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DIAGNOSTIC INFLATION ANALYSIS IN MONTENEGRO

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Introduction

Inflation became a global phenomenon in 2022. For the first time since the 1970s, the world economy faced high inflation rates. However, the growth of inflation was not unexpected, given the large amount of monetary base initially created by leading central banks to combat the global financial crisis and then the COVID-19 pandemic.

Economic disorders affected by the pandemic, which caused the reduction of supply and disturbances in global supply chains, have led to inflation growth generated primarily by the growth in energy and food prices. On the other hand, after one of the largest economic contractions and GDP decline in 2020 induced by strong responses of economic policies, there was an abrupt recovery of aggregate demand and economic growth in 2021, which also affected inflation growth. The 2021 GDP growth rate in Montenegro reached 13%, while the annual inflation rate trended upward from January (-0.7%) to December 2021 (4.6%).

The revival and growth of economic activities and the growth of employment would positively affect the supply growth in the upcoming period, and thus the improvement of medium-term inflation outlook, both at the national and international level. However, the outbreak of the Russian-Ukrainian war has completely changed the inflation perspective as the expected short-term factors of the broken market mechanism which encourage inflation, are now further enhanced. As a result, price growth in Montenegro continued during 2022, ranging from 5.7% in January to 17.2% in December.

In general, inflation can be generated by one-time supply shocks, which affect the productive capacity of the economy, and the growth of aggregate demand. The events we have witnessed in the last two years, the COVID-19 pandemic and the war in Ukraine are examples of negative supply shocks that reduce the availability of goods and services and make them more expensive. The health shock of the pandemic affected reduced employment, international mobility and created problems in supply chains that were reflected in rising prices. The war in Ukraine was an additional shock, having in mind that the countries involved in the war have significant roles in the international market of energy and raw materials. Namely, Russia and Ukraine are producers and

exporters of wheat, barley, corn, oil and gas (energy), as well as artificial fertilizers, which are key inputs for the production of numerous food products. The reduced supply of these inputs, due to the war, significantly increased the prices of food raw materials and products on the world market. The rise in the prices of raw materials on the world market reflected on overall inflation, both in Montenegro and in other countries in the region and the world, especially having in mind the fact that Montenegro is a highly import-dependent economy with a very low level of domestic production, so the price growth on the global market, as a rule, directly spills over to inflation in the country.

Aggregate demand is another source of inflation. Its growth is determined by fiscal and monetary policy measures, but it can occasionally be affected by other shocks. By applying the reference interest rate, monetary policy can effectively deal with demand-driven shocks. Namely, higher interest rates moderate demand and prevent overheating of the economy.

An important factor of inflation from the domestic market is the so-called built-in inflation, which most often occurs as a result of existing cost inflation and rising aggregate demand. At a certain point, inflation is fuelled by inflationary expectations of economic operators. Inflationary expectations are often used to explain the puzzling behaviour of inflation after crisis periods. For example, Coibion and Gorodnichenko (2015) and Friedrich (2016) argued that households' explicit inflationary expectations fuelled a surprising development of inflationary pressures after the global financial crisis.

The aim of this paper is to examine to what extent inflation in Montenegro depends on global factors and inflation in the euro area, and how much factors from the domestic market affect inflation.

The paper is divided into five sections. Section 1 presents a descriptive statistical analysis of inflation in Montenegro and inflation in the euro area. Then, using a special statistical technique and the method of principal components, Section 2 shows the separate contributions of global and domestic factors to inflation in Montenegro, using patterns of correlation between inflation in a large number of countries. Section 3, by applying an adequate econometric model, analyses the relationship, i.e. interdependence of time series of inflation in Montenegro and inflation in the euro area. Section 4 examines the dynamic relationships of factors from the global and domestic markets on the development of inflation in this year. Section 5 presents the concluding remarks of the paper.

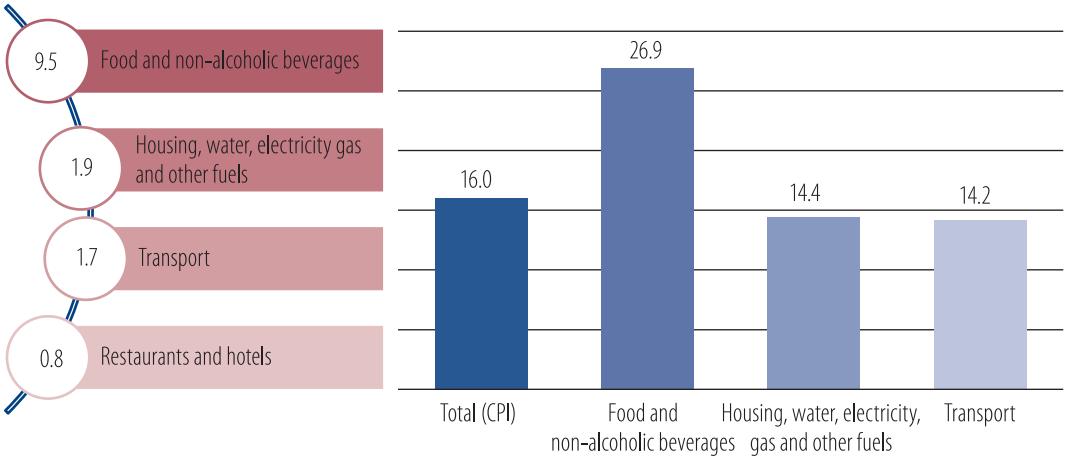
1. Descriptive analysis of inflation in Montenegro

As there has been a constant trend of price growth in Montenegro in the last year and a half, the goal of this section is to diagnose the sources of inflation and describe their impact on inflation dynamics.

