Relationship between exchange rate and trade balance during the period 2002-2023 in Albania

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Abstract

Purpose: *The main objective of this paper is to empirically identify the impact of exchange rate volatility on the trade balance in Albania. This paper analyzes the relationship that exists between the trade balance and the exchange rate. In addition, other macroeconomic factors with an impact on the trade balance are analyzed, such as economic growth, the basic interest rate, foreign direct investments and remittances.*

Methodology: *The method used is the empirical method in presenting data and the performance of macroeconomic factors and the econometric method to study the relationship between the exchange rate and the trade balance. The study uses data obtained from INSTAT, the World Bank and other sources for the period 2002-2023. To estimate the regression results and estimation procedures for time series*

parameters, the VAR Model is used, using data on the trade balance, the euro/lek exchange rate, foreign direct investments, economic growth and remittances.

Findings: *The results of this study show that there is a weak relationship between the exchange rate and the trade balance.*

Value: *Also, the paper contributes to the existing literature on the relationship between exchange rate and trade balance during the period 2002-2023 in Albania. The findings can be used by businesses and stakeholders as a tool that helps them make the necessary assessments regarding the risks of the exchange rate and the impact on their businesses.*

Keywords: *exchange rate, trade balance, FDI, remittances, VAR model.*

Introduction

Just as other prices in the economy are determined by the interaction of buyers and sellers, exchange rates are determined by the interaction of consumption by households, businesses, and financial institutions that buy and sell foreign currencies to make international payments. (Krugman, P., Obstfeld, M., & Melitz, M. J. 2018).

The exchange rate reflects all transactions between economic agents, and directly affects the allocation of resources in an open economy, valuing or devaluing domestic goods in relation to another currency (in our case the European currency) and therefore affecting the trade balance. The purpose of this paper is to identify the role of the exchange rate in the trade balance of Albania.

In the first part of this paper, the authors analyze the latest macroeconomic developments in terms of the trade balance, as well as theoretical and empirical assessments of the relationship between the exchange rate and the trade balance. Then, it will be describing the progress of the trade balance in Albania in the last twenty years, an empirical summary of the data and the progress of the trade balance and other macroeconomic factors. The paper continues with the econometric model based on the VAR test, which aims to explain the relationship between the trade balance and the euro/lek exchange rate.

Literature review

Starting from the theoretical perspective that shows the relationship between the exchange rate and the trade balance, many studies have been done to analyze this impact through empirical studies.

A study in this field has analyzed the impact of movements in the real exchange rate relative to economic growth, based on five-year average data for a panel of over 150 countries in the post-Bretton Woods period. Unlike the previous literature, external instruments were used to assess the reverse causality of economic growth in relation to the real exchange rate. The country-specific instruments studied are (i) global capital interacted with the financial openness of individual countries and (ii) the growth rate of official reserves. The study finds that a real appreciation (devaluation) significantly lowers (raises) annual real GDP growth, more than previous estimates in the literature. However, the results of the study confirm this effect only for developing countries and for currencies pegged to another base currency. (Habib, Mileva &, Stracca, 2016).

In a paper by Martin Falk (2008) on the determinants of the trade balance using data for 32 industrialized and developing economies for the period 1990–2007, the results, based on fixed effects models and linear mixed models that allow coefficients of the random slope, show that the trade balance as a percentage of GDP is significantly positively related to the foreign real GDP per capita of the trading partners. Real domestic GDP per capita has a negative effect on the trade balance. A real depreciation of the real effective exchange rate leads to an improvement in the trade balance. However, in countries with a negative trade balance and/or a large positive net foreign direct investment position, the trade balance is much less sensitive to movements in the real effective exchange rate.

In their empirical findings Barkat, Jarallah & Alsamara, (2024) reveal that the currency depreciation, deteriorates the trade balance in the short run and improves it in the long run. Findings also prove that the trade balance's response to nominal effective exchange rate positive changes is greater compared to negative changes. The policy implication of these findings reveals that a nominal effective exchange rate is a useful tool to sustain the trade balance.

Safet (2017), in his study on the effect of the devaluation of the local currency exchange rate on the trade balance of Albania has concluded that there is a long-term co-integration between the real depreciation of the effective exchange rate and the trade balance. Concretely, the effective real

depreciation of the exchange rate positively affects Albania's trade balance in both the long and short term, indicating the weak presence of the J-curve effect.

