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Determinants of Inflation in North Macedonia: 2005-2022

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Abstract
In this paper we analyze the determinants of inflation for a small open economy such as North Macedonia during the period 2005-2022. Using the Auto Regressive Distributed Lag (ARDL) model we find long run convergence of the inflation rate in North Macedonia, i.e. previous errors are corrected in the current period. We find the rate of this adjustment to be 1.17%. Furthermore, we do not find significant short run effects on the inflation rate in North Macedonia whereas the long run determinants of inflation which resulted as significant are: the inflation rate of EU countries, the base interest rate, the consumption to GDP ratio as well as the nominal effective exchange rate.
Keywords: inflation rate, ARDL model, convergence, North Macedonia, EU
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1. Introduction

The causes of inflationary dynamics to a great extent determine the choice of instruments of economic policy aiming to promote economic growth and development, thus inflation remains in the focus of contemporary macroeconomic stabilization policies. Many authors point out the importance and role of price stability emphasizing that optimum economic development implies a monetary balance, but there is also economic and structural balance, alluding to a wider macroeconomic stability ((Burton & Fischer, 1997), (Snowdon & Vane, 2005)).

The price stability is the main objective for most of the central banks, including the National bank of the Republic of Macedonia (NBRM). The development of inflation is crucial for monetary policy, particularly the forecast of future inflation, as the transmission of monetary policy decisions to real economy occurs with a time delay.

The coronavirus (COVID-19) pandemic shock required lockdowns and containment measures in the euro area, which implied a shutdown of businesses and/or an increase in costs for some sectors. The shock was multidimensional, stemming from both external and domestic sources, hitting both demand and supply and affecting both the aggregate and the sector-specific level. At the same time, the pandemic shock was countered by an unprecedented policy response both at the national and the supranational level. In combination, all of this has led to considerable volatility of inflation in the euro area and North Macedonia. As measured by the Harmonised Index of Consumer Prices (HICP), headline inflation in the euro area, which had equaled 1.2% in 2019, fell to 0.3% in 2020 and was even negative in the second half of 2020 before increasing again to 2.6% in 2021. Since mid-2021, headline inflation increased particularly sharply and reached a historical high of 5.9% in February 2022 (see figure 1). Also in North Macedonia at the beginning of 2019 inflation was 2%, to become negative during 2020 (-0.8%). While in the middle of 2021, inflation increased to the levels of 3.5%, to increase to 9% in May 2022 (see figure 1). This article discusses the drivers of inflation in North Macedonia from 2005 to 2022, being provoked by high inflation starting from 2021 and continuing until 2022.

The paper is organized as follows. Section 2 reviews the relevant literature related to the determinants of inflation. Section 3 presents the data and methodology, while section 4 presents the results of the model. Section 5 concludes.

2. Literature Review

There are several empirical studies undertaken to identify the possible determinants of inflation based on different techniques and time periods. Although the topic is no more new, there are continuing studies on this topic to reveal the possible factors affecting the movement of inflation. These studies report different results.

For instance, Bashir, et al. (2011) and Adu & Marbuah (2011) discussed that the money supply is a significant determinant of inflation. However Kim (2001) found that there is no evidence to show money supply affect in inflation.

Bashir, et al. (2011) and Bandara (2011) in their study also found Gross Domestic Product (GDP) has a positive influence on inflation but Aurangzeb & Haq (2012) claim that GDP has negative relationship with inflation. Khan, Bukhari, & Ahmed (2007) also discussed inflation expectation and imported inflation have positive pressure on inflation.

A study has developed a methodology for decomposition of total inflation, obtained with macroeconomic

model (MAKPAM) of NBRM, to CPI components (Andonova, 2018). This decomposition of inflation to its components - food, energy and core inflation can facilitate discussion on inflation and help monetary policy decision making. A methodology uses a small system that accounts for the interactions among total inflation dynamics and other exogenous factors, such as output gap, world commodity prices, and foreign effective inflation, to obtain projections for inflation components by applying the Kalman filter procedure. Namely, food and domestic oil prices have a relatively good fit, and the recursive forecasting shows that the capture of turning points is quite well. Regarding the core inflation, there is weak explanatory power of the determinants after 2012, which to some extent is effect of one-time factors rather than economic factors. Overall, the performances tests showed that the model is useful analytical tool in the process of inflation forecast.