In September 2022, Montenegro recorded the highest inflation rate since gaining independence. The annual CPI inflation amounted 16% in September. The biggest contribution to the inflation rate was made by prices in the category of food and non-alcoholic beverages (9.5 percentage points).

Comparing the prices in September of this year with the same period of the previous year, we can see that the prices of food and non-alcoholic beverages increased by 26.9%; prices of housing, water, electricity, gas and other fuels rose 14.4%, and transport prices increased by 14.2%. Prices in these three categories made up 60.7% of the consumer price index, which indicates that changes in these categories have a dominant effect on the overall inflation rate.

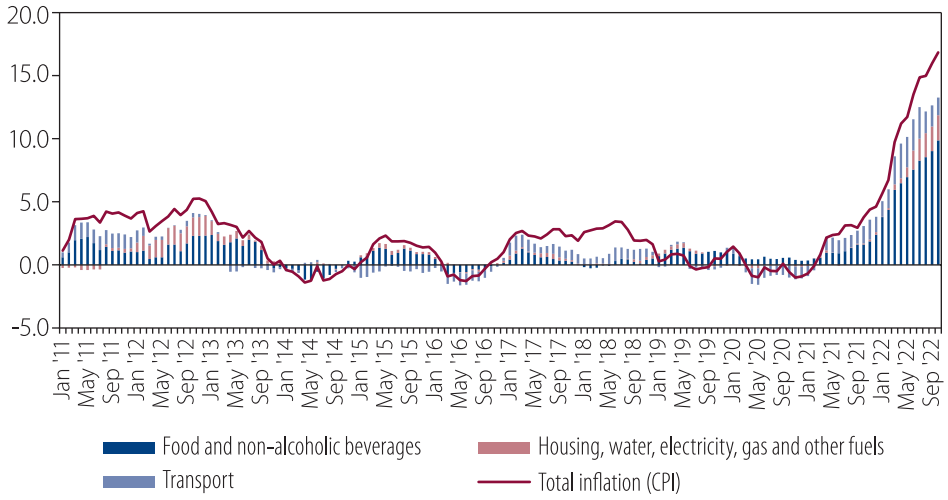
Graph 1 – Contribution of individual categories to the annual inflation rate in September 2022



Source: MONSTAT

Having in mind that the prices of food, transport, and housing, water, electricity, gas and other fuels determine the rate of inflation, we will begin the analysis with an overview of how price increases in these categories have historically spilled over to the rate of total inflation. Graph 2 shows that from 2011 until September 2022, with the exception of 2017 and 2018, the largest contribution to overall inflation was made by prices in the category of food and non-alcoholic beverages. In the period 2017-2018, the biggest contribution to the inflation rate was made by prices in the transport category, under the influence of the increase in oil prices on the international market.

Graph 2 – Contribution of key categories to the annual inflation rate in the period 2011-2022



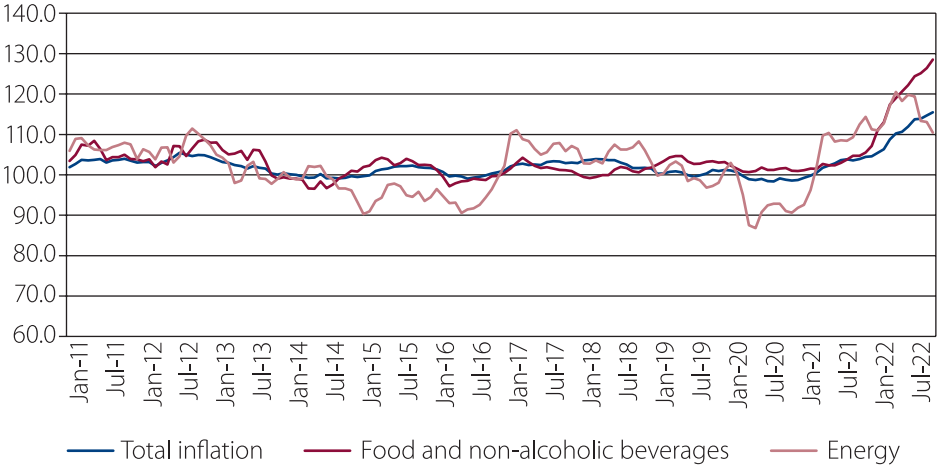
Source: MONSTAT

Graphs 3a and 3b show the evolution of the price level in the categories of goods and services, which is made possible by using the Harmonized Index of Consumer Prices (HICP). The current weights of these two main components in the total HICP in Montenegro are 73.16% for goods and 26.84% for services.

