPO : Bank Efficiency

As was done in the testing phase of the Research Model I at the level of  $\alpha = 5\%$ :

*ChowTest*: Common Effects vs Fixed Effects

*Hausman test*: Fixed Effects vs Random Effects

*Lagrange Multiplier (LM-test): Common Effect vs Random Effect*

**Table 7. Chow test: Common Effects vs Fixed Effects Endogenous Variable: Capital Adequacy Ratio (CAR)**

Effect Test	Statistics	df	Prob.
Cross-section F	2.846615	(19,134)	0.0002

Source: Secondary data processed by the author

The test results in table 7 show that the probability value of the F test is  $0.0002 < \alpha = 0.05$  (5%) so that it will accept the alternative hypotheses ( $H_a$ ) and reject the null hypotheses ( $H_0$ ). Thus, in this Chow-Test it would be better to use the Fixed Effect Model.

**Table 8. Hausman Test: Fixed Effects vs Random Effects Endogenous Variable: Capital Adequacy Ratio (CAR)**

Test Summary	Chi-Sq. Statistics	Chi-Sq. df	Prob.
Random cross-sections	1.758856	6	0.9405

Source: Secondary data processed by the author

The test results in table-8 will reject the alternative hypotheses ( $H_a$ ) and accept the null hypothesis ( $H_0$ ) so that in this Hausman Test it would be better to use the Random Effect Model to be used in estimating the panel data regression method.

**Table 9. Lagrange Multiplier (LM-Test) Breusch-Pagan Common Effects vs Random Effects Endogeneous Variable: Capital Adequacy Ratio (CAR)**

	Test Hypothesis		
	Cross-section	time	Both
Breusch-Pagan	81.92360 (0.0000)	2.103649 (0.1469)	84.02725 (0.0000)
Gouririoux, et al.*	--	--	81.92360 ( $< 0.01$ )
*Mixed chi-square asymptotic critical values:			
	1%	7,289	
	5%	4,321	
	10%	2,952	

Source: Secondary data processed by the author

Table 9 test results, the LM test Breusch-pagan (BP) of 84.02725 is a smaller value than the Chi-Square table with  $\alpha = 0.05 = 4.321$ , or the probability value of the LM-test Breusch-pagan ( $0.0000 < \alpha = 0.05$ ) or rejects the null hypotheses ( $H_0$ ) and accept alternative hypotheses ( $H_a$ ). so that it can be interpreted that the Random Effect Model is better than the Common Effect Model in estimating the panel data regression method.

**Results of the Paired Conformity Test of the Research Model II****Table 10**

No	Method	Testing	Results
1	Chow-Test	Common Effect vs Fixed Effect	Fixed Effect
2	Hausman test	Fixed Effect vs Random Effect	Random Effect
3	Lagrange Multiplier	Common Effect vs Random Effect	Random Effect

Table 10 is a recapitulation of tables 7, 8, and 9 from the results of the suitability test of the research model II, which concludes using the Random Effect Model.

**Endogeneous Variable Capital Adequacy Ratio (CAR) in Research Model II****Table 11. Cross-sectional Random Effects Models**

Variables	coefficient	std. Error	t-Statistics	Prob.
Inflation (INF)	-3.129519	0.737483	-4.243517	0.0000
Institutional Ownership (IP)	0.967858	0.309290	3.129290	0.0021
Firm Size (FS)	0.444402	0.076309	5.823735	0.0000
Loan to Deposit Ratio (LDR)	-1.760699	0.810508	-2.172341	0.0314
Non-Performing Loans (NPL)	-9.905246	4.853493	-2.040849	0.0430
Bank Efficiency (BOPO)	-0.982212	0.410730	-2.391380	0.0182
C	12.25969	2.535088	4.836001	0.0000
Weighted Statistics				
R-squared	0.861903	Mean dependent var		0.862443
Adjusted R-squared	0.832958	SD dependent var		0.996996
SE of regression	0.873179	Sum squared residue		116.6535
F-statistics	19.04832	Durbin-Watson stat		1.701040
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.744092	Mean dependent var		1.311400
Sum squared residue	131.3238	Durbin-Watson stat		1.511015

Source: Secondary data processed by the author

**Research Results Model II, Direct Influence on CAR and Discussion (Table 11)**

[6] The results of testing the sixth hypothesis partially using the t-test show that the inflation variable has a significant effect with a negative correlation to the Capital Adequacy Ratio in banking companies in Indonesia. An increase in inflation theoretically will increase interest rates but it is not efficient as the results in the first research model have an indirect effect. These results are different in Aktas, et al (2015), Delbariragheb & Zadeh (2015), Kalifa & Bektaş (2017), also in Dao & Nguyen (2020), that inflation has a significant effect with a positive correlation to the Capital Adequacy Ratio ( CAR).