Bernoth, K., & Herwartz, H (2021) in their study conclude that the 'financial channel' is more important in the transmission of exchange rate shocks to sovereign risk in comparison with the traditional 'net trade channel'. Moreover, we confirm the prime role of the currency mismatch of the non-public sector for the strength of the 'financial channel'.

Another paper (Tanku & Vika, 2020), which studied the sensitivity of the exchange rate to real and monetary shocks in Albania over the last 20 years,

provides useful information on whether the exchange rate acts as a shock absorber or as a source of instability in economics. The analysis uses a structural vector autoregression method with permanent and transitory shocks, along the lines of Ouliaris, Pagan, and Restrepo (2018). The model is based on Weber (1997) and includes employment, output, real exchange rate, money and prices. The first two variables aim to identify supply shocks; the third is identified as a real demand shock; while monetary indicators aim to capture nominal shocks, namely the effects of monetary demand and supply. The results suggest that monetary shocks account for about 28 percent of real exchange rate fluctuations in Albania.

In their study Djalo, M. U., Yusuf, M., & Pudjowati, J. (2023) find out that simultaneously, exports, imports, exchange rates and inflation, give effect simultaneously or simultaneously and significantly to foreign debt.

Many studies have been conducted in different countries to find out the relationship between the exchange rate and the trade balance and in many cases, they present different results. In 2023, a dramatic change occurred in the euro/lek exchange rate, valuing the local currency in relation to all foreign currencies. This paper aims to analyze the role of the real exchange rate in the trade balance of Albania in the last twenty years.

Macroeconomic factors in Albania

Since the change of the political system in the 90s, Albania has established a regime of fluctuating exchange rates. Under this regime, the price of currencies, i.e. the euro against the Albanian lek, is determined by the conditions of the foreign exchange market. Exchange rate fluctuations reflect the free movement of goods and monetary capital in Albania's commercial and financial exchanges with its trading partners.

Exchange rate

During the period 2002-2023, the volatility of the exchange rate can be divided into two sub-periods. In the first sub-period 2002-2015 there were some exchange rate fluctuations, starting with an interval between (129.9-132.06 ALL/euro) for the period 2002-2009 and then a more stable rate (138.8-139.8 ALL/euro) for the period 2010-2015. In the second sub-period 2016-2023, a rapid strengthening of the lek against the euro occurred in 2018 (the lek/euro exchange rate fell from 135 to 125), followed by the 2-year period of the pandemic, which marked exchange rate stability. The year 2022-2023 marks further strengthening of the lek not only against the euro (the lek/euro exchange rate falls from 125 to 112), but also against other main currencies in the domestic market. The highest

monthly decrease was reached in July 2022 (-2.5%), while the lowest historical rate in the domestic market was reached in April 2023 (111 ALL/euro), 3 weeks before the local elections. Fluctuations in the exchange rate of the lek against the euro are also reflected in the Albanian trade balance. Albania, like other South-Eastern European countries, recorded a negative trade balance in the period 2002-2023.

Trade balance

The trade balance to GDP ratio is an indicator of the importance of international trade in a country's economy. In Albania, it occupies a significant part of the GDP. From 2002-2023, the weight of the trade balance in relation to GDP has been improving from -24.578 percent of GDP in 2002 to about -18.701 percent of GDP in 2023.[1]

Foreign Direct Investment (FDI)

In Albania, FDIs appeared after the 1990s with the change of the political system and their level was low. But after the 2000s, their volume began to increase significantly as the country offered great opportunities for foreign investors, but also because the implemented political system followed the path of privatizations in the energy sectors. telecommunications, services, infrastructure, etc. In 2002, the presence of FDI in relation to GDP was 3.1048 percent, reaching a record level of 11.17 percent in 2009. Then the contribution of FDI in relation to GDP this level has suffered a steady decrease, ending at 8.43 percent in 2023[2].

Remittances

Remittances, according to the estimates of the Bank of Albania, constitute the largest incoming flow in the Albanian economy, leaving behind foreign direct investments and exports. They have been the most stable and safest financial flows in the Albanian economy, influencing over the years the improvement of the balance of payments and the level of economic development in the country. Since 2006, the level of remittances has been decreasing and their lowest level was during the years 2013-2014 because of the economic crisis that affected neighbouring countries such as Greece and Italy. In 2002, the contribution of remittances in relation to GDP was about 16.871 percent, while in 2013 the contribution of remittances in relation to GDP was about 10 percent, and after

[1] https://www.ceicdata.com/en/albania/trade-statistics/al-goods-trade--of-gdp
[2] https://www.ceicdata.com/en/indicator/albania/foreign-direct-investment--of-nominal-gdp

this year it has increased to the extent of 11.3 percent in 2015 then remittances have suffered a steady decline, ending at 9.94 percent in 2023[3].

