JOURNAL OF MANAGEMENT, ACCOUNTING, GENERAL FINANCE AND INTERNATIONAL ECONOMIC ISSUES
(MARGINAL)
Volume 2 Issue 1 (2022)

ANALYSIS OF MACROECONOMIC VARIABLES ON THE RUPIAH EXCHANGE RATE BASED ON ERROR CORRECTION MODEL

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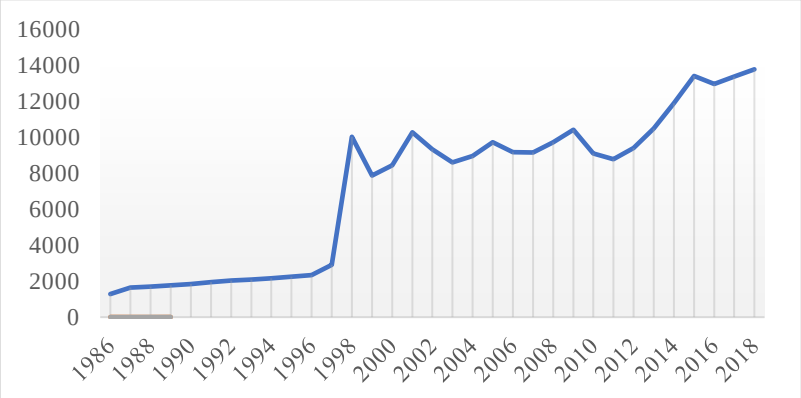
Abstract
This study aims to determine the relationship of economic growth, tax revenue, exports, imports to the rupiah exchange rate against the United States dollar in the long term and short term in the period of 1986 to 2018. The methodology used in this study is Error Correction Model (ECM). The variables used are GDP, tax revenue, export, import as independent variables, and the rupiah exchange rate against the dollar as the dependent variable. The result of this study in long run variables of exports and imports affect the exchange rate. For research result in short term GDP and tax revenue affect the exchange rate of the rupiah.

Keywords: *ECM, Exchange Rate, Export, GDP, Import*

1. INTRODUCTION

An economic development cannot be separated from how economic growth occurs (Sasana, 2022). One of the factors that can be seen that a country has achieved good economic growth is the stability of the currency value in that country. However, for developing countries such as Indonesia, fluctuations in the rupiah exchange rate continue to change due to economic conditions at home and abroad. Various policies have been carried out by Bank Indonesia to maintain stability, changes in exchange rates are also influenced by the demand and supply of foreign exchange in the market that occurs due to expectations from economic and non-economic variables (Hussein, 2019).



Source: Bank Indonesia (2022)

Figure 1. Changes in the exchange rate of the rupiah against the US dollar

Exchange rate movements from year to year always increase or experience a decline in the value of the Rupiah. Based on Figure 1 which is exchange rate data for the 1986 - 2018 period, it can be seen that the rupiah exchange rate against the US dollar fluctuates with a tendency to weaken in value from year to year, this weakening causes the inflation rate to increase, import costs are getting bigger. The value of the rupiah was corrected quite deeply in 1998, the cooperation between Indonesia and Thailand and the cooperation between Indonesia and the US, as well as the weak economic fundamentals of Indonesia, became the cause of the crisis that lowered the rupiah exchange rate (Keumala Sari & Fakhrudin, 2016).

According to Coric (2010) in Diana and Dewi (2019), Exchange rate fluctuations will cause anxiety and uncertainty in international trade. The decline in the value of the rupiah will cause the international trade system to be disrupted, with the weakening of the government's currency it will be difficult to meet import needs, these problems will cause an increase in the prices of goods and services and if ignored will cause inflation. This is in line with the view Sukirno (2013), that the exchange rate is influenced by exports, imports, and inflation.

The stability of macroeconomic variables such as inflation will positively affect tax revenue. Tax revenue is a view of business simulation that simulates economic aggregates (Wahyudi et al., 2009). The balance between taxes and economic growth is directly and positively proportional, the increase in economic growth is driven by tax revenues originating from economic activities. The exchange rate, which is an indicator of Indonesia's economic growth, has an important role. When the value of the currency decreases, it will reduce the level of people's purchasing power for commodities due to higher prices, a decrease in people's purchasing power and a contraction in international trade due to the weakening of the rupiah exchange rate causing a decrease in tax revenues to the state (Sinambela and Rahmawati, 2019).