Based on these graphs, we can conclude that the basic trend of overall inflation is closely related to the trend of goods inflation, whereby large fluctuations in energy and food prices led to the volatility of overall inflation (Graph 3b). In 2020, all observed price growth rates (goods and services, food and energy) were low, with a significant negative energy inflation rate. During the period 2021-2022, the increase in the total inflation rate was a combination of a very sharp increase in energy (oil) prices and a significant increase in food prices.

Graph 3a – HICP components for goods and services

Graph 3b – HICP for food, non-alcoholic beverages and energy



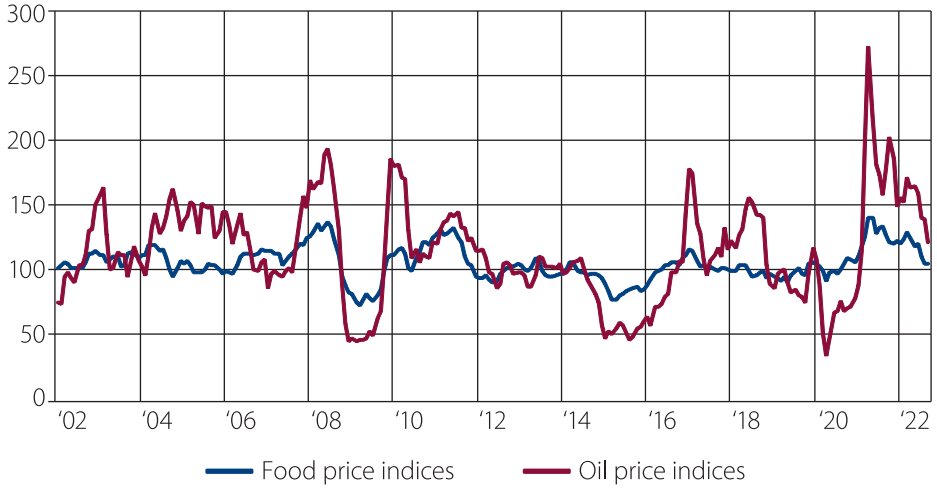
Source: MONSTAT

Observing Graph 3a, we see a faster increase in the prices of goods over the prices of services. There has been much discussions in the current empirical literature about the role of the pandemic in changes in the prices of goods and services. Public health policies aimed at tackling the pandemic around the world have limited international mobility and created problems related to global production capacity and the functioning of global supply chains. The mismatch between supply and demand in the goods sector was particularly strong in the period 2020-2021. The pandemic also caused a change in consumer spending patterns. Namely, the possibility of e-commerce has, understandably, directed consumer preferences towards the goods sector.

The interaction of a strong global recovery in goods demand in 2021 and disruptions in global supply chains have led to goods prices rising. The war in Ukraine intensively increased product shortages and additional costs in the intermediate stages of production, which had a strong impact on the further increase in the prices of final goods. It is important to emphasize that the category of goods has a larger share of internationally exchangeable inputs and products than the category of services. This means that global factors play a greater role in determining prices in the goods category, which includes predominantly food products and oil, while domestic factors play a greater role in price movements in the services category. Consequently, the increase in inflation in the service sector has been less pronounced and its growth has manifested later in relation to the goods sector.

Graph 4 shows the dynamics of the global movement of oil and food prices, which are important considering their direct impact on consumer prices and their indirect impact through food products and intermediate inputs used in food production.

Graph 4 – Food and energy prices on the international market



The increase in inflation was also affected by increase in the costs of domestic food production, which is predominantly caused by the increase in import prices. In the third quarter of 2022, compared to the same period in 2021, the prices of imported manufactured products recorded a growth of 14.3%, and the growth of prices in the manufacturing sector was 19.6%. The growth of prices in the manufacturing industry sector was fuelled by a 34% increase in the prices of food products.

Graph 5 provides a comparison of import and export prices with goods' prices in Montenegro.

Graph 5 – Import and export prices

Source: MONSTAT

Table 1 – Correlation between import prices, export prices and domestic goods prices

	Goods inflation	Export prices	Import prices
Goods inflation	1	0.668	0.786
Export prices	0.668	1	0.799
Import prices	0.786	0.799	1

Source: Author's calculations

The high correlation between export, import and domestic prices of goods indicates the prevailing role of global factors in determining the prices of goods. The growth rates of goods prices and the prices of imported goods largely followed each other. These price movements are expected, having in mind that the prices of domestic products sold on the domestic market are also affected by global factors. However, since June this year, we have noticed opposite trends. Namely, import prices have shown a downward trend, while goods prices continue to show an upward trend. Prices of exported goods show higher fluctuations, which can be partly explained by exchange rate fluctuations, especially during the last two years.