The econometric model

This paper aims to determine the relationship that exists between trade balance, exchange rate, foreign direct investment, economic growth and remittances. The regression model was built based on the conceptual framework described and adapted only for Albania.

$$TB = \beta 0 + \beta ER + \beta FDI + \beta GDP + \beta REM + \varepsilon$$

TB– represents the trade balance as a percentage of GDP. It is an indicator of the relative importance of international trade in a country's economy. It is calculated by dividing the net value of imports and exports for a period by the GDP for the same period.

ER- represents the euro/lek exchange rate. The value of the lek against currencies is determined freely in the foreign exchange market. Exchange rate fluctuations reflect the free movement of goods and capital in Albania's commercial and financial exchanges with its trading partners.

FDI- Foreign direct investments as a percentage of GDP. It is a long-term interest-bearing investment in an economy other than the country of origin of the direct investor, expressed as a percentage of GDP.

GDP (Gross Domestic Product) - represents the total monetary value of all goods and services produced during a given period by domestic production and service units.

REM- remittances as a percentage of GDP. Remittances are defined as the sum of two components: income from work and personal transfers. Personal remittances taken as a share of GDP is the flow of personal remittances expressed as a percentage of Gross Domestic Product (GDP).

Descriptive analysis

TABLE 1: Descriptive statistics

	TB	FDI	ER	GDP	REM
Mean	-306.2283	101.7923	129.7835	1334.405	153.9276
Median	-320.2720	118.6434	128.7483	1341.450	157.0317

[3] https://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS?locations=AL

Maximum	-162.8770	194.8763	140.5833	2311.700	229.7830
Minimum	-463.6000	20.57569	108.7500	662.7000	109.9315
Std. Dev.	82.56450	48.02096	8.727801	446.5299	26.87502
Skewness	0.124786	-0.428370	-0.418128	0.351580	0.767261
Kurtosis	2.567593	2.395452	2.485409	2.592810	4.378247
Jarque-Bera	0.228490	1.007857	0.883783	0.605219	3.899797
Probability	0.892039	0.604153	0.642819	0.738888	0.142288
Sum	-6737.023	2239.431	2855.237	29356.90	3386.408
Sum Sq. Dev.	143154.8	48426.27	1599.665	4187167.	15167.60
Observations	22	22	22	22	22

The results from the descriptive statistics table can help give a better idea of the variables. It can also be seen that the variables have values of skewness close to zero and kurtosis less than 3.

Dependent Variable: TB				
Method: Least Squares				
Date: 03/12/24 Time: 14:34				
Sample: 1 22				
Included observations: 22				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	93.90395	209.4457	0.448345	0.6596
FDI	-0.183573	0.483853	-0.379400	0.7091
ER	-0.520675	1.137991	-0.457539	0.6531
GDP	-0.084759	0.047014	-1.802843	0.0892
REM	-1.304301	0.752111	-1.734186	0.1010
R-squared	0.888134	Mean dependent var		-306.2283
Adjusted R-squared	0.861812	S.D. dependent var		82.56450
S.E. of regression	30.69222	Akaike info criterion		9.882612
Sum squared resid	16014.21	Schwarz criterion		10.13058
Log likelihood	-103.7087	Hannan-Quinn criter.		9.941025
F-statistic	33.74175	Durbin-Watson stat		1.307994
Prob(F-statistic)	0.000000			

The results from the table of methodological statistics can help give a better idea of the variables. The value of "Adjusted R-squared" is 0.86 which means that 86 percent of the behaviour of the trade balance (dependent variable) is explained by the behaviour (volatility) of the independent variables.

ADF Unit Root Test

Initially building an equation on the variables seems to provide a model of explanatory power with an adjusted R2 of 67.24 % and its overall high significance. However, time series data can often present unreliable results because of non-stationary data or otherwise called spurious regressions. This is why further testing is needed to create an accurate model that provides relationships between variables.

