The Effect of Macroeconomic Variables and the Covid-19 Pandemic on National Income in Indonesia

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Abstract. Gross domestic product is one of the measuring tools in looking at a country's economy. Macroeconomic variables have an essential role in increasing or decreasing national income. The COVID-19 pandemic has had an impact on the economy. This study aims to analyze macroeconomic variables and the effect of the Covid-19 pandemic on national income. The data used are quarterly data from 2012 to 2021. Data analyzed using the Auto Regressive Distributed Lag (ARDL) method shows a stable long-term relationship between macroeconomic variables and national income. This study shows that interest rates, inflation, and the Covid-19 period have a significant negative effect. The exchange rate and money supply have a significant positive impact on national income in the long-term coefficient. For short-term coefficients, interest rates, inflation, and money supply have a significant effect, while inflation has no significant impact on national income.

Keywords: Macroeconomic variables, national income, Covid-19, Auto-Regressive Distributed Lag (ARDL), money supply (MS)

1 Introduction

The initial appearance of this virus started in China at the end of 2019. The virus's rapid spread increased the number of Covid-19 cases that began to spread to other countries [1]. In 2020, the Covid-19 virus entered Indonesia with a rapid spread of the virus, and the peak pandemic situation caused panic in the community. So, to suppress the growth rate of the positive number of Covid-19, the government has implemented policies including lockdown, regional quarantine [2]. Controlling the spread of the Covid-19 virus has reduced economic mobility and caused a decline in the economy [2]. In addition, the Covid-19 pandemic has impacted the global economic downturn, with macro problems on the demand side and supply side causing a downturn in the economy. This condition in the economic downturn causes macroeconomic variables to change [3]. Previously, shocks to the economy had occurred in 1997-1998 that hit the world and Indonesia due to the monetary crisis. Indonesia experienced a high depreciation and a high inflation rate [4]. Historically, the 1998 crisis caused an economic recession. It triggered some research to raise the crisis issue of what significantly happened to the Indonesian

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economy. Now, the economic recession experienced in Indonesia due to the Covid-19 pandemic is interesting to study further. We can see the importance of macroeconomic variables as factors that affect national income to measure the country's level of prosperity [5].

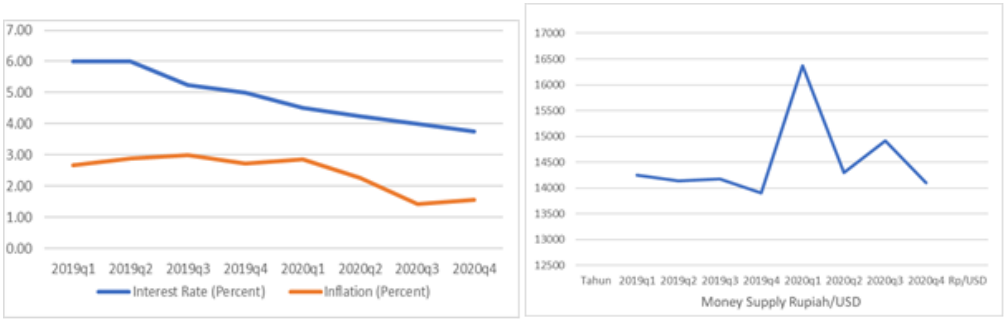

Fig. 1.. Inflation, interest rates and exchange rates in Indonesia

Figure 1. shows interest rate, inflation, and money supply in 2019 and 2020 [6]. The inflation rate in 2019 was categorized as normal at around 3.5 percent [7]. As for inflation, there was a very significant decline due to the impact of the Covid-19 pandemic, mainly due to changes in people's consumption patterns during the Covid-19 pandemic, which triggered a decrease in market commodity prices [3]. Inflation in the long and short term can affect the economy; inflation in the short term can positively impact the economy. In the long term, inflation has a negative impact, thereby reducing the size of GDP. Figure 1 [6] shows the exchange rate in 2019, which was still in normal conditions. In the second quarter of 2020, precisely during the outbreak of the Covid-19 case in Indonesia, the exchange rate depreciated higher due to shocks that caused uncertainty in the global economy resulting in an increased response [2]. The long-term and short-term exchange rates play a role and impact Indonesia's export activities. According to research [8] on [3], the amount of the rupiah exchange rate against the dollar is very important to trigger an increase in exports that Indonesia continues to do, especially during the Covid-19 pandemic. Figure 1. shows a significant decrease in interest rates, meaning that the determination is expected to increase national income or GDP. During the Covid-19 pandemic, which began in 2020, interest rates declined every quarter. The interest rates during the Covid-19 pandemic are expected to increase national income [7].