By using a Factor-Augmented VAR (FAVAR) model, was shown that a monetary policy shock affects high income households less compared to middle and lower income households, although the differences between the separate income groups are generally small. Then, by using a small scale gap model, was find that the prices of low income households are the most sensitive to a monetary policy shock, while the prices of the top income households are the least sensitive to the shock (Jovanovic & Josimovski, 2021).

A study (Lim & Sek, 2015) examines factors affecting inflation in two groups of countries (high inflation group and low inflation group) using annual data from 1970 to 2011. An Error Correction Model based on the Autoregressive Distributed Lag (ARDL) modeling has been used to explain the short run and long run impacts of each variable on inflation. The results respectively indicate that GDP growth and imports of goods and services have the significant long run impact on inflation in low inflation countries. Results also indicate that money supply, national expenditure and GDP growth are the determinants of inflation which impose long run impact on inflation in high inflation countries.

Also several studies have examined the determinants of inflation in transition economies. Coorey, Mecagni, & Offerdal (1996) consider the effect of relative price changes on inflation in transition economies. They find that, while money and wage growth were the most important determinants of inflation, relative price variability had a sizable impact during the high inflation associated with the initial liberalization, which a more modest effect at moderate inflation rates. Using a panel of transition economy, Fischer, Sahay, & Vegh (1996) find that fixed exchange rates, lower fiscal deficits and a number of structural variables are associated with lower inflation rates.

In general, most studies focus the analysis in the developing countries. The common approaches used to investigate the determinants of inflation are Co-integration and Vector Error Correction method. Most of the studies also find that the main determinants affecting inflation are money supply, interest rate and exchange rate.

3. Data and methodology

3.1 Data, variables and summary statistics

To analyze the determinants of inflation in North Macedonia we use data from the State Statistical Office of the Republic of North Macedonia, Eurostat as well as data from the National Bank of North Macedonia. Our dependent variable is the quarterly Harmonized Consumer Price Index of North Macedonia for the period 2005-2022. All the independent variables are on quarterly basis as well.

Table 1 reports summary statistics and the correlation matrix of all the variables used, while Figure 2 shows the time series plot of inflation rates for North Macedonia and the EU countries. As we can see, the inflation rates closely follow each other. From the correlation matrix we can also see that the two variables have a correlation of 0.632. The highest value of quarterly inflation in North Macedonia is realized in the first quarter of 2022 and amounts 4.32% and the lowest value was in the third quarter of 2008 and amounted to -1.424%. In the EU the highest and the lowest values of quarterly inflation are 3.83% and -0.55%, realized during the first quarter of 2022 and the third quarter of 2020, respectively. The other variables exhibit substantial variation as well. For instance, the base interest rate in North Macedonia during our sample period has varied from the lowest value of 1.25% to the highest value of 10%.

The budget deficit variable also shows variation ranging from a maximum of 12.029% in the fourth quarter of 2008 to -6.381% in the third quarter of 2007.

3.2 Methodology

Given the time series nature of the data the first step is to test for unit roots, that is, to determine the order of integration of the variables. To this end we conduct stationarity tests of our time series using the Dickey-Fuller test. Results are shown in Table A1 in the Appendix. The hypotheses tested through this test are as follows:

H_0: There is unit root (the series is non-stationary)

H_a: There is no unit root (the series is stationary)

A rejection of the null, means evidence in favor of stationarity. As can be seen from Table A1, for the variables HICP_NMK, Base rate, Budget deficit, Consumption to GDP and NEDK we find that the absolute value of the test statistic is higher than all the interpolated Dickey-Fuller 1%, 5% and 10% critical values, rejecting the null hypothesis of non-stationarity. Likewise, the MacKinnon approximate p-values are close to zero for these variables,

thereby rejecting the null hypothesis at the usual 1%, 5% and 10% significance levels. On the other hand for the variables HICP_EU, M2_GDP and ln(Grosswage) we cannot reject the null hypothesis of non-stationarity as the absolute value of their test statistics are lower than the interpolated Dickey-Fuller critical values. When we take the first difference of these variables they become stationary, i.e. the null hypothesis of non-stationarity is rejected. As a robustness check we also use the Phillips-Perron test and confirm the above results.