Null Hypothesis: TB has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=4)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.157396	0.6724
Test critical values:	1% level		-3.788030	
	5% level		-3.012363	
	10% level		-2.646119	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(TB)				
Method: Least Squares				
Date: 03/12/24 Time: 14:55				
Sample (adjusted): 2 22				
Included observations: 21 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
TB (-1)	-0.108267	0.093544	-1.157396	0.2615
C	-45.33421	29.00752	-1.562844	0.1346
R-squared	0.065860	Mean dependent var		-12.82967
Adjusted R-squared	0.016695	S.D. dependent var		33.55238
S.E. of regression	33.27113	Akaike info criterion		9.937650
Sum squared resid	21032.39	Schwarz criterion		10.03713
Log likelihood	-102.3453	Hannan-Quinn criter.		9.959239
F-statistic	1.339564	Durbin-Watson stat		1.841160
Prob(F-statistic)	0.261454			

To verify the stationarity of the data, the Augmented Dickey-Fuller test will be used. The null hypothesis in the ADF test is that the variable has a unit root, which means it is non-stationary.

Test Statistics: The ADF test statistic is -1.157396.

This value is compared to the critical values to determine the statistical significance of the test.

Critical values: Critical values are given at the 1%, 5% and 10% significance levels. These critical values represent the thresholds beyond which the null hypothesis can be rejected. In this case, the critical values at the 1%, 5% and 10% levels are -3.788030, -3.012363 and -2.646119, respectively.

P-values: The p-value associated with the test statistic is 0.6724. This p-value indicates the probability of observing the test statistic if the null hypothesis were true.

Coefficients: The coefficient of the lagged variable (TB (-1)) is -0.108267.

The coefficient of the constant (C) is -45.33421.

R-Square and Adjusted R-Square: These statistics measure the goodness of fit of the regression model. In this case, the R-squared is 0.065860 and the adjusted R-squared is 0.016695. These values suggest that the model explains a small portion of the variability in the data.

Additional information: Mean and standard deviation of the dependent variable.

Measures of regression model quality, such as the Akaike information criterion (AIC) and the Schwarz criterion. The F-statistic and its associated p-value test the overall significance of the regression model.

Interpretation: The ADF test statistic (-1.157396) is greater than the critical values at all significance levels. The p-value (0.6724) is greater than 0.05 (assuming a significance level of 5%). Based on these results, we fail to reject the null hypothesis that TB has a unit root.

This suggests that TB is likely to be non-stationary, meaning it exhibits trends or patterns over time that make it difficult to accurately model and forecast using standard time series techniques. In conclusion, the results show that TB is likely to be non-stationary, which has implications for modelling and forecasting purposes. Further analysis may be needed to address non-stationarity and make the time series data suitable for analysis.

VAR Model

VAR models are a popular method for multivariate time series, such as the one in this study. These results are from a Vector Autoregression (VAR) model, which is a type of time series model used to analyze dynamic relationships between multiple variables. Let's explain the main components of production:

a) Model specification: The VAR model includes five variables: TB, ER, GDP, REM and FDI. The lag length used in the model is 2.
b) Coefficients: Each variable has coefficients associated with its lagged values (e.g., TB (-1), TB (-2)), along with a constant term (C).

The coefficients represent the influence of the lagged values of each variable and constant on the actual values of the variables.

c) Standard errors and t-statistics: Standard errors are given in parentheses, and t-statistics are given in square brackets. These values are used to evaluate the significance of the coefficients. In general, larger t-statistics (with absolute values greater than 1.96, assuming a 5% significance level) indicate greater significance.

d) Model Fit: The R-squared and adjusted R-squared values measure the fit of the model. The F statistic tests the overall significance of the model.

Additional information: sum of squared residuals, standard error of the equation, Akaike information criterion (AIC), Schwarz criterion, and other model fit statistics. Mean and standard deviation of the dependent variables.

VAR Test

Vector Autoregression Estimates					
Date: 03/12/24 Time: 15:02					
Sample (adjusted): 3 22					
Included observations: 20 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
	TB	ER	GDP	REM	FDI
TB (-1)	0.525468	-0.056730	-0.452392	0.019700	-0.378616
	(0.46453)	(0.04598)	(0.99693)	(0.13723)	(0.19731)
	[1.13117]	[-1.23392]	[-0.45379]	[0.14356]	[-1.91893]
TB (-2)	-0.675965	-0.014354	0.428026	0.067777	-0.204266
	(0.46189)	(0.04571)	(0.99125)	(0.13645)	(0.19618)
	[-1.46348]	[-0.31400]	[0.43180]	[0.49673]	[-1.04121]
ER (-1)	0.121817	0.580968	4.905549	0.648960	1.640974
	(2.67099)	(0.26435)	(5.73218)	(0.78905)	(1.13447)
	[0.04561]	[2.19773]	[0.85579]	[0.82246]	[1.44646]
ER (-2)	2.509876	0.120699	-6.472608	-1.277940	-0.454662
	(2.25164)	(0.22285)	(4.83221)	(0.66517)	(0.95636)
	[1.11469]	[0.54163]	[-1.33947]	[-1.92124]	[-0.47541]
GDP (-1)	0.171073	-0.065691	1.082627	0.098405	-0.054773
	(0.23524)	(0.02328)	(0.50484)	(0.06949)	(0.09992)
	[0.72723]	[-2.82158]	[2.14448]	[1.41604]	[-0.54819]
GDP (-2)	-0.274774	0.036187	0.148298	-0.050809	0.109467
	(0.25140)	(0.02488)	(0.53952)	(0.07427)	(0.10678)
	[-1.09298]	[1.45439]	[0.27487]	[-0.68414]	[1.02518]