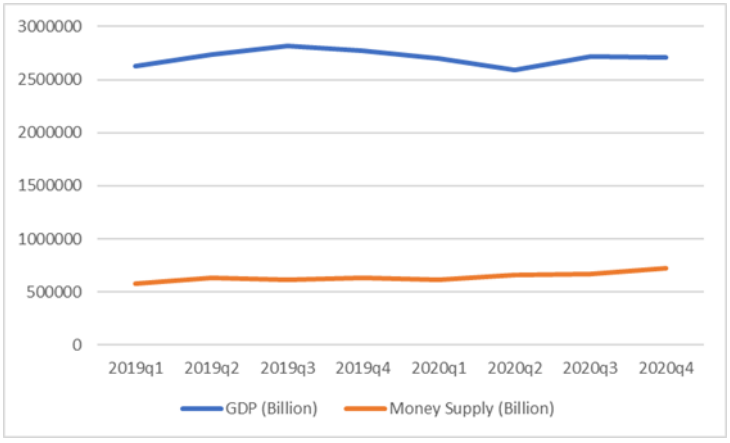

Fig. 2. GDP and the money supply

Figure 2 describes the data on GDP and the money supply from 2019 to 2021 [9]. Economic conditions were reflected in the third quarter of 2019, which showed the achievement of GDP with the highest peak [2]. Meanwhile, the economy affected by Covid-19 was shown in the year the outbreak of cases began, namely in 2020. It is reflected in GDP, which decreased by minus 4.19% in the second quarter of 2020 [10]. The decline in GDP was due to a decrease in economic activity in the real sector due to the stipulation of policies to limit community activities with the implementation of lockdown and regional quarantine [2].

The condition of the money supply is described in Figure 2. There is an increase in the money supply every quarter [9]. The money supply continued to increase to support the economy due to the shock of the Covid-19 Pandemic [7]. The increasing money supply during the Covid-19 pandemic is under contractionary monetary policy intervention [11]. The real impact of increasing public consumption that can directly increase GDP is reflected in the third quarter of 2020. Therefore, monetary intervention is needed to influence GDP, especially during the Covid-19 pandemic.

Previous research [3] explains that the long-term and short-term exchange rates play a role and impact Indonesia's export activities, affecting the amount of GDP. The long- and short-term effects of inflation can have a negative impact on GDP, especially related to price stability in the market. Using the Error Correction Model (ECM) [5], the same study concluded that long-term exchange rates significantly affected GDP. In contrast, inflation had no significant impact on GDP. A similar study using the Error Correction Model (ECM) method [12] stated that in the short term, the money supply had no significant effect, while in the long term, the money supply had a significant impact on Indonesia's economic growth. Subsequent research [13] stated that inflation negatively affects economic growth. Another study [13] said that interest rates have no significant effect. In contrast, inflation and exchange rates significantly impact economic growth, while there are no variables that affect the economy in the long term. Most previous studies showed a difference in the analysis between short-term and long-term relationships [5]; [12]; [13]. Therefore, it is necessary to conduct research related to the study of the relationship in the short term and long term it is essential to do.

ARDL is able to detect long-term and short-term relationships of the variables by producing the coefficient values of each relationship that will provide conclusions [15]. This study wants to analyze using the ARDL method, which looks at the long and short-term relationship of the macroeconomic variables studied, and the addition of the Covid-19 dummy to see the impact of the pandemic on national income. Research by testing only on the macroeconomic variables such as inflation and exchange rates on the economy [3]; [14]; [5], research that only discusses the variable of the money supply to the economy [12], and research that studies macroeconomic variables during the 1998 crisis [4]. Therefore, this study will use a more comprehensive analysis of the factors that affect national income in terms of macroeconomic variables and the impact of the Covid-19 pandemic.