As the above test have shown that we have series of different orders of integration i.e. I(0) and I(1) we proceed by estimating an Autoregressive Distributed Lag (ARDL) model. First, we perform bounds cointegration test. The outcome of this test will show if we need to specify an error correction model. The null hypothesis of this test is that there is no levels relationship i.e. there is no cointegration among the variables. The criterion used is: we reject the null if the F statistics is greater than the critical value for the I(1) regressors, whereas, we accept the null if the F statistics is smaller than the critical value for the I(0) regressors.

4. Results

The results of the bound cointegration test are presented in Table 2. As we can see, the value of the F statistic is 17.9 which is higher than the critical values for the I(1) regressors even at 1% significance level. This means that there is cointegration among variables in our model and we need to specify an error correction model.

Having obtained cointegration results indicating that there is long run convergence we proceed to estimate an error correction model. The results are shown in Table 3. As we can see, the results are presented in three parts: the adjustment coefficient, the long run and the short run. The adjustment coefficient is -1.17 and is statistically significant at the 1% level. The fact that we obtained a negative adjustment coefficient means that there is going to be long-run convergence, i.e. previous errors will be corrected in the current period. In our case the speed of adjustment is 1.17%.

In terms of the other variables we find long term relations between the inflation rate in North Macedonia and all the other explanatory variables. The inflation rate in EU countries has a positive impact on the inflation rate in North Macedonia. This is expected as North Macedonia is a small open economy, dependent on imports. A 1 percentage point increase in the EU inflation rate increases the inflation rate in North Macedonia by 0.9 p.p. which is a large effect only statistically but also economically. The base interest rate determined by the Central Bank of North Macedonia is also significant at 5% significance level. An increase of 1 p.p. of the base rate decreases the rate of inflation by 0.2 p.p. Other variables found to be significant determinants of the inflation rate are consumption as a percentage of GDP and the nominal effective exchange rate (NEER), both with a positive sign.

We perform some diagnostic test to make sure our results are valid and strong. The results are presented in Table A2 and Figure A1 in the Appendix. First, we start by testing for serial correlation using the Durbin-Watson and Breusch-Godfrey LM test for autocorrelation. The DW d-statistics at 1.98 indicates that there is no serial correlation. The p-value of the Breusch-Godfrey test is 0.85 therefore, we cannot reject the null hypothesis of no serial correlation. Second, we test for heteroskedasticity using the White's test. The p-value of this test is 0.88, therefore we cannot reject the null hypothesis of homoskedasticity. Third, we test for normality using the Jarque-Bera test and obtain a p-value of 0.87. With this result we cannot reject the null hypothesis of normality. Finally, we test for model stability using the cusum test and find that the model is stable i.e. the line (shown in Figure A1 in the Appendix) is between the five percent boundaries.

5. Concluding remarks

In this paper we have analyzed the determinants of inflation for a small open economy – North Macedonia, during the period 2005-2022. Based on theory we have considered several factors as potential determinants of the inflation rate such as: the inflation rate of EU countries as the main trading partners of North Macedonia, the base interest rate, the money supply, the budget deficit, gross wage, consumption as well as the exchange rate. We found these variables to have different orders of integration, i.e. some being I(0) while others I(1), therefore the Autoregressive Distributed Lag (ARDL) model is used. This model allows for measuring the adjustment coefficient of the inflation rate along with the short run and the long run determinants of inflation. We found no short run effects while the determinants of inflation which showed significant long run relations with the inflation rate are: the EU inflation rate, the base interest rate, consumption as well as the exchange rate. Furthermore, we found the adjustments coefficient to be negative and significant implying long-run convergence.

References

Adu, G., & Marbuah, G. (2011). Determinants of inflation in Ghana: An empirical investigation. South African Journal of Economics, vol. 79, no. 3, 251-269.

