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# ГОДИШНИК
## НА ЕКОНОМСКИ ФАКУЛТЕТ - СКОПЈЕ

# ANNUAL
## OF THE FACULTY OF ECONOMICS - SKOPJE

# СОДРЖИНА

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# THE EFFECT OF IMPORTED EU INFLATION ON MACEDONIAN INFLATION – A COINTEGRATION APPROACH

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## Abstract

Inflation has become one of the most important challenges in a world that is still recovering from the pandemic, and it is suffering the consequences from the conflict between Ukraine and Russia. Pandemic restrictions, bottleneck pressures in supply chains, jump in energy prices – these are all causing the inflation to rise, and slowing the recovery of many economies globally.

This paper investigates the foreign drivers of national inflation using the cointegration approach and the Vector Error Correction Model. It tends to prove that there is long-term relationship between the national inflation and the inflation in the European Union. This is understandable, having in mind that North Macedonia is small and open economy, dependable on imports of food, energy, and other products.

The impulse response function estimated in the model confirm that shocks in EU inflation have significant and long-term implication on the national inflation. The effect from the shock starts in the first month and it pertains throughout the observed period of 12 months, reaching its maximum of 0.7315 percentage points. This is a clear indicator that every shock that occurs in the inflation in the European Union almost immediately transfers to the national inflation. Forecasts of the model predict steady increase in the national inflation rate, ending the year 2022 with 14.8%.

The existence of this relationship should be important guideline to policy makers, who should be aware of the significant foreign impact. They should create appropriate and timely policy consisted of monetary, fiscal, social, and other measures that could fight the rising inflation in more effective manner.

**Keywords:** Inflation, Vector Error Correction Model, Forecasting

**JEL classification:** E31, C32, C53

# Introduction

Past few years have imposed considerable economic challenges on a global level. Rising inflation has become one of the main issues for many governments. There are probably three main causes for the increase in prices. The first is the pandemic and its restrictions that have limited the economic activity globally. The second cause is the major increase in the energy prices, starting from the summer of 2021, which is a significant macroeconomic shock. The third driver is the Russian invasion of Ukraine, causing amplification of the energy shock and downward revisions in consumer and business confidence (Lane, 2022).

North Macedonia did not remain immune to this external shocks. As a small open economy, with significant share of imports from the European Union, national inflation is on the rise, almost with the same dynamics as the inflation in the EU. The imported prices of food and energy are causing the main pressure on the national inflation. In June 2020 the national inflation was 2.30%, and after two years, in August 2022 it has reached 16.80%. The predictions are that the inflation will continue to increase in the months to follow. International Monetary Fund Managing Director Kristalina Georgieva, at the hybrid meeting of the G20 Finance Ministers and Central Bank Governors, pointed out that the current conflict in Ukraine is adding pressures on commodity and food prices. If the inflation is to become more persistent more stronger policy interventions will be required (IMF, 2022).

To navigate this challenging environment three policy are set i.e., bringing the inflation down (more than three-quarters of the central banks have raised interest rates 3.8 times), fiscal policy must help to tame inflation (reducing debt and providing targeted measures to support vulnerable households) and global cooperation regarding food security and high debt (IMF, 2022). North Macedonia has imposed some of the measures regarding the monetary policy. In July 2022 the interest rate on Treasury Bills was increased by 0.50 percentage points, reaching 2.5%.

This paper investigates the national inflation dynamics and its long-term foreign drivers – the inflation from the European Union, using cointegration and Vector Error Correction Model. If the long-term relation is confirmed, this will signify that the national inflation is mostly determined by the foreign inflation (since national economy is in large part import oriented). This will raise the question are the current measures undertaken by the monetary policy sufficient to control the inflation or should the policy makers take additional measures in time to countereffect the severe impact of the rising prices and their impact on the economy.

## Literature Review

The idea of using inflation in European Union to predict the national inflation is not new. This is understandable, having in mind the development of international trade within the EU countries, and other countries that trade with European Union, yet are still not part of it, such as North Macedonia.

In their paper Cavallo and Ribba (2014) use structural VECM for period 1999 to 2011 and conclude that the Euro area inflation can be interpreted as a long run predictor of the national inflation rates, for small number of Euro area countries. A positive conclusion of convergence of inflation dynamics regards France and Italy, two of the biggest economies in EU.