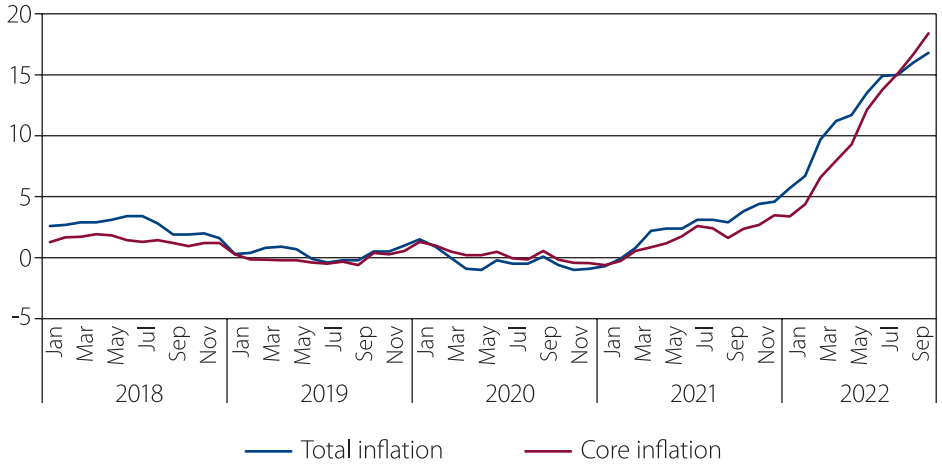
A good indicator of the long-term trend of inflation is core inflation, bearing in mind that, as a rule, it tracks the components of inflation that are stable over a long period of time. The categories of products that are most often excluded from the calculation of core inflation are those in which the formation of prices is not affected by the usual economic trends, but the prices are primarily a result of certain one-off and/or seasonal shocks. Thus, agricultural and food products are most often excluded from the calculation (their movement is largely the result of climate change), en-

ergy (under the influence of shocks on the supply side), administratively controlled prices (result of changes in the decisions of economic policymakers) and the like[1].

According to the latest estimates of the Central Bank of Montenegro, core inflation is above the total inflation rate, which indicates the persistence of inflationary pressures (Graph 6). Namely, the high core inflation rate shows that, in recent months, inflation has been widespread in many components of the index used to measure inflation. This reflects the widespread impact of rising prices of raw materials, food and energy on rising costs in the goods and services sectors, thus representing a common factor exerting inflationary pressure on the overall economy.

Furthermore, it should be emphasized that the increase in core inflation above the level of total inflation also indicates a certain degree of inflationary pressure that can be generated by domestic demand. In addition, the persistence of core inflation, evident in the third quarter of 2022, indicates the presence of built-in inflationary expectations, which represents a special challenge. Recent researches suggests that the longer inflation remains high, the more embedded it is likely to become. Also, researches point to the growing awareness of the public that inflation is at a record level. Namely, surveys of the Global Enterprise Risk Survey conducted by Oxford Economics (2022) show that short-term inflationary pressures are increasing to the level of inflation that is expected further.

Graph 6 – Total and core inflation



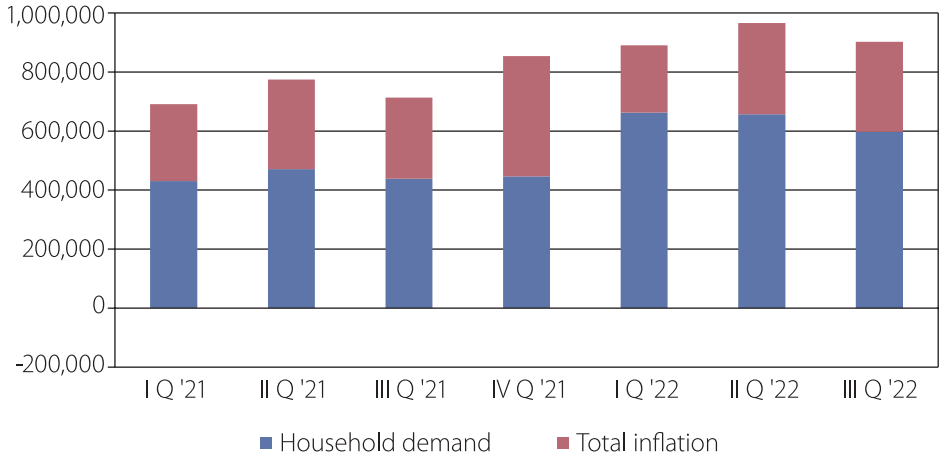
Source: CBCG

[1] *More details about core inflation in the Working Paper of the Central Bank "Calculation of core inflation rate in Montenegro - methodological and practical considerations" (2008)*

A special dimension of looking at the sources of inflation is the analysis of aggregate demand. Changes in aggregate demand are conditioned by changes in monetary policy (that is, in the money supply) and changes in fiscal policy (state spending and tax policies), and generally changes in the consumption of companies and households that may be affected by other shocks.

After one of the biggest economic contractions and a drop in GDP in 2020, due to a strong and coordinated response by economic policy makers, there was a sudden recovery of aggregate demand and economic growth in 2021, which also reflected on the growth of inflation. The GDP growth rate in Montenegro was 13% in 2021, while in 2022 the growth is estimated to be over 7%. According to the latest estimates of the Central Bank, the aggregate demand in the third quarter of 2022 recorded the year-over-year increase of some 36%, while compared to the last quarter of 2021 it was higher around 34% higher.