Andonova, D. U. (2018). Inflation Decomposition Model: Application to Macedonian inflation. Skopje, North Macedonia: Working paper n.6, NBRM.

Aurangzeb, & Haq, A. (2012). Determinants of inflation in Pakistan. Universal Journal of Management and Social Sciences, vol. 2, no. 4, 89-96.

Bandara, R. (2011). The determinants of inflation in Sri Lanka: An application of the vector autoregression model. South Asia Economic Journal, vol. 12, no. 2, 271-286.
Bashir, F., Nawaz, S., Yasin, K., Khursheed, U., Khan, J., & Qureshi, M. (2011.). Determinants of inflation in Pakistan: An econometric. Australian Journal of Business and Management Research, vol. 1, no. 5, 71-82.
Burton, D., & Fischer, S. (1997). Ending Moderate Inflations. IMF, 15-96.
Coorey, S., Mecagni, M., & Offerdal, E. (1996). Disinflation in Transition Economies: The role of relative price adjustment. IMF Working Paper 96/138.
Fischer, S., Sahay, R., & Vegh, C. (1996). From Transition to Market: Evidence and Growth Prospects. MIT Press, Cambridge, Massachusetts.
Jovanovic, B., & Josimovski, M. (2021). Income-specific inflation rates and the effects of monetary policy: the case of North Macedonia. Skopje, North Macedonia: Working paper no.1, NBRM.
Khan, A., Bukhari, S., & Ahmed, Q. (2007). Determinants of recent inflation in Pakistan. MPRA, working paper 16254.
Kim, B. (2001). Determinants of inflation in Poland: A structural cointegration approach. BOFIT, Discussion Paper, no. 16.
Lim, Y., & Sek, S. (2015). An Examination on the Determinants of Inflation. Journal of Economics, Business and Management, Vol. 3, No. 7, 678-682. doi:10.7763/JOEBM.2015.V3.265
Snowdon, B., & Vane, H. (2005). Modern Macroeconomics, Its Origins, Development and Current State. USA: Edward Elgar Publishing Inc., Northampton.

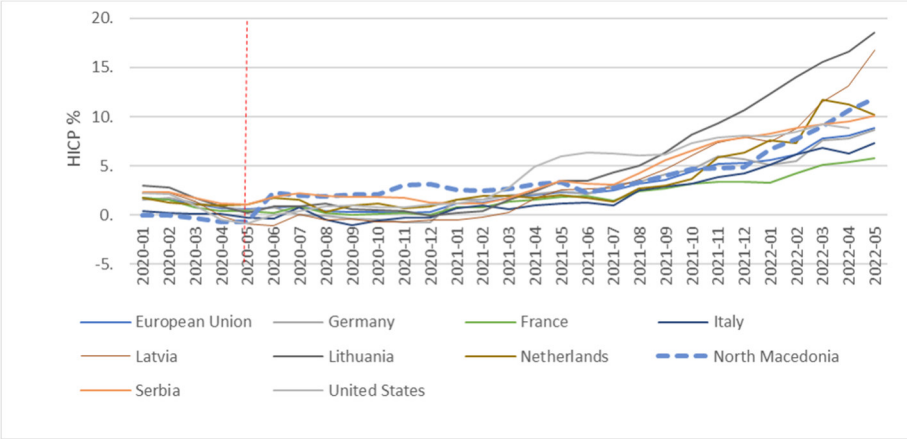

Figure 1: Harmonised Index of Consumer Prices (HICP) monthly 2020-2022. Source: Eurostat