Based on the description above about how macroeconomic variables, especially economic growth, tax revenue, and exports and imports affect the occurrence of exchange rate fluctuations, researchers are interested in conducting research using different variables, namely economic growth, tax revenues, exports, imports. The purpose of this study was to determine the long-term and short-term relationship to the exchange rate variable.

2. LITERATURE REVIEW

2.1. The Relationship Between Exchange Rates and Economic Growth

The relationship between the exchange rate and GDP is often done by researchers as an indicator to see the economic growth of a country. The use of these indicators is also used to see the problems that exist in the economic system. Indonesia determines the value of the rupiah against foreign currencies (US dollars), meaning that every time there is a movement in the value of the rupiah, the comparisons are made by analysts using US dollars.

Dependence on foreign currencies (US dollars) will have an impact on the domestic economy, if the US dollar strengthens with high interest rates, the rupiah will depreciate, because the rupiah currency is considered unattractive. The weakening will have a rolling effect on economic growth which will also experience a weakening, investors who invest in Indonesia will withdraw investments in Indonesia, in order to get a more profitable

return than investing in Indonesia, which will affect Indonesia's economic growth. because until now Indonesia still needs foreign investment to carry out economic development.

2.2. Relationship Between Exchange Rate and Tax Revenue

The exchange rate has a substitution effect on tax revenues received by the government. According to Wijayanti (2010) Consumption activities carried out by developing countries such as Indonesia are the main economic activities that are often carried out, the higher the consumption carried out, the higher the amount of VAT receipts will be. When the exchange rate weakens against the US dollar, the prices of commodities and services will increase, this is because the import costs that must be paid increase in prices, when there is an increase in commodity prices will affect the level of public consumption, so that when there is a depreciation of the exchange rate rupiah will cause a decrease in people's purchasing power. When the level of public consumption is low, state revenues from consumption taxes will decrease

2.3. The Relationship Between Exchange Rates and Exports

Export has a relationship with foreign exchange reserves, because when a country exports, the country will get money with a certain amount of value in foreign currency which is often referred to as foreign exchange which is a source of state income (Agustina & Reny, 2018). Currency exchange rates have an influence on a country's foreign exchange reserves. The more foreign exchange obtained or the more foreign exchange reserves a country has, the greater the economic opportunity of a country in carrying out international economic activities, and the ability of the country to carry out international transactions will be stronger. With good international trade capabilities, the international trade will affect the level of economic stability of a country and the stronger the value of the country's currency.

2.4. The Relationship Between Exchange Rates and Imports

The link between imports and foreign exchange reserves is that a company needs raw materials used to produce goods, to meet these raw materials the company imports, in importing it requires sufficient foreign exchange to pay for international transactions (Agustina & Reny, 2018). If the required foreign exchange reserves are limited, the production activities carried out by the company are limited because the data does not meet the import needs. These problems will have an impact on the disruption of domestic production and affect the domestic economy. Thus, the use of foreign exchange reserves must be done as well as possible to maintain the stability of the domestic economy.

2.5. Purchasing Power Parity (PPP) Theory

According to Mkenda (2001) in a scientific article conducted by Rahutami (2017) PPP theory originated at the Spanish Samanca School in the 16th century. This theory was developed by Cassel by using PPP as the basis of exchange rates. Cassel also links foreign exchange to commodity prices on international markets in domestic currencies. The PPP approach is enforced by using the spot rate which takes into account the condition of the equilibrium. The exchange rate is the domestic price compared to the foreign price and the formulation can be seen as below.

$$S = \frac{P_d}{P_f}$$

According to Holmes (2001) two main reasons why PPP testing is done frequently, namely:

1) In developing countries that experience large differences in domestic and foreign inflation, PPP can be used as a model to determine the criteria for the domestic currency to be undervalued or overvalued.
2) In research conducted by experts, the construction of exchange rate modeling often uses PPP as the foundation.