The presence of the Covid-19 pandemic caused various problems in the global economic downturn, including the impact on Indonesia's macroeconomic variables, such as declining inflation rate and depreciation [2]. The significant decline was mainly caused by lockdown regulations and regional quarantine [3]. Further, the impact of the Covid-19 pandemic is not only about a temporary decline in economic activity but also about the potential of whether it triggers a more prolonged effect on the economy than the 1997-1998 crisis [1]. The Covid-19 pandemic has affected the decline in national income; therefore, the government needs to anticipate the future. Currently, uncertainty about when the Covid-19 pandemic will end is a challenge for the government and a big question of whether the impact will be in the long term. Therefore, a more comprehensive study discussing Indonesia's national income and the long-term effect of Covid-19 on national income needs to be analyzed more deeply.

2 Data and Methodology

This study uses secondary data from the first quarter of 2012 to the fourth quarter of 2021. Table 1 shows the data and its definition. Various sources are taken from Bank Indonesia and BPS Indonesia.

Table 1. Types and Sources of Data

Data	Definition	Unit	Source
GDP	Real Gross Domestic Product in Indonesia base year 2010	Billion Rupiah	BPS Indonesia
CPI	Consumer Price Index	Index	Bank Indonesia
Interest Rate	Interest rate for loan	Percent	Bank Indonesia
M1	Money Supply	billion rupiah	BPS Indonesia
Exchange rate	Ratio exchange local rate (rupiah) against money foreign exchange (dollars)	Rupiah/USD	Bank Indonesia

Covid-19	Dummy Covid-19 0 = before a pandemic Covid-191 = during Covid-19	Dummy	Covid-19.go.id

This study uses time-series data using the Autoregressive Distributed Lag (ARDL) analysis method. The ARDL method is one of the econometric models used to determine the short-term and long-term regression equations by looking at the influence between the independent variable (Y) and the dependent variable (X) from time to time [16]. The model equation in this study is used to identify and analyze macroeconomic variables and the Covid-19 pandemic on national income from 2012 to 2021. Equation 3.1 shows the research estimation model, which is transformed into econometrics.

$$\Delta LNGDPt = \alpha 0 + \sum p\ \beta \Delta LNCPI\ t\text{-}i + \sum q\ \delta \Delta IRt\text{-}i + \sum r\ \gamma \Delta LNEXt\text{-}i + \sum s\ \sigma \Delta LNM1t\text{-}i + \lambda 1 LNCPIt\text{-}p + \lambda 2 IRt\text{-}p + \lambda 3 LNEXt\text{-}p + \lambda 4 LNM1t\text{-}p + \lambda 5 Covid19t\text{-}p + \mu i \quad (3.1)$$

GDP = gross domestic product period t ; CPI = consumer price index or inflation period t ; IR = interest rate period t; EX = exchange rate of rupiah against dollar period t; M1 = money supply period t ; Covid19 = Covid-19 pandemic dummy ; α0 = intercept ; = the difference between the changes in the current year's data and the previous year ; t-i = lag time to be used (i = 0.1,2,..) ; t-p = previous time ; β, δ, γ, σ = short-term relationship coefficient; λ1,2,3,4,5 = long- term relationship coefficient; μi= error (error) in period t; p, q, r, s, t = lag optimum.

3 Results

3.1 Data Pre-estimation Test

This chapter performs an initial estimate on the ARDL model and whether it is good to use. Several tests are used, such as stationary data test, optimum lag test, and cointegration test.

1. Stationarity Test

Research using time series data needs to be tested for stationarity. Data can be stationary when the variance value is constant and does not fluctuate systematically during the observation period and the average value [17]. The stationarity test was carried out to see whether the variables studied were stationary. A variable is said to have no unit root if the probability value of the test results is more than the critical value (1%, 5%, or 10%). Stationarity test results based on Augmented Dickey-Fuller (ADF) are shown in Table 2.

Table 2. Stationarity Test

	Augmented Dickey-Fuller	
Variable	Level I (0)	First Difference I (1)
	Augmented Dickey-Fuller	

LNGDP	0.5291	0.0000***
LNM1	0.3621	0.0000***
LNEX	0.0115***	0.0000
LNCPI	0.0044***	0.0000
IR	0.0951	0.0000***

***), **), and *) significance at 1%, 5%, 10% significance level

Based on Table 2, the test results show that all variables are stationary in this study, lnex and lncpi are stationary at the level, and lngdp, lnm1, and ir are stationary at the first difference level. It can be proven by comparing the ADF value greater than the critical value. This study uses a significance level with a significance level of 5%. If the data used in this study is not stationary at level I (0), it is necessary to look for stationarity at the first difference level I (1). The ARDL method will not be suitable for data whose stationarity level is in the second difference I (2).

