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Econ-312 Time-Series Analysis
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Final Project
Relationship between Inflation rate and Real interest rate

Introduction

Article aims to show the relationship among inflation rate and real interest rate through time series econometric model. I have used Dickey-Fuller test for check time series stationarity. Because that is a nonstationary time series, there are used several statistical tests in order to turn into a stationary series. After applying these tests, the time series became stationary and integrated of order I.
Then by performing Cointegration Test I have noticed that my variables are cointegrated and these variables have a long run equilibrium. By creating and comparing long and short-run models I have noticed that in a short run inflation rate is going to change in slower pattern than in a long run. Finally, I have conducted normality test and Portmanteau test for white noise and conclude that at the 5% significance level our residuals look normal and they are white noise.

Data Description

The source of the data is Federal Reserve official webpage. It shows inflation rate and real interest rate in USA. Time frame from 2010 to 2023.

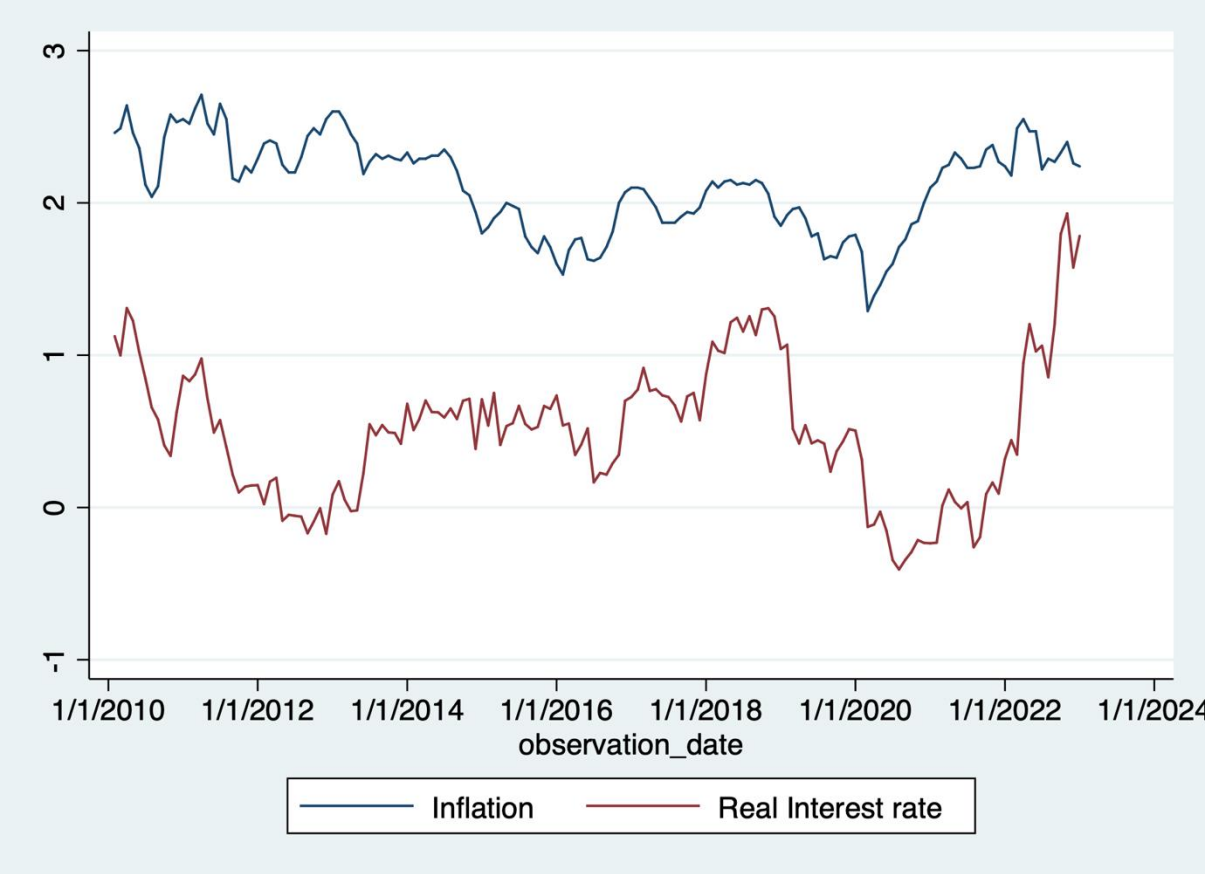
Summary report

Variable	Obs	Mean	Std. Dev.	Min	Max
Inflation	156	2.115128	.3013421	1.29	2.71
Real Int. rate	156	.5120827	.4627531	-.407134	1.930713

Correlation between variables

	Inflation rate	**R. Int. rate**
Inflation rate	**1.0000**	
R. Int. rate	**0.1669**	**1.0000**

Graphical Representation of the variables



At the first glance from the graph inflation rate and real interest rate seems more or less stationary as it is pretty much the same over the life of the series. But we should check it.

Check for stationarity

In order to check time series stationarity or nonstationarity we performed statistical test:
Dickey-Fuller test for Inflation rate

		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.250	-3.492	-2.886	-2.576

MacKinnon approximate p-value for Z(t) = 0.1888

Dickey-Fuller test for Real Interest rate

---------- Interpolated Dickey-Fuller ---------

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.765	-3.492	-2.886	-2.576

MacKinnon approximate p-value for Z(t) = 0.3980

By obtaining the following results we can say that we fail to reject H_0 and conclude that our variables are non-stationary i.e., it contains a unit root; this conclusion is supported also by the ρ-values associated with t-statistic, which is higher than 0.005.

Correcting for a Unit Root

Using the first difference transformation result in a stationary process.