In a study conducted by Meese and Singleton (1982) in Rahutami (2017), suggested that in conducting exchange rate research on PPP theory testing, it is better to do unit root test Augmented Dickey-Fuller (ADF), Dickey Fuller (DF), Phillips Perron (PP). The test should be carried out, because in his research he found that the exchange rate followed a random walk process and the movement of the exchange rate was unpredictable. This means that the use of time series data as a short-term and long-term relationship cannot be ascertained

2.6. Previous Research

In research conducted by Sofyana (2019), by using GDP as the dependent variable and the exchange rate, exports, and the money supply as the dependent variable. The purpose of the research is to see to what extent exports affect Indonesia's economic growth. Assuming that exports are influenced by the exchange rate. The method used by the researcher is PAM (Partial Adjustment Model) analysis. The results of the study found that GDP had no significant effect on the exchange rate.

The study entitled "The Influence of Inflation Rate, SBI Interest Rate, and Economic Growth on the Rupiah Exchange Rate Study at Bank Indonesia for the Period 2003-2012" was conducted by (Puspitaningrum et al., 2014). Based on multiple regression testing, it is known that GDP partially does not have a significant effect on the exchange rate, this is because imports in the study period tend to be larger than exports, causing Indonesia's economic fundamentals to be less good.

Al Safassi (2010), obtained the results of research that the USD exchange rate has an effect on income tax revenues, when the USD exchange rate increases and the rupiah exchange rate decreases, the demand for dollars increases while the supply against the dollar decreases. higher. Multiple linear regression research to determine the extent to which the independent variable affects the dependent variable.

Singh (2015) the research conducted found that the USD exchange rate variable against the rupiah had a significant effect on tax revenue, the relationship between the two variables was positive in the direction, meaning that any increase in the USD exchange rate would have a significant effect on state revenues. This also happens with the variable of economic growth with tax revenues, every change with economic growth will affect tax revenues.

Mulianta Ginting (2013), research entitled "The Influence of Exchange Rates on Indonesian Exports", the purpose of this study is to review the relationship between the exchange rate and exports by looking at the long-term and short-term relationships. Based

on the analysis conducted, in the long-term regression, exports have a significant negative effect on the exchange rate, as well as in the long-term, the short-term between export variables and the exchange rate also has a significant negative effect.

According to Dewi (2018), in the analysis the variables used are GDP, inflation, and Exchange Rate as independent variables, for the dependent variable using export and import variables. The analysis carried out on the exchange rate on exports in the short term is not simultaneously significant on the exchange rate, and in the long term it has a significant negative effect on exports.

Arfiani (2019) in the analysis conducted, it is concluded that the exchange rate is only significant on the export variable. However, based on the results of the Impulse Response Function and Variance Decomposition, it shows that the variables of exports, imports and economic growth are quite influential on the exchange rate.

2.7. Research Hypothesis

Based on the observations and analysis conducted in the literature review, it can be concluded that the hypotheses used in the analysis are:

H0 = GDP, tax revenue, exports, and imports have a long-term effect on the exchange rate for the period 1986 to 2018

Ha = GDP, tax revenue, exports, and imports have no long-term effect on the exchange rate for the period 1986 to 2018.

3. RESEARCH METHODS

The data in this study are quantitative data derived from secondary data collected and described in numbers. This study uses one independent variable and four dependent variables, for the dependent variable, namely the rupiah exchange rate against the US dollar, while the independent variable uses the GDP, tax revenue, exports, and imports variables. The type of data used is time series data. Time series data is data that is collected and recorded based on time periods (Juanda & Junaidi, 2012). The data uses a time series from 1986 to 2018. The data collection in this study was carried out by Library Research. The data sources used are from the website of Bank Indonesia, the Central Statistics Agency, and the State Budget for the period 1986 to 2018.

The method used in this study in analyzing the data is the Error Correction Model (ECM). The use of the Error Correction Model (ECM) method is the right model to use because the data used in the study uses time series data. ECM is used to view and analyze the long-term and short-term relationship of the variables of Gross Domestic Product (GDP), tax revenues, exports, imports of the rupiah exchange rate against the dollar as the dependent variable. Cointegration test is needed to see and analyze the relationship between variables. Testing is needed to find out whether the data used has a cointegration relationship. The test is carried out in several ways, namely: stationarity test, degree of integration test, residual cointegration test.

3.1. Stationarity Test

Stationarity testing is to do a Unit Roots Test which aims to see if the data is stationary after the 1st Difference is done. Unit roots test using Augmented Dickey-fuller is used for time series data. The data can be said to be stationary if the p-value (Prob. Chi-square) is smaller than the tariff level. The data is not stationary if the P value < 0.05. The data can be said to be stationary if the P value > 0.05.