Shamloo (2011) uses different forecasting methods for Macedonian inflation. The VECM analysis, as one of the methods, confirms strong cointegration between domestic inflation, output, policy rates and inflation in the Euro area. Their interpretation of this results comes from policy perspective and indicates significant pass-through of foreign prices (cointegration with Euro area inflation).

Interesting approach towards treating the inflation shocks can be found in Globan et al. (2014). Eight non-EU member states are analyzed for their domestic and external inflation determinants. This paper tends to fill the literature gap since it considers that it has been silent on the comparison of the domestic versus foreign inflation determinants. The results confirm that foreign shocks are major factor in explaining the inflation dynamics in the medium run, while the short run inflation dynamics is mostly affected by domestic shocks.

The importance of external versus domestic inflation drivers in twelve new EU members is examined by Mihailov et al. (2009). Their analysis is based on the New Keynesian Phillps Curve from small open economies, which they find to be well supported for the new EU member states. The important finding in their research is that the inflation process is mostly dominated by domestic variables in larger countries, while external variables are more relevant for smaller countries. Like Globan et al. (2014) they also state there are few studies that empirically assess inflation dynamics, and none focuses of the relative importance of external and domestic inflation determinants. Policymakers should understand the factors that influence the price level when they forecast inflation or manage inflation expectations.

In the Economic bulletin from European Central Bank (2017) there is whole article about domestic and global drivers of inflation in the euro area. The key findings are that domestic prices pressures result from wage and price-setting behavior, which is closely linked to domestic business cycle.

Import prices are the external drivers, especially prices of commodities. They seem to play important role in development of domestic inflation via energy and food inflation. Recent addition is that the global integration has increased the influence of global business cycle on domestic inflation and thus supported a convergence of inflation developments globally. The bulleting stresses out that in medium term, inflation expectations play a key role in achieving central's bank inflation target, while in short term fluctuations in inflation are affected by both domestic (wages, profit margins, domestic business cycles) and external (import prices, oil, and food prices) developments.

Ha et al. (2019) discusses the global and domestic drivers as main sources of inflation in very interesting manner. They find that global demand shocks and oil price shocks are the main drivers of variations in global inflation. Also, they state that domestic shocks have explained major part of domestic inflation variation, yet their importance has declined since the 1970s and 1980s. Global shocks seem to take about one-quarter of the variations in domestic inflation, and they contribute more to domestic inflation variation in advanced economies than in developing economies.

Attempts for forecasting inflation and deriving its determinants were made by national authors and authors from the region. In the research by Petrovska et al. (2017) the primary goal to describe several models for short-term forecasting of inflation – autoregressive integrated moving average models, three equation structural model and a dynamic factor model. They conclude that the forecasting accuracy of the models is highest when they are used for forecasting one quarter ahead because the errors increase as the forecasting horizon increases. Disaggregated ARIMA model has the smallest forecasting errors and majority of the forecast evaluation criteria suggest that composite forecasts are superior in comparison to the individual models.

To forecast Albanian short-term inflation rate Papavangjeli (2021) uses Bayesian vector autoregressive model, which unlike standard autoregressive vector models, addresses the over-parameterization problem, allowing for the inclusion of more explanatory variables, and in this way enabling a more comprehensive explanation of inflation. Two benchmark models are used, a univariate model and an unrestricted VAR. Results confirm that the BVAR approach, which incorporates more economic information, outperforms the benchmark univariate model.

For modeling of inflation in Croatia Vizek and Broz (2009) derive a model of inflation that suggests that inflation inertia and Croatian trading partners' inflation are most important for explaining the short-run behavior of inflation. Apart from these two variables, markup, excess money, output gap, nominal exchange rate, and broad money also contribute to inflation changes

in the short run.

The literature about the inflation drivers continues to expand. Inflation is not an isolated phenomena and there is no country that can fully control it, discarding both the domestic and global influence. It is important to emphasize the constantly increasing role that the global factors have on the domestic inflation and to create an effective policy in accordance with this influence.

## Dynamics of National and EU Inflation

Figure 1 presents the trends of the harmonized index of consumer prices (HICP) for North Macedonia and the European Union. Inflation in North Macedonia is characterized with more short-term variations than the inflation in the EU. Despite this, there is obvious synchronization in the long-term movement of the series which implies to potential cointegration.