For Inflation

---------- Interpolated Dickey-Fuller ---------

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.014	-3.492	-2.886	-2.576

MacKinnon approximate p-value for Z(t) = 0.0000

For Real Rate

---------- Interpolated Dickey-Fuller ---------

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-12.684	-3.492	-2.886	-2.576

MacKinnon approximate p-value for Z(t) = 0.0000

As we can see t-values are beyond the 1% critical value in the left-hand side of the tail.
So we can reject the H_0 and conclude that series are stationary.

Cointegration Test:

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.551	-3.969	-3.376	-3.072

By conducting the Engle-Granger test for cointegration we got the results above.
We are rejecting that series have a unit root and say that our variables (inflation and real interest rate) are stationary and they are cointegrated and the residuals are I(0).
So we can say that on the long run inflation rate and the real interest rate have a relationship.
This variables have a long run equilibrium.
As we have cointegrated variables we need to estimate Short run model (Error Correction Model) as well as long run model.
Results show that there is a discordancy between the long run and the short run.
In a short run inflation rate is going to change in slower pattern than in a long run.
Notice that when the real interest rate increases in unit over the long-run the expected change would be of 0.13 units on the inflation rate, statistically significant with a 5% level of significance.

Long run model

$y_t = -0.01 + 0.13x_t + e$

Short run model

$y_t = -0.006 + 0.06x_t - 0.11\varepsilon_{t-1} + V$

Normality test for Residuals

Shapiro-Wilk W test for normal data shoes that as p-value is bigger than 0.5 we can say that at the 5% significance level our residuals look normal.

Portmanteau test for white noise

As our p-value is bigger than 0.5 we can say that the residuals are white noise.

Conclusion

To sum up I can say that my expectations was satisfied. There exists a relationship among Inflation rate and Real interest rate.
It is found that variables show non-Stationarity and after taking first difference of their time series, the stationarity in time series is checked using empirical approaches of unit root. After 1st difference they were stationary at 5% significance level.
Using co-integration technique Engle-Granger co-integration test (residual based) it is obtained that there exists a relationship for long run or co-integration relationship in Inflation rate and Real interest rate at 5% significance level for period of 2010-2023 in USA.