3.2. Cointegration Test

Cointegration test is needed to identify whether the data used in the study has a long-term relationship. Coordination testing by regressing the independent variable to the dependent variable by means of OLS (Basuki & Prawoto, 2019). The Engle-Granger (EG) test is used in the cointegration test and all stationer variables are at the first level of differentiation.

3.3. Classic Assumption Test

Destination from the classical assumption test is to identify the research model to get the BLUE (Best Linear Unbiased Estimator) trait.

Autocorrelation Test aims to see whether the model used does not have a correlation between one variable and another with changes in time. Autocorrelation test is used on time series data or time series in linear regression model. If there is autocorrelation in the research model, the autocorrelation test does not pass.

Heteroscedasticity test was conducted to determine whether the regression model contained deviations from the requirements of the regression model (Basuki & Prawoto, 2019). This test is used to observe whether the model has residual variance inequality. A good regression model must be homoscedastic and free from heteroscedasticity.

Normality test is used to test the data whether the data in the regression analysis, namely the independent variables and fixed variables, have been normally distributed or not. Good data that can be used in conducting regression analysis is data that is normally distributed. The condition for the data to pass the normality test is if the Jarque Prob value is greater than 0.05.

3.4. Error Correction Model

If the test proves that there is cointegration, the research can be continued with ECM modeling. The ECM regression model in this study is as follows:

Regression Model:

$$Exchange\ rate = f(PDB, TR, EX, IM)$$

Long term ECM model:

$$Exchange\ rate = \alpha 0 + \beta_1 PDB + \beta_2 TR + \beta_3 EX + \beta_4 IM + \varepsilon_t$$

Short-term ECM models:

$$Exchange\ rate = \alpha 0 + \beta_1 \Delta PDB_t + \beta_2 \Delta TR_t + \beta_3 \Delta EX_t + \beta_4 IM_t + ECt + \varepsilon_t$$

As for ECM Model used in this research:

$$Exchange\ rate = \alpha 0 + \beta_1 \Delta PDB_t + \beta_2 \Delta TR_t + \beta_3 \Delta EX_t + \beta_4 IM_t + \beta_5 \Delta PDB_{t-1} + \beta_6 \Delta TR_{t-1} + \beta_7 \Delta EX_{t-1} + \beta_8 IM_{t-1} + \beta_9 ECt + \varepsilon_t$$

Information:
Exchange rate = Rupiah exchange rate against the US dollar
GDP = Gross domestic product
TR = Tax revenue
EX = Export
IM = Import

4. RESULTS AND DISCUSSION

4.1. Research result

4.1.1. Unit Roots Test

Based on the unit root test using the Augmanted Dickey-Fuller test on the degree level condition, it can be seen in table 1 that all data variables are not stationary at the degree level.

Table 1. ADF Test (Level) Result

Variable	t-Statistic	Prob.	Description
Exchange rate	-0,860755	0,78575	Not Stationary
GDP	3,356833	1,0000	Not Stationary
TR	2,790481	1,0000	Not Stationary
EX	-0,349215	0,9063	Not Stationary
IM	-0,371329	0,9026	Not Stationary

Source: Results of Eviews 10 (2022)

The Augmanted Dickey-Fuller unit root test is continued by increasing the degree to the 1st difference level. Based on table 2, it can be seen that all stationary variables are at the 1st difference level. This is because the probability value for each variable is less than 0,05.

Table 2. ADF Test (1st difference) Result

Variable	t-Statistic	Prob.	Description
Exchange rate	-6,706786	0,0000	Stationary
GDP	-3,106-87	0,0365	Stationary
TR	-5,310520	0,0001	Stationary
EX	-4,745665	0,0010	Stationary
IM	-5,039135	0,0003	Stationary

Source: Results of Eviews 10 (2022)