*Figure 1. Harmonized Index of Consumer Prices (annual rate of change)*
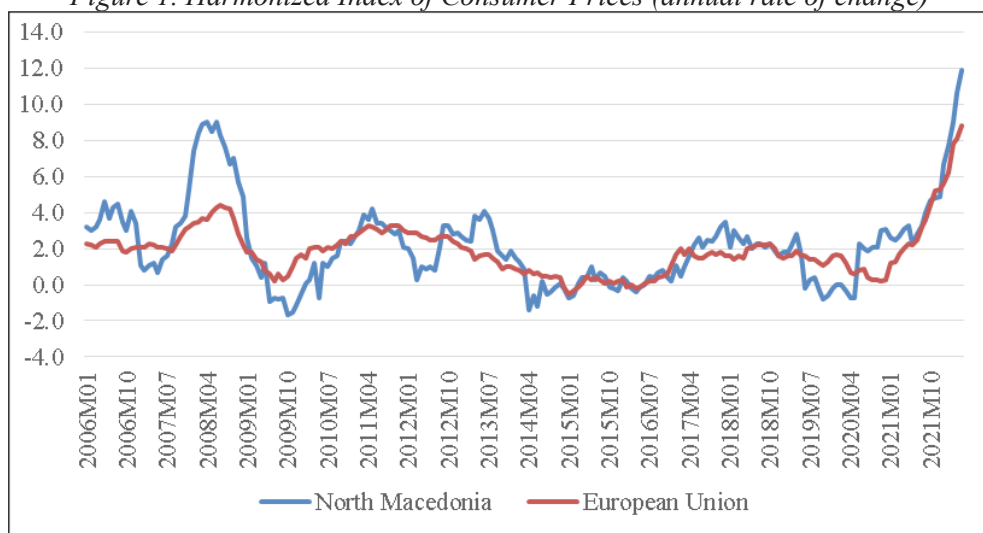


Source: Eurostat Database

North Macedonia is a small open economy highly dependable on the imports. The statistics confirm that more than 60% of the total national import, in the last six years, comes from the EU countries (Figure 2).

*Figure 2. Proportion of EU Import in Total National Import*
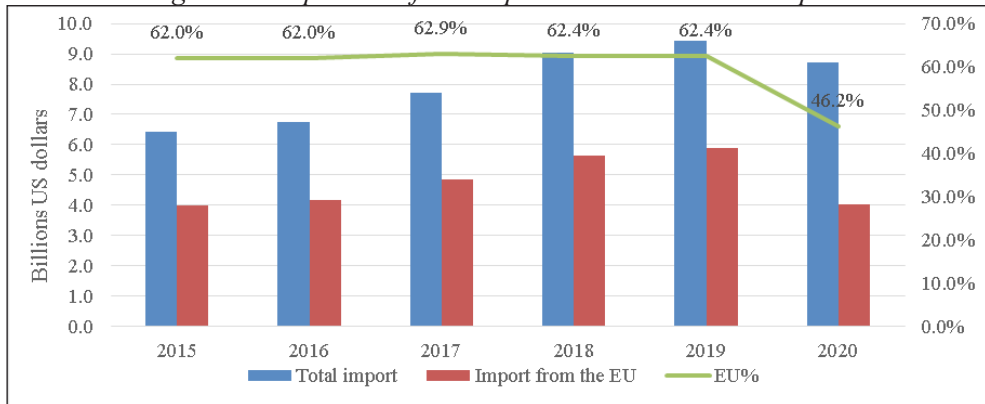


Source: State Statistical Office, Statistical Yearbook of the Republic of North Macedonia (2016–2022)

Total import in North Macedonia continues to rise, from $6.2 billion in 2015 to $9.4 billion in 2019 (the decrease in 2020 to $8.7 billion is mostly due to the COVID-19 pandemic). The share of import from the EU countries remains significant throughout the period, surpassing 62% (again, the decrease to 46.2% in 2020 is due to the pandemic). With such a substantial share, it is reasonable to expect that significant and long-term impact from the EU prices on the national inflation should exist.

## Research Methodology and Empirical Results

One way to examine the existence of the long-term relationship between the harmonized indices of consumer prices for North Macedonia and European Union is trough cointegration. If the cointegration is confirmed, the analysis can be expanded with estimation of vector error correction model. The analysis will include the effects of the shocks from the EU inflation on the national inflation and forecasts for the upcoming period.