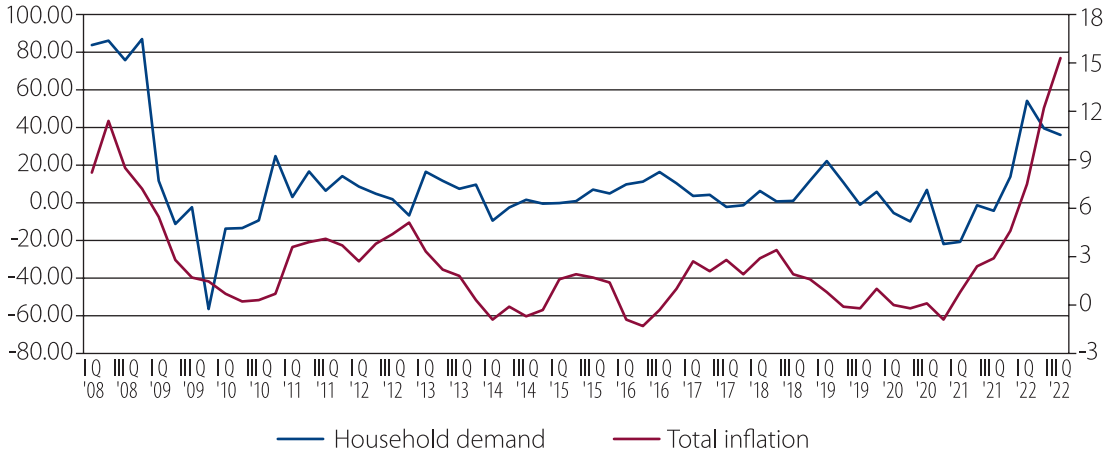
Graph 7 – Aggregate demand in Montenegro



Source: CBCG

Observed historically, household demand is a key determinant of aggregate demand. Looking at the structure of total demand, there has been a sharp increase in the share of household demand in the first quarter of 2022 (by 23.4 pp). In the household demand structure, the prevailing share refers to paid earnings (about 67%). The growth in household demand is the result of the implementation of a tax reform under the "Europe Now!" programme. The reform was based on major fiscal cuts: the health insurance contribution was abolished and the minimum wage was increased to 450 euros. A non-taxable part of the gross salary up to 700 euros is introduced as well as a progressive taxation over that amount. As a result of the implemented reform, there was an increase in net earnings of around 32% already in the first month of 2022, i.e. by 33% for nine months of the current year, compared to the end of 2021.

Graph 8 – Annual growth rates of households' demand (lhs) and inflation (rhs)



Source: CBCG

If we analyse the series of household demand and inflation (Graph 8), we can conclude that since 2009, these series had different trends. However, from the third quarter of 2021 to the second quarter of 2022, these series had the same upward trend. From the second quarter of 2022, aggregate demand growth rates have slowed down, while inflation rates have continued rising.

Finally, the descriptive analysis of inflation clearly indicates that the high inflation rate is fuelled by rising food and energy prices, together with the impact of the pandemic cycle and the war in Ukraine on supply and demand dynamics.

1.1. Comparison of inflation in Montenegro with inflation in the euro area countries

Since the introduction of the euro as the official legal tender, and with the limited instruments of monetary policy that cannot directly affect the money supply, the inflation rate in Montenegro is, understandably, linked to inflation trends in the euro area.

Graph 9 shows that since 2011, inflation in Montenegro has followed the inflation trend in the euro area, excluding pronounced cyclical changes (higher growth and/or decline) in certain periods. In comparison with the euro area, since 2011, the HICP inflation in Montenegro has been 0.46 percentage points higher on average than the inflation registered in the euro area. If we analyse the range of inflationary differences (differentials) of Montenegro in relation to the euro area, the extreme values are within the limits of a minimum of -1.96 percentage points and a maximum of 4.81 percentage points. These extreme deviations in the inflation rate have been recorded in the last two years. Namely, the largest negative value of the differential had been recorded in July 2020

when a negative inflation rate was recorded in Montenegro, while the largest positive value of the differential was recorded in July 2022.

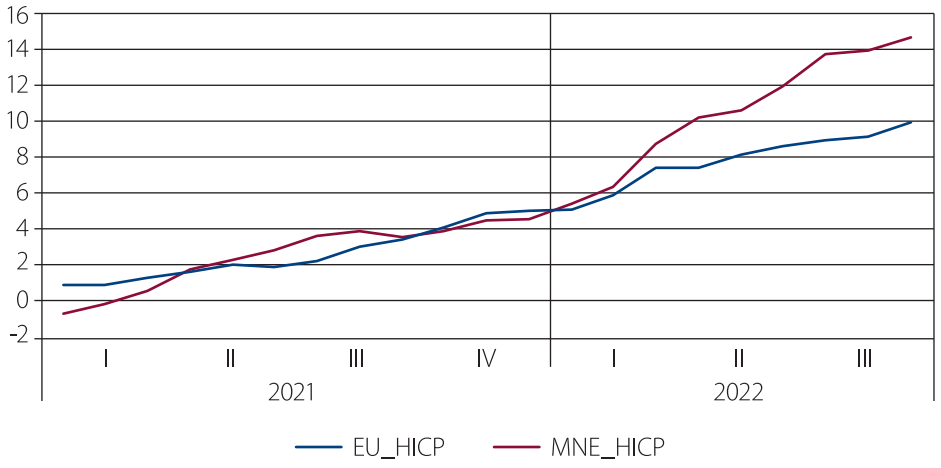
Graph 9 – Inflation trends in Montenegro and the euro area