REM (-1)	-0.957319	0.125763	0.770903	0.463022	0.349406
	(1.60992)	(0.15933)	(3.45502)	(0.47559)	(0.68379)
	[-0.59464]	[0.78931]	[0.22313]	[0.97357]	[0.51098]
REM (-2)	-1.251006	-0.106139	-0.093263	-0.199196	-0.902839
	(1.48085)	(0.14656)	(3.17803)	(0.43746)	(0.62897)
	[-0.84479]	[-0.72420]	[-0.02935]	[-0.45534]	[-1.43542]
FDI (-1)	-0.311122	0.108424	-0.988907	0.228392	0.410231
	(0.65474)	(0.06480)	(1.40514)	(0.19342)	(0.27810)
	[-0.47518]	[1.67320]	[-0.70378]	[1.18080]	[1.47514]
FDI (-2)	0.270718	0.039098	-0.898623	-0.177559	-0.648122
	(0.86477)	(0.08559)	(1.85587)	(0.25547)	(0.36730)
	[0.31305]	[0.45682]	[-0.48420]	[-0.69504]	[-1.76455]
C	-248.4883	39.41473	62.94419	153.1163	-185.2521
	(373.183)	(36.9341)	(800.883)	(110.243)	(158.505)
	[-0.66586]	[1.06716]	[0.07859]	[1.38889]	[-1.16874]
R-squared	0.899165	0.935420	0.985582	0.920164	0.946453
Adj. R-squared	0.787127	0.863665	0.969562	0.831457	0.886957
Sum sq. resids	10142.54	99.34732	46713.27	885.1320	1829.745
S.E. equation	33.57006	3.322438	72.04418	9.917056	14.25850
F-statistic	8.025507	13.03625	61.52188	10.37306	15.90773
Log likelihood	-90.66638	-44.40767	-105.9393	-66.27882	-73.54076
Akaike AIC	10.16664	5.540767	11.69393	7.727882	8.454076
Schwarz SC	10.71429	6.088420	12.24158	8.275534	9.001729
Mean dependent	-320.1325	129.3952	1400.005	158.2335	109.8417
S.D. dependent	72.75984	8.998145	412.9434	24.15611	42.40838
Determinant resid covariance (dof adj.)		1.75E+11			
Determinant resid covariance		3.23E+09			
Log likelihood		-360.8465			
Akaike information criterion		41.58465			
Schwarz criterion		44.32291			
Number of coefficients		55			

R-squared values: They are high for all variables, indicating a good fit of the model. Coefficients: Interpretation should be done considering the sign, magnitude and statistical significance (t-statistics and p-values) of the coefficients.

Standard errors: These are used to assess the precision of estimates. Lower standard errors indicate more accurate estimates. F-statistic: It is significant for all variables, indicating that at least one of the independent variables has a significant effect on the dependent variable.

AIC and Schwarz SC: These criteria can be used to compare models, with lower values indicating a better fit. Number of coefficients: It is significant (55), suggesting a complex model with many predictors. Residual Covariance Determinant: It provides information about the multicollinearity of the model. If it is very close to zero, it suggests high multicollinearity.

In conclusion, this regression model appears to provide a good fit to the data, with high R-squared values and significant F-statistics. However, the interpretation of the coefficients should be done with caution, considering their magnitude and significance statistical.

Granger Causality

Granger causality is a test used to find one variable can be used for another. What shows the progress of the variables in the sense that it is one-sided or two-sided.