2. Optimum Lag Test

After the stationarity test is carried out, the next step that needs to be used to estimate the model is to determine the optimum lag. Lag testing avoids autocorrelation symptoms in the model (Gujarati, 2004). In addition, lag testing was carried out to see the effect of time-lapse on research observations. The results of the optimum lag testing carried out on the models are (2, 2, 4, 3, 4) with the model D (LNGDP), D (LNGDP (-1)), D (LNM1), D (LNM1(-1)), D (LNEX), D (LNEX (-1)), D (LNEX (-2)), D (LNEX (-3)), D (IR), D (IR (-1)), D (IR (-2)). The lag selection in this research is made automatically to choose the best model, based on the Akaike Info Criterion (AIC), which can reduce the degrees of freedom. Optimum lag test results can be seen in the attachment.

3. Cointegration Test

Cointegration testing is carried out on the ARDL model to know whether there is a long-term relationship between variables. The cointegration test uses the Bound Test by comparing the F-statistic value with the bound test value. If the F-statistic value is at the lower bound value, then there is no long-term integration in the model. The estimation model is said to have a long-term relationship if the F-statistic value is greater than the upper bound value. The following are the tests carried out for long-term cointegration estimates between variables, as shown in Table 3.

Table 3. Bound Test Results

	Value	**K**
F-statistic	19,58	4
Critical Values Bound Test		
Signifikansi	I (0)	I (1)
10%	2,45	3,52
5%	2,85	4,01

2,5%	3,25	4,49
1%	3,74	5,06

The results of the tests concluded that the F-statistic value in this model had a critical value at the upper bound, either the 1 percent, 5 percent, or 10 percent actual level. H0 is no long-term relationship between variables, while H1 states a cointegration and long-run relationship between variables. The decision is to reject the H0 hypothesis and accept the H1 hypothesis. The conclusion shows that there is a long-term balance in the model.

3.2 Post Estimation Test

The classical assumption test is a method to determine whether the estimation results are carried out to avoid a biased regression model, commonly called the best linear unbiased estimator (BLUE). If the model avoids the problem of classical econometric assumptions, then the analysis and conclusions from the regression results can be carried out. Several classical assumption tests are commonly involved, such as the normality test, autocorrelation test, heteroscedasticity test, multicollinearity test, and linearity test [18]. Multicollinearity testing was carried out to see the relationship between the independent variables and other independent variables. However, the study from [19], [20], and [21] shows that the ARDL model does not require multicollinearity testing. The multicollinearity test is not needed because there are different levels of data in the use of the model. In theory, multicollinearity only develops regression coefficient errors, but the coefficients remain unbiased, so testing is not needed in ARDL analysis [19]. Therefore, the classical assumption test used in this study consisted of an autocorrelation test, normality test, heteroscedasticity test, and linearity test.

1. Normality test

The results of the tests show that the probability value is greater than the critical value. The normality test conducted in this study was the Shapiro-Wilk test. Based on the parameters used for comparing, the probability value (Prob>z) is 0,11, and the critical value is 0,95. It can be concluded that the variables used in this study fulfil the assumptions of normality, and the data is typically distributed.

2. Autocorrelation test

The autocorrelation test is used to determine whether there is a relationship or not between observations at different times. This study uses the Breusch-Godfrey test method by comparing the values of Obs*R-square Prob. The results is Chi-square is greater than the critical value 0,64 > 0,21. It was found that there was no autocorrelation between the variables studied.

3. Heteroscedasticity test

The heteroscedasticity test used in this study uses the Breusch Pagan Godfrey Test to test whether there is an inequality of residual variance from one observation to another. Testing by

comparing the probability value with the level of significance. Based on the model studied, the results of this test is the value of Obs*R-square with Chi-square probability is obtained, which Obs*R-square is 0,75 and Chi-square probability is 0,10 and means that this model is free from heteroscedastic problems.

4. Linearity test

The linearity test used in this research is the Ramsey RESET test. This test aims to see if the model specifications are correct or not. This test will determine the form of the empirical model and can avoid specification errors or misspecifications. The results can be concluded that there was no omitted variable in this study because Prob-F was more significant than the alpha value of 0,41> 0,05.