Source: MONSTAT, Eurostat

** Note: Since January 2011, MONSTAT has started publishing the harmonized index of consumer prices (HICP), which measures inflation in the countries of the European Union and enables comparative measurement of inflation in Europe.*

The biggest deviations in inflation were recorded in 2012, 2015 and 2018. Thus, for example, in 2012, due to the late price adjustment of certain categories of imported products, the increase in excise duties and the introduction of new taxes, and the increase in controlled prices, there was an increase in inflation in Montenegro and larger inflation differentials compared to the euro area. In 2015, the growth of the differential was conditioned by the low inflation rate in the euro area, due to weaker aggregate demand. Also, in 2018, the higher inflation rate in Montenegro, compared to the euro area, refers to the increase in VAT and the increase in excise duties as part of the then fiscal consolidation measures, as well as to the increase in electricity prices.

Graph 10 – A special overview of inflation trends for the period 2020 - 2022



Source: MONSTAT, Eurostat

Differences in the structure of the index used to measure inflation, i.e. the participation of subcategories in the HICP, additionally encourage differences in inflation. Data on inflation depend on the way in which the representation of products and services in the consumer basket is determined, i.e. from their weights. The relative representation of individual products and services in the consumer price index is based on data on the average consumption of individual products or services obtained from the Household Budget Survey. If we compare Montenegro with the euro area member countries, we can conclude that the categories food and energy dominantly determine inflation in Montenegro and that these categories are represented more in the consumer basket in Montenegro than in the euro area.

Table 2 – Special inflation aggregates

	MNE		EURO AREA	
	Share ‰	Annual rates in September 2022	Share ‰	Annual rates in September 2022
Products	731.6	16.4	583.3	14.0
Services	268.4	10.6	416.7	4.3
Food, alcoholic beverages, tobacco	314.3	26.4	208.9	11.8
HICP, excluding food, alcoholic beverages, tobacco	630.1	9.7	681.8	4.8
Energy	121.8	13.1	109.3	40.7
Administrative inflation[2]	101.2	2.0	125.2	10.4

Source: MONSTAT, Eurostat

[2] *Inflation, which measures the movement of administratively formed prices and includes the prices of water supply, sewage, garbage removal, electricity, energy, maintenance fees in residential buildings, co-payments for health services, technical inspection of passenger vehicles, parking services, driving test costs, tolls for passenger vehicles, postal services, entrance fees for national parks, school textbooks, preschool education, state kindergarten, mandatory vehicle insurance and issuance of administrative documents such as birth certificate.*

Namely, in Montenegro, the "products" category, which dominantly refers to the subcategories "food, non-alcoholic beverages" and "alcoholic beverages and tobacco", has a larger share in the HICP basket compared to the euro area. On the other hand, the share of "services" category is lower than in the euro area. In the euro area, services are the largest component, accounting for around 41.7% of the consumer basket. Also, the subcategory related to administrative inflation has a smaller share in the Montenegrin HICP.

These data are not surprising, having in mind that a larger share of total income of Montenegrin households goes to the purchase of essential products and services for basic life needs, such as food and energy. The largest share in the total personal consumption of households in Montenegro is made up of expenses for food and non-alcoholic beverages (37.1%), and for housing, water, electricity (15.1%). This is followed by the expenses for clothing and footwear (9.8%); transport (9.1%); communications (6.1%); healthcare (4.9%); other products and services (4.5%); furnishing, household equipment and routine household maintenance (4.4%); alcoholic beverages and tobacco (3.4%); restaurants and hotels (2.6%); recreation and culture (1.7%) and education (1.3%).

This is also visible from the comparison of the representation of individual food products in the overall consumer price index in Montenegro, in relation to the euro area.

Table 3 – Subcategories of Food and non-alcoholic beverages category

	MNE	euro area
	Share ‰	Share ‰
01 FOOD AND NON-ALCOHOLIC BEVERAGES	**314.3**	**166.2**
011 Food	**288.5**	**151.4**
0111 Bread and cereals	46.2	27.7
0112 Meat	69.8	36.0
0113 Fish	9.2	10.7
0114 Milk, cheese and eggs	57.6	22.2
0115 Oil and fats	9.9	4.7
0116 Fruits	24.4	14.4
0117 Vegetables	45.9	19.3
0118 Sugar, jam, honey, chocolate and confectionery	17.5	9.9
0119 Other food products	8.0	6.5
012 Non-alcoholic beverages	**25.8**	**14.8**
0121 Coffee, tea and cocoa	7.6	5.2
0122 Mineral water, non-alcoholic beverages, fruit and vegetable juices	18.2	9.6
02 ALCOHOLIC BEVERAGES AND TOBACCO	55.7	42.7
021 Alcoholic beverages	27.5	18.49
022 Tobacco	28.2	24.2