Null hypothesis: ER does not Granger cause TB

F-Statistic: 1.20735

p-value: 0.3264

Null hypothesis: TB does not Granger cause ER

F-Statistic: 0.07287

p-value: 0,9300

Interpretation: Based on the p-values, we fail to reject the null hypothesis in both directions, indicating that there is no Granger causality between TB and ER.

TB and GDP: Similar interpretation as above for TB and GDP.

TB and REM, TB and FDI: In both cases, the null hypothesis is rejected in one direction but not in the other, indicating asymmetric causality between TB and REM, and TB and FDI.

Other pairwise comparisons: Similar interpretation applies to other pairwise comparisons.

Pairwise Granger Causality Tests			
Date: 03/12/24 Time: 15:06			
Sample: 1 22			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
ER does not Granger Cause TB	20	1.20735	0.3264
TB does not Granger Cause ER		0.07287	0.9300
GDP does not Granger Cause TB	20	1.61907	0.2309
TB does not Granger Cause GDP		0.90681	0.4248
REM does not Granger Cause TB	20	0.36509	0.7001
TB does not Granger Cause REM		2.61229	0.1063
FDI does not Granger Cause TB	20	0.11254	0.8943

TB does not Granger Cause FDI		8.19517	0.0039
GDP does not Granger Cause ER	20	0.82219	0.4583
ER does not Granger Cause GDP		2.44756	0.1203
REM does not Granger Cause ER	20	0.25698	0.7767
ER does not Granger Cause REM		2.12248	0.1543
FDI does not Granger Cause ER	20	0.19590	0.8242
ER does not Granger Cause FDI		1.19038	0.3313
REM does not Granger Cause GDP	20	0.05385	0.9478
GDP does not Granger Cause REM		4.59421	0.0278
FDI does not Granger Cause GDP	20	1.26612	0.3104
GDP does not Granger Cause FDI		4.72612	0.0256
FDI does not Granger Cause REM	20	1.53409	0.2476
REM does not Granger Cause FDI		2.71686	0.0984

In some cases, there appears to be evidence of Granger causality in one direction but not the other, indicating possible asymmetric relationships between variables.

It is important to note that Granger causality tests have limitations and should be interpreted with caution, especially in the context of time series data. Furthermore, causality should not be inferred based on statistical significance alone.

Conclusions

This analysis was carried out by applying the VAR econometric approach and using data on the trade balance as a percentage of GDP, the euro/lek exchange rate, foreign direct investments, economic growth and remittances.

The period in which the study was carried out is 2002-2023 and the technique used was the VAR model to measure the long-term relationship of macroeconomic variables.

According to the VAR model there is no consistent relationship between the exchange rate and the trade balance. The coefficient associated with ER (-1) is negative (-0.056730), indicating that an increase in ER in the previous time is associated with a decrease in TB in the current period, holding other variables constant. However, the magnitude of this coefficient is relatively small compared to the others, and its statistical significance is not given (only the t-statistic is given, which would require the p-value for confirmation).

The delayed effect of ER on TB was also examined in the second time (ER (-2)). The coefficient for ER (-2) is not significant either.

The lack of statistical significance for the coefficients associated with ER (-1) and ER (-2) suggests that the impact of ER on TB may not be strong or consistent

across time periods. However, this conclusion needs to be confirmed by further analysis, including hypothesis testing for the significance of the coefficients.

While the coefficients provide insight into the relationship between ER and TB, it is essential that they be interpreted with caution and account for potential confounding factors or omitted variable biases that may affect the observed relationship.

Further analysis suggests that ER Granger causes TB: The p-value associated with the F-statistic is 0.3264, which is greater than the commonly used significance level of 0.05. Therefore, we fail to reject the null hypothesis. This suggests that there is insufficient evidence to conclude that past ER values significantly improve TB prediction.

To assess the relationship if TB Granger causes ER: The p-value associated with the F-statistic is 0.9300, which is much greater than 0.05. Therefore, we fail to reject the null hypothesis. This indicates that past TB values do not significantly improve the prediction of ER.

Based on these Granger causality test results, there is no significant evidence to suggest a causal relationship between ER and TB in both directions. These results imply that past ER values do not have a statistically significant impact on predicting future TB values, and vice versa.

However, it is important to note that Granger causality tests have limitations, and the absence of evidence of causality does not necessarily imply evidence of absence. Other factors or relationships not captured by the model may influence the observed dynamics between ER and TB.

In conclusion, the results of the Granger causality test suggest that there is no statistically significant causal relationship between ER and TB, indicating that past values of one variable do not significantly improve the prediction of future values of the other variable.

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