3.3 Long-term and Short-term Results

Based on the tests conducted using ARDL, it was concluded that there was a long-run and short-run relationship. The dependent variable is GDP, and the independent variable is inflation, interest rates, exchange rates, money supply, and the Covid-19 dummy.

Table. 4 Long-term Estimation Results

Variable	Coefficient	Probability (P > t)
LNM1	0.0090731***	0.002
LNEX	0.4100025**	0.010
IR	-0.0396792**	0.000
LNCPI	-0.9379688*	0.067
Covid	-0.7713772***	0.001
Constanta	7.313871*	0.066

***), **), and *) significance at 1%, 5%, 10% significance level

Based on Table 4, the long-run ARDL estimation model results show that the money supply, exchange rate, interest rates, inflation, and Covid-19 dummy variables significantly influence national income. An asterisk indicates a significance result with a significance level of 10 percent.

Table 5. Short-term Estimation Results

Variable	Coefficient	Probability (P > t)
D(LNM1)	-0.7776975	0.030
D(LNM1(-1))	-0.6414547	0.006***
D(LNEX)	-0,4392946	0,038
D(LNEX(-1))	-0,4358302	0,014

D(LNEX(-2))	-0,3861381	0,008
D(LNEX(-3))	-0,1838051	0,026***
D(IR)	0,006044	0,799
D(IR(-1))	0,0262247	0,315
D(IR(-2))	0,0773122	0,001***
D(LNCPI)	1,012002	0,189
D(LNCPI(-1))	0,4206429	0,470
D(LNCPI(-2))	0,947103	0,074*
D(LNCPI(-3))	-0.5138152	0.267

***), **), and *) significance at 1%, 5%, 10% significance level

Based on Table 5, the ARDL estimation model results state that the money supply, interest rates, and exchange rates significantly affect national income in the short run. In contrast, the inflation variable has no significant effect on national income.

The Relationship of Macroeconomic Variables with National

Relationship of Inflation with National Income

Long-term analysis of inflation (CPI) is negative and significantly affects national income because the p- value is smaller than the alpha of 10%, with a coefficient of -0.94, which negatively affects national income. It indicates that an increase in inflation of 1 percent can reduce national income by 0.94 percent. The inflation rate can affect national income in the long term. If there is a general and continuous increase in prices, it will make people reduce consumption and result in a decrease in national income. Inflation that continuously occurs in the real economy causes a decrease in national income because it can reduce aggregate demand. It is in line with research conducted by [23]; [24]; [25]; and [13]; which stated that a continuous increase in inflation was able to reduce national income due to pressure from prices that generally increased in the long term.

The inflation variable has a negative value to national income in the short term and does not significantly affect national income. The result of the short-term analysis is that the p-value is greater than the alpha of 10 percent. The coefficient of inflation variable in the short term is -0.51 and does not affect national income. It can be related to volatility or inflation, which in the short term, does not have much effect on reducing economic growth [5]. People tend to reduce consumption if prices generally move up continuously in the long term.

The Relationship between Interest Rates and National Income

The results of the long-term analysis show that the interest rate has a significant effect because the p-value is smaller than the alpha of 10 percent and the coefficient of -0.04 has a negative effect on national income. It explains that if there is an increase in interest rates by 1 percent, it can reduce national income by 0.04 percent. The market will respond to any changes in the interest rate; eventually, it can affect national income. Specifically, if the interest rate on loans

increases, the public or investors will reduce the number of loanable funds in the banking sector. When the number of funds used for production and investment decreases, investment and income will drop. Finally, it reduces national income in the long term. It is in line with research conducted by [23]; and [25]; that interest rates affect people's daily lives and have a major impact on economic conditions.

The results of the short-term analysis show that interest rates have a significant effect because the p-value is smaller than the alpha of 10 percent and the coefficient of 0.07 has a positive impact on national income. If there is an increase in interest rates by 1 percent, it can increase national income by 0.07 percent. It concludes that the public or investors who borrow funds from banks do not see interest rates in the short term. Interest rates that often fluctuate in the short term are not a reference for the public to borrow funds from the banking sector [14].

The Relationship between the Money Supply and National Income

The results of the long-term analysis show that the money supply has a significant effect because the p- value is smaller than the alpha of 10 percent and the coefficient of 0.009, which means it has a positive influence on national income. It explains that if there is a 1 percent increase in the money supply or M1, it can increase GDP by 0.009 percent. The amount of money in circulation or money held by the public (M1) positively affects the economy. The indication is that when people have more money, it means they are able to increase the amount of consumption they make. It is in line with the rising money supply in the economy, which can be used for public consumption or production in the real sector. An increase in money in society will encourage domestic demand and increase national income [25]. In the long term, money will circulate widely to producers and consumers to improve the economy [12].