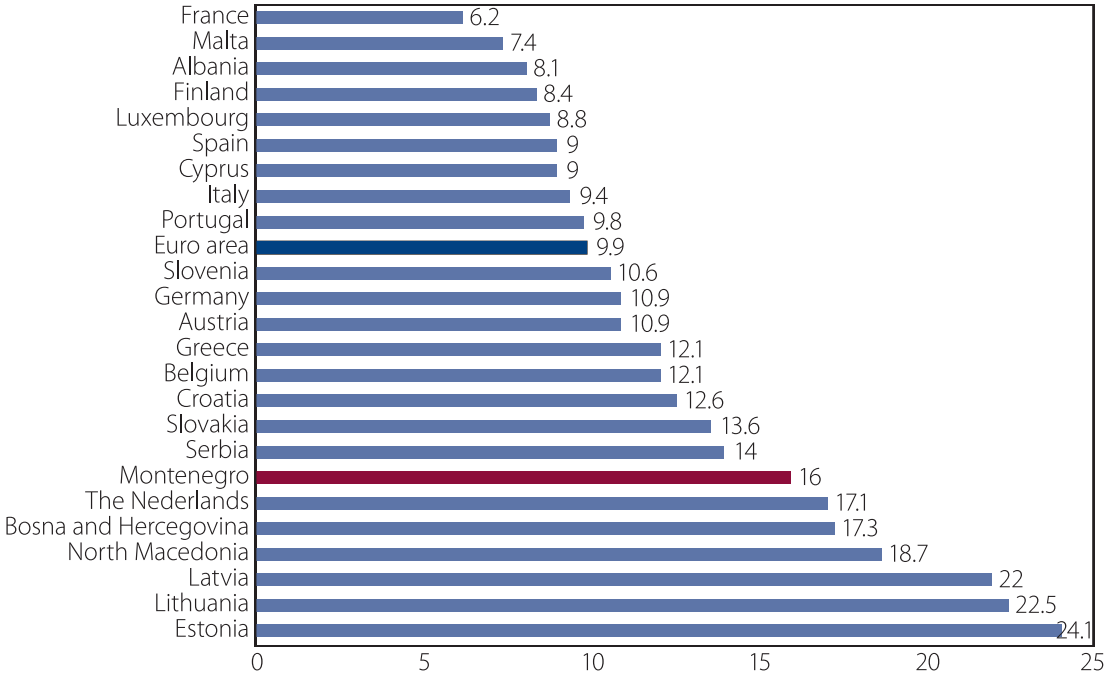
Source: MONSTAT, Eurostat

The representation of all subcategories of food and beverages, except for fish prices, in the total consumer basket in Montenegro is higher than in the euro area, which is in accordance with the results shown at the aggregate level. The same was observed in other countries of the European Union with a lower level of income, which confirms that the weights in the index, which measure inflation, reflect the real structure of consumption.

Differences in inflation exist within the monetary union itself. On the one hand, differences in inflation imply convergence factors, primarily price level convergence, as well as income convergence. According to Eurostat's final data, as part of the purchasing power parity project, the price level of consumer products and services in Montenegro was 60% of the EU average in 2021. The price levels for consumer products and services varied significantly among the euro area member countries in 2021. Ireland and Luxembourg recorded the highest price levels (140% and 132% of the EU average, respectively), while the lowest price levels are recorded in Latvia and Lithuania (79%), and Poland (72%). On the other hand, structural differences, such as different levels of rigidity in wage and price determination or different exposure to external shocks, also generate differences in inflation.

Inflation in the euro area in September 2022 was 9.9%, with inflation reaching two-digit levels in some euro area members. In this month, ten euro area countries recorded higher than average inflation. The range of measured inflation in the euro area ranged from 6.2%, as recorded in France, to 24.1% in Estonia.

Graph 11 – Comparison of inflation rates with countries in the region and the euro area



Source: MONSTAT, Eurostat, Statistical offices of the countries in the region

We can conclude that higher inflation than that in the euro area was recorded by all countries from the region, except Albania. In most countries, inflation is largely driven by rising food and energy prices. The war in Ukraine caused significant inflationary risks, mostly in the prices of energy, raw materials and food. Their growth is the main reason for the growth of inflation because it encourages price growth in many other sectors.

2. Assessment of impact of global, regional and domestic factors on inflation in Montenegro

For the fact that Montenegrin market is import-dependent and that any change in the prices of certain products on the international market affects the creation of the final inflation rate in Montenegro, we hereby examine the relevance of the impact of global, regional and domestic factors on inflation. We will analyse these influences using the *Principal components analysis - PCA* method. The mentioned analysis represents a statistical technique of data analysis that allows reducing the dimensionality of large data sets, thus increasing the possibility of their interpretability, while minimizing the loss of information contained in each variable at the same time.

The following explanation of the principal component method is based on the working paper by Jolliffe (2002): Principal Components Analysis – Second Edition. The central idea of principal components analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much variations from the data set as possible. This method achieves this by transforming the existing variables into a new set of variables, the principal components (PC), which are uncorrelated and ordered so that the first few retain most of the variance from the original variables. Therefore, the first component, as a rule, includes the largest part of the variance of the original data series, and each subsequent component includes the largest remaining part of the variance.

Written in formulae:

x is a p-dimensional vector of random variables

Σ_{pxp} is the covariance matrix of x (if the unknown is replaced by the sample covariance matrix S)

for $k = 1; ...; p$ k-th PC is given with $z_k = \alpha_k^T x$, where α_k eigenvector corresponds to its k-th largest eigenvalue λ_k.