Two time series are analyzed – harmonized indices of consumer prices as annual rate of change for European Union (*Inf_EU*) and North Macedonia (*Inf_NM*). The observed period is January 2006 to May 2022. Data are in monthly frequency, with total of 197 observations (presented in Figure 1). Data source is the Eurostat database.

The first part of the analysis is testing for stationarity. Since the series do not follow specific trend, or their values are not around zero, the specification for Augmented Dickey-Fuller test is only for intercept. The test

statistics are presented in Table 1.

*Table 1. Results from the Unit Root Tests for Stationarity*

| Variable | p - values | |
|---|---|---|
| | I(0) | I(1) |
| (Inf_NM) | 0.9351 | 0.000 |
| (Inf_EU) | 0.9476 | 0.000 |

Source: Author's calculations

As expected, the series are not stationary when expressed in their original units of measurement. When transformed in their first differences, they both become stationary. The next step is to examine if there is cointegration between these two series. Cointegration is defined as stationary linear combination of two or more nonstationary time series. This stationary linear combination represents the cointegrating relationship (Trpkova-Nestorovska, 2014). Lag order selection criteria, which is needed for cointegration testing, suggested two time lags (Schwarz information criterion and Hannan-Quinn information criterion). Both tests indicate one cointegrating equation (Table 2).

*Table 2. Cointegration Tests*

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized number of cointegrating equations | Eigenvalue | Trace statistic | 0.05 critical value | Probability |
| None* | 0.0788 | 15.9329 | 15.4947 | 0.0429 |
| At most 1 | 0.0000 | 0.0008 | 3.8415 | 0.9780 |
| Trace test indicates 1 cointegrating equation at the 0.05 level | | | | |
| Hypothesized number of cointegrating equations | Eigenvalue | Trace statistic | 0.05 critical value | Probability |
| None* | 0.0788 | 15.9321 | 14.2646 | 0.0270 |
| At most 1 | 0.0000 | 0.0008 | 3.8415 | 0.9780 |
| Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level | | | | |

*Denotes rejection of the hypothesis at the 0.05 level
Source: Author's calculations

Next step is the estimation of vector error correction model since the series are integrated of first order and the cointegration is confirmed. The following equation represent the estimated cointegration relation:

$$Inf\_NM_{t-1} = 1.064 Inf_{EU_{t-1}} - 0.686$$

The equation confirms that the national inflation is directly affected by the inflation in the EU in the long run. A rise in EU inflation will cause an increase

of the prices in North Macedonia.

The matrix representation of the estimated vector error correction model is:

$$\begin{bmatrix} \Delta Inf\_NM_t \\ \Delta Inf\_EU_t \end{bmatrix} = \begin{bmatrix} -0.116 \\ -0.003 \end{bmatrix} \begin{bmatrix} 1.000 & -1.604 \end{bmatrix} \begin{bmatrix} Inf\_NM_{t-1} \\ Inf\_EU_{t-1} \end{bmatrix} + [0.686][const]$$

$$+ \begin{bmatrix} 0.033 & 0.806 \\ 0.103 & 0.332 \end{bmatrix} \begin{bmatrix} \Delta Inf\_NM_{t-1} \\ \Delta Inf\_EU_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$$

The equation from the vector error correction model for the North Macedonian inflation is:

$$\Delta Inf\_NM_t = -0.116 ECT_{t-1} + 0.033 \Delta Inf_{NM\ t-1} + 0.806 \Delta Inf\_EU_{t-1}$$

The following part refers to testing of the assumptions of the model. The first assumption is about the model residuals. The results from the Portmanteau test for autocorrelation are presented in Table 3.

The Portmanteau test tests the null hypothesis of no residual autocorrelation up to $h$ time lag, or $H_0 : E(u_t u`_{t-1}) = 0$, $i = 1, \ldots , h$. The alternative hypothesis states that there is at least one autocorrelation different than zero (Lutkepohl et al., 2006). The null hypothesis of no autocorrelation is accepted for $h = 4$ and higher.