4.1.2. ECM Test Results

Table 3. Short Term Test Result

Dependent Variable: D(EXCHANGE) Method: Least Square Sample (adjusted): 1987 2018 Included Observation: 32 after adjustment			
Variable	Coefficient	t-statistics	Prob.
C	1361,687	-4,390043	0,0002
D(GDP)	-0,004416	-4,410795	0,0002
D(TR)	0,007561	2,328862	0,0279
D(EX)	-0,014085	-0,748428	0,4609
D(IM)	-0,020944	-1,355150	0,1870
ECT(-1)	-0,325631	-3,058232	0,0051
R-squared	0,622892		
Adjusted R-squared	0,550371		
SE of regression	977.6809		
Sum squared resid	24852356		
Likelihood logs	-262.4097		
F-statistics	8,589156		
Prob(F-statistic)	0,000066		

Source**:** Eviews 10 (2022) Results

On table 3, it shows the estimation results of using short-term ECM, it can be seen that the ect value obtained is negative (-0,325631) which is a negative value indicating that there is an adjustment between the types of short-term ECM models and long-term ECM. This shows an error correction of 32% which shows the discrepancy between the long-term model and the short-term model.

The GDP variable (gross domestic product) has a probability of 0,0002, it shows that the GDP variable has a short-term effect on the exchange rate variable (exchange rate). GDP has a significant and negative effect, meaning that if GDP increases by 1 point, the exchange rate will decrease by 0,004416 points if other factors are ceteris paribus. Tax revenue (TR) has a positive significant effect on the exchange rate, the probability value obtained is 0,007561, meaning that every 1 point increase in tax revenue will have a positive effect of 0,007561 points on the rupiah exchange rate if other factors are ceteris paribus. The probability value is 0,0279, which is greater than the value of (0,05).

Economic growth is inversely proportional to the exchange rate of the rupiah against the dollar. In looking at the increase and decrease in the value of the rupiah, one of the important factors that cannot be ignored is the policy of Bank Indonesia as the central bank in regulating interest rates or the BI rate. An increase in the benchmark interest rate (BI rate) will encourage people to save their money in the form of savings. When people save their money, economic growth is hampered, the economy is hampered due to a decrease in economic activity caused by people choosing to save their money in banks to get bigger profits. This is in accordance with the results of research conducted by Andriyani (2012) that when interest rates rise, investors tend to save their money in banks to earn higher interest rates, compared to investing in the risky real sector.

The results of the analysis show that tax revenue has a significant positive effect on the exchange rate. The strengthening of the exchange rate against the US dollar will have a significant impact on tax revenues. Tax is a source of state income originating from

taxpayers that must be paid by individuals and agencies, when tax revenues increase, this indicates stable and good economic growth. If the exchange rate strengthens against the US dollar, people will tend to consume, this is because the cost of imports will be cheaper and tend to lower commodity prices in the market, this consumption will affect state revenues through taxes, this is in accordance with what was stated Sinambela & Rahmawati (2019) that public consumption will greatly affect VAT.

Testing continued to show the existence of a long-term relationship between the dependent and independent variables. The test was carried out using the Eagle Granger method.

Table 4. Long Term Test Result

Dependent Variable: EXCHANGE
Method: Least Square
Sample (adjusted): 1987 2018
Included Observation: 33

Variable	Coefficient	t-statistics	Prob.
C	72.19988	0,031743	0,9749
GDP	0,001156	1,499353	0,1450
TR	0,003658	0,954656	0,3479
EX	0,074330	2.993655	0,0057
IM	-0,091113	-4,000045	0,0004
R-squared	0,832650		
Adjusted R-squared	0,808743		
SE of regression	1863,022		
Sum squared resid	97183872		
Likelihood logs	-292.6025		
F-statistics	34.82854		
Prob(F-statistic)	0,000000		

Source**:** Eviews 10 (2022) Results

Based on the results of data processing above, the Long-term ECM regression equation is obtained as follows:

$$KURS = 72{,}19988 + 0{,}001156PDB + 0{,}003658TR + 0{,}074330EX - 0{,}091113IM$$

The R-squared value in the Long-term estimation test is 0.83. The relationship between the variables of GDP, TR, EX, IM and EXCHANGE shows a simultaneous relationship that affects each other between variables, it can be seen from the value of Prob (F-statistic) which is 0,00000 which is smaller than alpha of 0,05.

Based on the long-term estimation results in table 4, the export coefficient has a significant positive relationship of 0,074330 in the long-term relationship, this indicates that every 1 point increase in the exchange rate will affect exports by 0,074330 points if other factors is ceteris paribus. The next variable that has an influence on the rupiah exchange rate is imports. The import variable shows a coefficient of (-0,09113), meaning that for every 1 point increase in imports, the exchange rate variable will decrease by 0,09113 points if other factors are ceteris paribus.