The results of the short-term analysis show that the money supply has a significant effect because the p- value is smaller than the alpha of 10 percent and the coefficient of -0.64 has a negative effect on national income. It means that if there is an increase in the money supply (M1) by 1 percent, it can reduce national income by 0.64 percent. The causes of the negative effect of the short-term money supply relationship on national income is people who prefer not to spend their money and the existence of money liquidity held in financial institutions [12].

Relationship of Exchange Rate with National Income

The results of the long-term analysis show that the exchange rate has a significant effect because the p- value is smaller than the alpha of 10 percent and the coefficient of 0.41, which means it has a positive influence on national income. Every 1 percent increase in the exchange rate can reduce national income by 0.41 percent. In theory, the increase in the rupiah exchange rate against the dollar is alarming because it causes the rupiah to depreciate. The weakening of the rupiah is not a good thing, but if it is related to export and import activities, the weakening of the exchange rate is quite good. Exporters can further increase their exports at a much higher price than the current strengthening rupiah. In line with exports, the weakening of the exchange rate led to a decrease in imports due to higher purchasing prices. The effect of the exchange rate on the economy significantly impacts real output in the long run [23].

The results of the short-term analysis show that the exchange rate has a significant effect because the p-value is smaller than the alpha of 10 percent and the coefficient of -0.18, which means it has a negative impact on national income. The cause of the negative impact of the exchange rate

in the short term is due to the unbalanced export activity in the short term [3]. With an increase in imported goods due to the depreciating rupiah, people will reduce consumption and affect the decline in national income in the short term [5].

The Relationship of the Covid-19 Pandemic with National Income

The long-run relationship in the ARDL model shows that the Covid-19 dummy variable has significant negative coefficient (-0,77). It means that the impact of the Covid-19 pandemic can reduce national income in the long run due to economic uncertainty. The government policies of lockdown and regional quarantine have a significant decline impact for the real sector. The lower productivity on society causes a decrease in aggregate demand. In addition, implementing these policies also triggers a reduction in aggregate supply by producers [23]. The lower aggregate value, both supply and demand, will impact a drastic decline in national income.

According to Statistics Indonesia (2021), the impact of pandemic causes a decline in economic growth by -4.19% in the second quarter of 2020. However, the impact of the Covid-19 pandemic will still last in the long run [11]. The result of ARDL analysis concludes that the impact of the Covid-19 pandemic affected the decline in Indonesia's national income in the long run. Therefore, the government must have macro-prudential surveillance for the long-run effect of the Covid-19 pandemic [4]. Furthermore, the pandemic's impact on multi-sectors can significantly reduce national income. As a result, the pandemic slows the economy and triggers a sharp decline in economic growth [25].

4. Conclusion and Recommendation

4.1. Conclusion

Based on the discussion and results previously presented regarding the effect of macroeconomic variables and the Covid-19 pandemic on national income, the conclusions that can be drawn are:

1. Inflation is the variable that has the most significant negative effect on national income in the long term. The exchange rate becomes the second significant negative variable. Interest rates are the third variable that has a significant negative effect on national income in the long run. The money supply or money held by the public (M1) positively affects the economy. Covid-19 has a negative effect on GDP and significantly impacts the decline in national income in the long term.

2. Inflation in the short term has no significant effect on growth. The money supply negatively impacts national income with the volatility of inflation in the short term, which often changes. Interest rates have a significant and positive effect on national income. The exchange rate and the money supply have a significant negative impact on national income.

4.2. Recommendation

Based on the discussion and results that have been described previously, the suggestions that can be given are:

1. For the government, it becomes an illustration to evaluate the factors that affect national income in terms of inflation, interest rates, money supply, and exchange rates on how to benefit Indonesia's national income.

2. For policymakers, it becomes a policy evaluation during the Covid-19 pandemic. The government needs to anticipate the impact of the Covid-19 pandemic on national income in the long term. Also, the study gives a lesson to anticipate the future similar shock to the economy.

3. Further research might add an interaction dummy to interact each macroeconomic variable with the effect of the Covid-19 pandemic to see the response on national income.

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