*Table 3. Portmanteau Test for Autocorrelation*

| Tested order $h$ | Test statistic | *p*-value | Adjusted test statistic | *p*-value | Degrees of freedom |
|---|---|---|---|---|---|
| 2 | 8.64 | 0.01 | 8.73 | 0.01 | 2 |
| 3 | 13.49 | 0.04 | 13.66 | 0.04 | 6 |
| 4 | 18.10 | 0.05 | 18.37 | 0.05 | 10 |
| 5 | 19.63 | 0.14 | 19.94 | 0.13 | 14 |

Source: Author's calculations

Second test for testing autocorrelation is the Breusch-Godfrey Langrange multiplier test. It tests the null hypothesis $H_0 : B_1^* = \cdots = B_h^* = 0$ against the alternative hypothesis $H_1 : B_1^* \neq or \ldots or\ B_h^* \neq 0$. The results are presented in Table 4.

*Table 4. Breusch-Godfrey Langrange Multiplier Test*

| Time lag $h$ | LM statistic | *p*-value | Degrees of freedom |
|---|---|---|---|
| 1 | 3.25 | 0.52 | 4 |
| 2 | 17.69 | 0.02 | 8 |
| 3 | 23.22 | 0.03 | 12 |

Source: Author's calculations

The null hypothesis is accepted for one time lag. Both tests confirm that the assumption of no autocorrelation of the residuals is valid for this model.

The following tests refer to the normality of residuals. The results from the first test of non-normality of the residuals are presented in Table 5.

Table 5. Tests for Nonnormality

| Reference: Doornik & Hansen (1994) | | | | | | |
|---|---|---|---|---|---|---|
| Joint test statistic | *p*-value | Degrees of freedom | Skewness only | *p*-value | Kurtosis only | *p*-value |
| 117.46 | 0.00 | 4 | 13.73 | 0.00 | 103.73 | 0.00 |
| | | | | | | |
| Reference: Lütkepohl (1993) | | | | | | |
| Joint test statistic | *p*-value | Degrees of freedom | Skewness only | *p*-value | Kurtosis only | *p*-value |
| 111.50 | 0.00 | 4 | 13.36 | 0.00 | 98.15 | 0.00 |

Source: Author's calculations

The results indicate that the null hypothesis of normality of residuals is not confirmed. One more test for normality is the Jarque-Bera test. The results are presented in Table 6.

Table 5. Tests for Nonnormality

| Variable | Test statistics | *p*-value ($x^2$) | Skewness | Kurtosis |
|---|---|---|---|---|
| $e_1$ | 56.93 | 0.00 | 0.15 | 5.71 |
| $e_2$ | 58.08 | 0.00 | 0.65 | 5.43 |

Source: Author's calculations

This test tests the residuals of both time series individually. The residuals of both series do not follow the normal distribution.

Stability analysis is performed to check for the estimated parameters consistency during the observed period. Chow tests for stability is used for this purpose. These tests also confirm or deny an existence of structural break. Basically, the sample is divided in two subsamples and the parameters are estimated for the whole sample, and for the two newly formed sample. The null hypothesis states that the parameters are constant. One possible date for a structural brake is June 2014. Until this point the inflation is characterized with fluctuations, and after this date it becomes more stable. The results from the test are presented in Table 6.

Table 6. Chow test for structural break
Sample range: 2007 M2 – 2022 M5, *n*=184
Tested break date: 2014 M6 (88 observations before break)

| Break Point Chow Test | | | |
|---|---|---|---|
| Break point Chow test | Bootstrapped *p*-value | Asymptotic $x^2$ *p*-value | Degrees of freedom |
| 20.82 | 0.10 | 0.01 | 9 |
| | | | |
| Sample Split Chow Test | | | |
| Sample split Chow test | Bootstrapped p-value | Asymptotic $\chi^2$ | Break Point Chow test |
| 8.69 | 0.2 | 0.19 | 6 |

Source: Author's calculations

Both tests accept the null hypothesis, the covariate matrix of residuals is constant and there are no variations in the estimated parameters. There is no structural brake for June 2014 and the model is stable.

The following results are part of the structural analysis: causality analysis and the impulse response function. The causality analysis performs two tests, test for Granger-causality and test for instantaneous causality. The results from both tests are presented in Table 7.

Table 7. Causality Analysis

| Null hypothesis: | Test statistics | *p*-value |
|---|---|---|
| Test for Granger-causality | | |
| *Inf_EU* do not Granger-cause *Inf_NM* | 13.71 | 0.00 |
| | | |
| Test for instantaneous causality | | |
| No instantaneous causality between *Inf_EU* and *Inf_NM* | 6.64 | 0.01 |

Source: Author's calculations

The tests confirm that there is causality from EU inflation towards national inflations. This is one indication of a good model.