The increase in exports that occurs will have an impact on export activities carried out. Based on the results of the analysis carried out, exports have a positive influence on the rupiah exchange rate, when exports experience growth, the Indonesian economy is in a good stage, and when export activities increase, economic growth will be more stable and better. The increase in export activities will affect Indonesia's foreign exchange reserves, with foreign exchange exports received by Indonesia increasing and the effect on the rupiah exchange rate will be strengthened. These finding is in line with research carried out by Agustina and Reny (2018) that foreign exchange reserves will affect the exchange rate.

The import variable shows that imports have a significant negative effect on the exchange rate, meaning that when there is an increase in imports, it will decrease the value of the rupiah, this phenomenon is inversely proportional to exports. Imports carried out by a country will drain foreign exchange or foreign exchange reserves owned by a country. Imports that are carried out continuously without going through policies will harm a country, because with limited foreign exchange reserves and the use of foreign exchange reserves that are carried out will disrupt the international trade activities of a country, because the country cannot carry out international trade activities. The impact of the disruption of the economy will have an impact on the exchange rate. The less a country's foreign exchange reserves, the weaker the exchange rate will be (Agustina & Reny, 2018).

4.1.3. Classic Assumption Test

To find out whether the research conducted already has BLUE properties, it is necessary to test the classical assumptions to find out there are no problems in the classical assumptions.

1) Heteroscedasticity Test

Table 5. Heteroscedasticity Test (Breusch-Godfrey) Result

Heteroscedasticity Test: Bruesch-Pagan-Godfrey			
F-statistics	2,583515	Prob. F(5,26)	0,0502
Obs*R-squared	10,62148	Prob.Chi-Square(5)	0,0594
Scaled explained	7,603650	Prob. Chi-Square(5)	0,1795

Source**:** Eviews 10 (2022) Results

Heteroscedasticity test using the Breusch Godfey model with the results in table 6 shows that the value of Prob.Chi-Square (5) is 0,0594, the value is greater than 0,05. So it can be concluded that H0 is accepted, this shows that the study does not have heteroscedasticity.

2) Autocorrelation Test

Table 6. Autocorrelation Test (LM Test) Result

Breusch-Godfrey Serial Correlation LM Test:			
F-statistics	0,698865	Prob. F(2,24)	0,5070
Obs*R-Squared	1,761078	Prob. Chi-square(2)	0,4146

Source**:** Eviews 10 (2022) Results

Based on the results of the autocorrelation test using the Breusch-Godfrey Serial Correlation LM test model in table 7 above, the value of Obs*R-squared is 1,761078, Prob.F(2,24) is 0,6070 and the value of Prob. Chi-square(2) at lag 2 is 0.4146. This value is greater than 0,05 (5%), meaning that the research model does not have autocorrelation and H0 is accepted.

3) Multicollinearity test

Table 7. Multicollinearity Test Result

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
D(GDP)	1,00E-06	3,361109	1,155336
D(TR)	1,05E-05	2,223666	1,480024
D(EX)	0,000354	2,779986	2,463973
D(IM)	0,000239	3,531482	3,284082
C	96209,28	3,220866	NA

Source**:** Eviews 10 (2022) Results

Based on Table 7 of the multicollinearity test above on each variable shows the Centered VIF value of less than 10, meaning that in this study there is no multicollinearity problem.

4) Normality test

The normality test shows that by using the Jarque-Bera method, it can be seen that the value is 0,939941, has a probability of 0,657428, meaning that the ECM model is normally distributed.

5. CONCLUSION

Based on the results of research conducted, in the short term the variable Gross Domestic Product (GDP) has a significant negative effect on the rupiah exchange rate, and the variable tax revenue has a significant positive effect on the rupiah exchange rate. In the short-term test for the export variable, it has no effect on the exchange rate, this also occurs in the import variable which does not have a short-term effect on the exchange rate.

Meanwhile, in the long-term test, the export variable has a significant negative effect on the exchange rate. In the import variable, the relationship that occurs is a significant positive effect, while for the GDP and tax revenue variables, in the long-term test no relationship is detected.

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