[7] Partial testing of the seventh hypothesis using the t-test shows that the variable Institutional Ownership has a significant effect with a positive correlation to the Capital Adequacy Ratio of Banking Companies in Indonesia. This can be interpreted that the more institutional ownership in corporate banking will increase the CAR value. These results are in line with the results in Delbariragheb & Zadeh (2015) but differ in Roth & Saporoschenko

(2001), Chou & Lin (2011), Jamil, et al (2015), that Institutional Ownership has a significant effect and has a negative correlation with CAR.

[8] The results of testing the eighth hypothesis on the Firm Size variable partially using the t-test show that this variable has a significant effect with a positive correlation to the Capital Adequacy Ratio of Banking Companies in Indonesia. The larger the firm size value will increase the CAR level and the results are consistent in Shirley et al (2010), Magdalena, et al (2017), but differ in Bateni et al (2014), Dewi & Yadhya (2018), Dao & Nguyen, (2020), that Firm Size has a significant and negative correlation with CAR.

[9] Partial testing of the ninth hypothesis based on the t-test shows that the Loan to Deposit Ratio (LDR) variable has a significant effect with a negative correlation to the Banking Capital Adequacy Ratio in Indonesia. This result is not as in theory which is positively correlated and also opposite in Ansary & Hafez (2015), Andini & Yunita (2015), Yokoyama & Mahardika (2019), Rianto & Salim (2020).

[10] In testing the tenth hypothesis partially based on the t-test, it shows that the Non Performing Loan (NPL) variable has a significant effect with a negative correlation to the Capital Adequacy Ratio in Banking Companies in Indonesia and is in line with theory. These results support the results in Septiani & Lestari (2016), Swandewi & Purnawati (2021) that NPL has a significant effect with a negative correlation to CAR.

[11] In testing the eleventh hypothesis partially based on the t-test shows that the Bank Efficiency variable (BOPO) has a significant effect with a negative correlation to the Capital Adequacy Ratio in Banking Companies in Indonesia. This can be explained that the higher the BOPO, the more inefficient banking management will be and will lower the CAR level so that this result is in line with theory and also in accordance with the results in Chiu et al (2008), Ismaulina et al (2020), that bank efficiency has a significant effect on significant with a positive correlation to the Capital Adequacy Ratio (CAR).

## CONCLUSION

Bank efficiency (BOPO) as an intervening variable can significantly mediate the Capital Adequacy Ratio (CAR), and from these results the consequence is that there is a direct or indirect influence on CAR. The results of this study indicate that the exogenous variable inflation has an effect and has a higher sensitivity level of direct rather than indirect influence on CAR.

The exogenous variable of Institutional Ownership can only explain its direct effect on CAR, while the indirect effect cannot explain the BOPO variable. This means that the effect on CAR can only be explained directly and not through the BOPO variable.

Firm size as an exogenous variable has a significant effect, directly correlated positively or indirectly through the intervening variable BOPO on Capital Adequacy Ratio (CAR). The results of both, directly or indirectly, are in accordance with the existing theory, but the level of sensitivity is greater than the indirect effect or through the BOPO intervening variable.

The results of the exogenous variable LDR test have a significant direct negative correlation or indirect positive correlation through the BOPO intervening variable on the Capital Adequacy Ratio (CAR). At the level of sensitivity between the two, direct effects are more sensitive than indirect or through intervening variables. The results of both direct and indirect are not in accordance with the existing theory.

One of the determinants of BOPO is the exogenous variable NPL. The test results, both directly and indirectly, have a significant effect and both are negatively correlated with the Capital Adequacy Ratio (CAR). The test results are only direct influences that are in line with the existing theory.

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