The impulse response functions are used for analysis of the dynamic interactions between the endogenous variables. The model calculates orthogonal impulse response function where the innovation (or shock) represents one standard deviation in the transformed model. One function is calculated for time of 12 months and is presented in Figure 3. Shocks in EU inflation have significant and long-term implication on the national inflation. The effect from the shock starts to impact the North Macedonian inflation even in the first month, and it is value is 0.2623 percentage points.

The shock is persistent, and it pertains throughout the observed period of 12 months, reaching its maximum of 0.7315 percentage points. This is a clear indicator that the national inflation is under significant influence from the EU inflation. This contributes to the findings from Shamloo (2011) and Trpkova - Nestorovska, M. (2014). Every shock that occurs in the inflation in the European Union almost immediately transfers to our national inflation and increases its value.
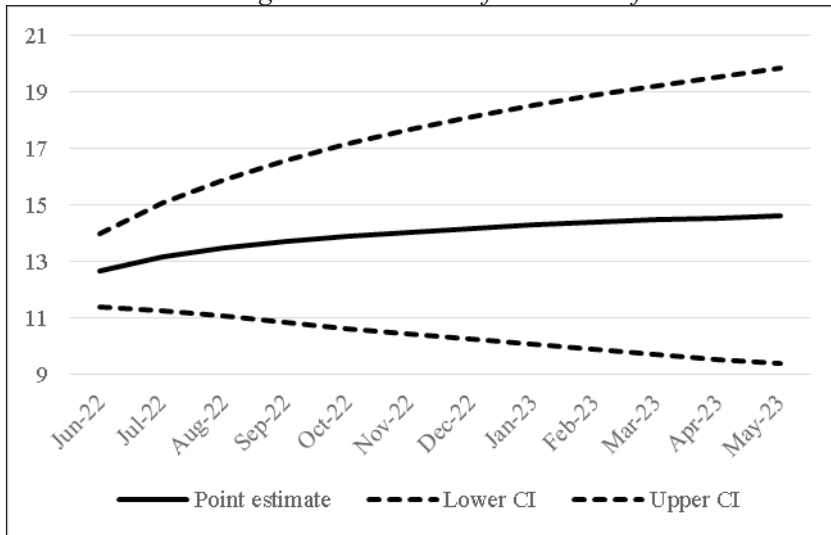
*Figure 3. VECM Orthogonal Impulse Responses*
*Inf_EU towards Inf_NM*
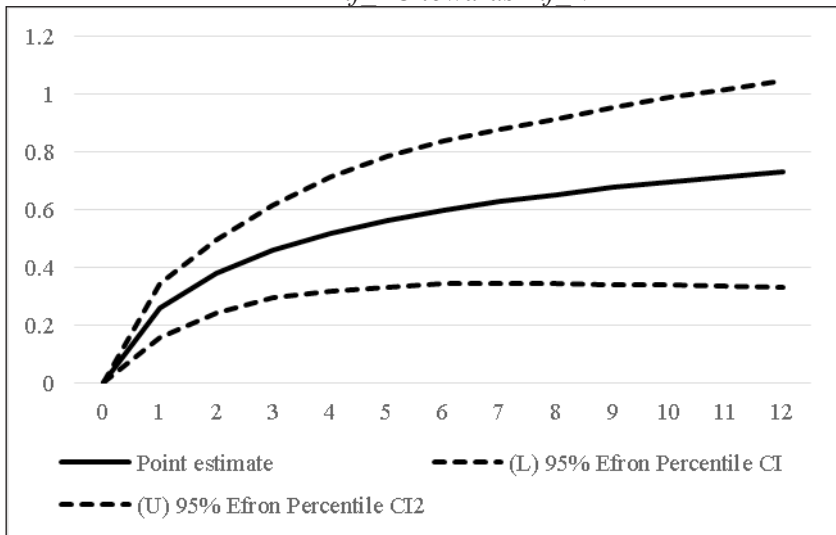


Source: Author's calculations

The last part of the analysis is forecasting. The model proved to be stable, thus it can be used to forecast the national inflation. The results for the forecasted period (June 2022 – May 2023) are presented in Figure 4.