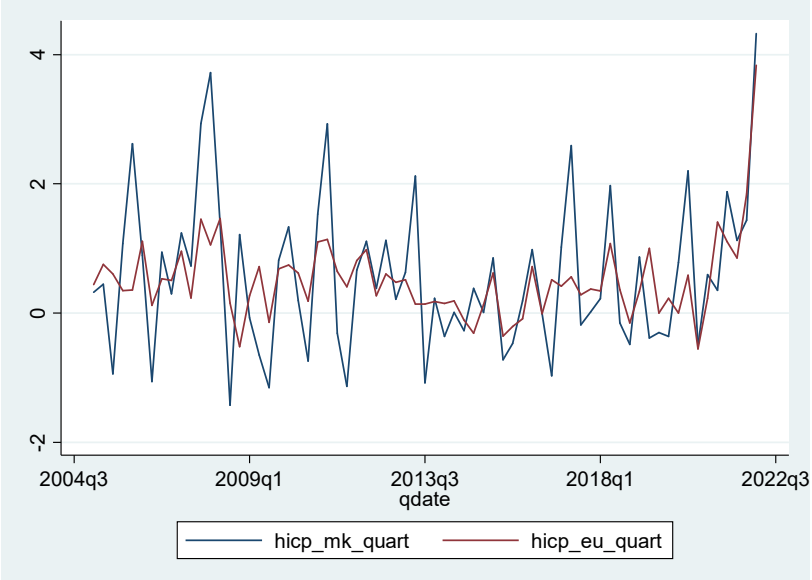

Figure 2: Time series plots: inflation rates

Table 1. Summary statistics and correlation matrix

Variable	Obs	Mean	Std. Dev.	Min	Max
HICP_MK	69	0.567	1.180	-1.424	4.323
HICP_EU	69	0.513	0.630	-0.553	3.837
Base rate	70	4.357	2.366	1.250	10.000
M2_GDP	70	177.628	26.499	107.202	255.341
Budget deficit	65	2.184	2.997	-6.381	12.029
Gross wage	69	10.350	0.190	9.952	10.746
Consumption_GDP	70	72.079	6.062	62.523	86.248
NEER	70	0.408	1.091	-1.724	3.852

Panel A.- Summary statistics

	HICP_MK	HICP_EU	Base rate	M2_GDP	Budget deficit	Gross wage	Consuption_GI
HICP_MK	1						
HICP_EU	0.632	1					
Base rate	-0.087	-0.102	1				
M2_GDP	0.256	0.324	-0.540	1			
Budget deficit	0.021	-0.116	-0.067	0.048	1		
Gross wage	0.005	0.156	-0.741	0.724	0.158	1	
Consuption_GDP	0.248	0.076	0.701	-0.237	-0.093	-0.751	1
NEER	0.162	-0.044	-0.075	0.018	0.178	0.105	-0.115

Panel B.- Correlation matrix

Table 2. Bounds cointegration tests

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship F = 17.906
t = -10.315

Critical Values (0.1-0.01), F-statistic, Case 3

	[I_0]	[I_1]	[I_0]	[I_1]	[I_0]	[I_1]	[I_0]	[I_1]
	L_1	L_1	L_05	L_05	L_025	L_025	L_01	L_01
k_7	2.03	3.13	2.32	3.50	2.60	3.84	2.96	4.26

accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

	[I_0]	[I_1]	[I_0]	[I_1]	[I_0]	[I_1]	[I_0]	[I_1]
	L_1	L_1	L_05	L_05	L_025	L_025	L_01	L_01
k_7	-2.57	-4.23	-2.86	-4.57	-3.13	-4.85	-3.43	-5.19

accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

Table 3. Results from the ARDL model

Sample: 2006q1 -	2022q1		Number of obs =		65	
			R-squared =		0.7189	
			Adj R-squared =		0.6788	
Log likelihood =	-76.5647		Root MSE =		0.8466	
D.HICP_MK	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ADJ						
HICP_MK L1.	-1.169	0.113	-10.32	0	-1.396	-0.942
LR						
HICP_EU	0.980	0.163	6.01	0.000	0.654	1.307
Base rate	-0.206	0.080	-2.58	0.012	-0.366	-0.046
M2_GDP	0.002	0.008	0.26	0.797	-0.015	0.019
Budget deficit	0.010	0.034	0.29	0.773	-0.059	0.078
Gross wage	-0.661	1.576	-0.42	0.677	-3.819	2.497
Consumption_GDP	0.081	0.036	2.24	0.029	0.009	0.153
NEER	0.219	0.084	2.62	0.011	0.051	0.386
SR						
Constant	1.691	20.106	0.08	0.933	-38.586	41.968

Appendix

Table A1. Augmented Dickey-Fuller test for unit root

HICP_NMK	**Number of obs** = **67**			
	---------- Interpolated Dickey-Fuller ----------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.017	-4.113	-3.483	-3.170
MacKinnon approximate p-value for Z(t) = 0.0000				
HICP_EU	**Number of obs = 67**			
	---------- Interpolated Dickey-Fuller ----------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.947	-4.113	-3.483	-3.170
MacKinnon approximate p-value for Z(t) = 0.6302				
Base rate	**Number of obs = 68**			
	---------- Interpolated Dickey-Fuller ----------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.089	-4.110	-3.482	-3.169
MacKinnon approximate p-value for Z(t) = 0.0066				

M2 to GDP **Number of obs = 68**

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller --		
Z(t)	-3.284	-4.110	-3.482	-3.169

MacKinnon approximate p-value for Z(t) = 0.0689

Budget deficit **Number of obs = 63**

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller --		
Z(t)	-4.511	-4.121	-3.487	-3.172

MacKinnon approximate p-value for Z(t) = 0.0014

Gross wage

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller --		
Z(t)	-1.439	-4.113	-3.483	-3.170

MacKinnon approximate p-value for Z(t) = 0.8490

Consumption to GDP Number of obs = 68

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

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.957	-4.110	-3.482	-3.169

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

NEER Number of obs = 68

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

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-7.589	-4.110	-3.482	-3.169

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

Table A2. Diagnostic tests

Durbin-Watson d-statistic(9, 65) = 1.967863
Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	0.037	1	0.8467

H0: no serial correlation
White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity
chi2(44) = 33.04
Prob > chi2 = 0.8867
Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	33.04	44	0.8867
Skewness	8.23	8	0.4116
Kurtosis	0.06	1	0.8130
Total	41.33	53	0.8777

Jarque-Bera normality test: .2709 Chi(2) .8733
Jarque-Bera test for Ho: normality:

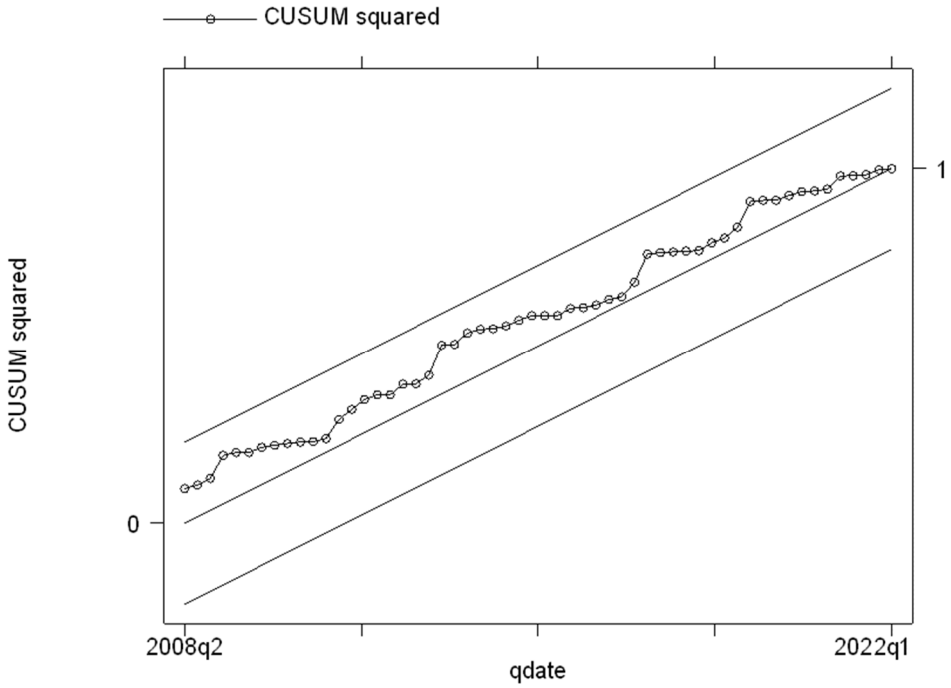

Figure A1: CUSUM test