*Figure 4. Forecasts of National Inflation*



Source: Author's calculations

The model predicts rather realistic inflation rates for North Macedonia, for the upcoming period of twelve months. For June 2022 the model forecast inflation of 12.68%, for July 2022 – 13.17% and for August 2022 – 13.49%. The real inflation in August 2022 is 16.80% (State Statistical Office, 2022). The model predicts steady increase in the national inflation rate, ending the year 2022 with 14.8%, and for the last forecasted period, May 2023, the model predicts 14.62% increase in prices.

**Conclusion**

While North Macedonia is facing double-digit inflation (15.60% in July 2022), there are countries in the EU that tend to keep the inflation on much lower level (for July 2022, inflation in EU is 9.8%, Denmark – 9.60%, Germany – 8.50%, France – 6.80%, Finland 8.00%, Sweden – 8.30%, Switzerland 3.30%).

North Macedonia, as small open economy, primary import oriented, is exposed to changes in prices of food and especially energy. The estimated model confirmed that there is long-term cointegration between the national inflation and the inflation in the European Union. This should be important guideline to policy makers in their attempts to control the rising inflation. National authorities do not have impact on the imported prices, yet they can

create a set of well-timed monetary, fiscal, and social measures that can prove to be sufficient and effective in inflation control.

Traditional measures like the one created by the monetary policy – higher interest rates and control of money supply, fiscal policy measures that includes increase in income tax and control of wages and prices could have an impact on inflation reduction. Yet, one important matter that the policy creators should consider, since the inflation in major part is imported, is to lower trade tariffs which could, at the end, lower the costs for consumers. Tariffs make the imports more expensive, and these additional costs are passed onto the consumers, which at the end results with increased prices and inflationary pressure. Government should consider reviving free trade agreements which would increase the supply of goods and reduce prices. According to report by Patnaik and Kunhardt (2002) free trade has historically brought down prices and increase the purchasing power, while protections policies leas to price increases that disproportionately hurt lower-income citizens, since they spend a larger proportion of their income on goods.

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# ЕФЕКТОТ НА УВЕЗЕНАТА ИНФЛАЦИЈА ОД ЕУ ВРЗ МАКЕДОНСКАТА ИНФЛАЦИЈА – КОИНТЕГРАЦИСКИ ПРИСТАП

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**Апстракт**

*Инфлацијата стана еден од најважните предизвици во свет кој сеште закрепнува после пандемијата и ги сноси последиците од конфликтот помеѓу Украина и Русија. Рестрикциите поставени за време на пандемијата, притисоците од „тесното грло" кај синџирите на понудата, скокот кај цените на енергијата – сите предизвикуваат раст на инфлацијата и забавување на опоравувањето на многу економии на глобално ниво.*

*Овој труд ги истражува надворешните двигатели на националната инфлација користејќи се со коитеграцискиот пристам и векторскиот модел со корекција на грешка. Во него се настојува да се докаже дека постои долгорочна врска помеѓу националната инфлација и инфлацијата во Европската Унија. Ова е разбирливо, ако се има во предвид фактот дека Северна Македонија е мала и отворена економија, зависна од увозот на храна, енергија и други производи.*

*Функцијата на импулсен одговор оценета со моделот потврдува дека шоковите кои настануваат кај инфлацијата во ЕУ имаат значајна и долгорочна импликација врз националната инфлација. Ефектот од шокот започнува во првиот месец и продолжува да има влијание во целиот опсервиран период од 12 месеци, достигнувајќи го својот максимум од 0.7135 процентни поени. Ова е јасен индикатор дека секој шок кој настанува кај инфлацијата во Европската Унија речиси веднаш се пренесува врз националната инфлација. Предвидувањата на моделот оценуваат стабилен пораст на националната стапка на инфлација, завршувајќи ја годината 2022 со 14.8%.*

*Постоењето на оваа врска треба да биде важна насока на креаторите на политиките, кои треба да свесни за постоењето на значајното надворешно влијание. Тие треба да креираат соодветна и навремена политика составена од монетарни, фискални и други мерки кои би се бореле со растечката инфлација на поефективен начин.*

**Клучни зборови:** Инфлација, Векторски модел со корекција на грешка, Предвидување

**JEL класификација:** E31, C32, C53