Furthermore, if it is chosen to have unit length ($\alpha_k^T \alpha_k = 1$) then $\mathrm{Var}(z_k) = \lambda_k$.

The PCA issue involves constrained maximization. Let's start by performing the first PCA:

$$max_{\alpha 1} \alpha_1^T \Sigma \alpha_1 \; s.t. \alpha_1^T \alpha_1 = 1, \quad were \quad Var\,(\alpha_1^T x) = \alpha_1^T \Sigma \alpha_1$$

Using the Lagrange multipliers method: L = $\alpha_1^T \Sigma\alpha_1 - \lambda(\alpha_1^T \alpha_1 - 1)$

$[\alpha_1]$: $\Sigma\alpha_1 - \lambda\alpha_1 = 0$

$(\sum - \lambda I_P)\ \alpha_1 = 0$, where I_p $(p\ x\ p)$ is the identity matrix. Hence, λ is the eigenvalue of Σ and α_1 is the corresponding eigenvector.

We emphasize that the quantity that should be maximized is

$\alpha_1^T \Sigma\alpha_1 = \alpha_1^T \lambda\alpha_1 = \lambda\ \alpha_1^T \alpha_1 = \lambda$

Therefore, it is necessary that λ be as large as possible. Thus α_1 is the corresponding eigenvector to the largest eigenvector of Σ.

In general, k-th PC of x is $\alpha_k^T x$ and $Var\ (\alpha_k^T x) = \lambda_k$, where λ_k is k-th

the largest eigenvalue of Σ and α_k is the corresponding eigenvector.

The performance of the second PC $\alpha_1^T x$ is the same, but in addition the maximatization of $\alpha_2^T \lambda\alpha_2$ is performed without correlation with a $\alpha_1^T x$.

Once we have our own values, we have to choose how many PCs we want to keep.

Each PC represents a certain variance corresponding to the size of its eigenvalue.

That is:

the proportion of variance explained by the k-th $PC = \frac{\lambda_k}{\Sigma_{K=1}^{n}\ \lambda_k}$

After determining the number of PCs to be used (j) the resulting PCs can be calculated as follows:

$$PC_{nxj} = D_{nxk}\ A_{kxj}$$

where D_{nxk} is a data matrix with n observations and k variables, and A_{kxj} is a matrix whose columns represent certain eigenvectors.

The number of principal components depends on the number of data series used in the analysis, and the key task of this analysis is to choose the optimal number of principal components. As we mentioned above, components whose variance is greater than the variance of the source variable should be included. Beck et al. (2006) suggest that components which together explain at least 75% of the total variance should be included.

In order to examine the impact of global, regional and domestic factors on the inflation rate in Montenegro, we used the approach applied by Krusper (2012) and Miletić et al. (2022), using the Stock–Watson (2002) methodology, which implies the decomposition of the inflation rate in two steps.

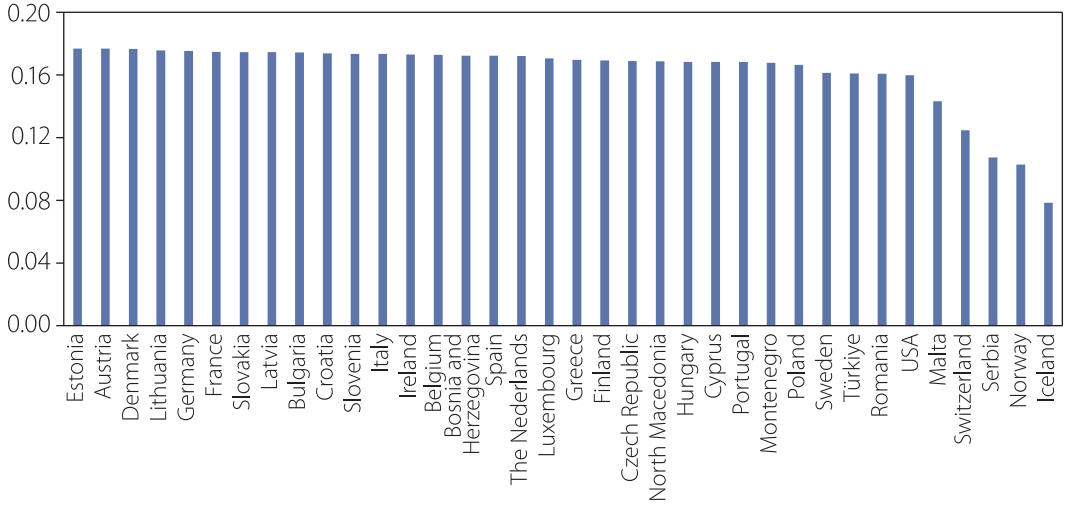
In the first step, we used the annual rates of 37 countries from which we extracted and created a new "global factor" variable, using the method of principal components analysis. The global factor is the variable that best explains the annual inflation rate in 37 countries.

In the second step, the annual inflation of the regional countries (Croatia, Serbia, Bosnia and Herzegovina, and the Republic of North Macedonia) is evaluated using the principal components analysis. The residuals obtained from the estimated relationship between the annual rate of the region and the global factor represent the regional factor. Finally, the annual inflation rate in Montenegro is regressed on global and regional factors, and the residuals obtained from this regression represent the contribution of domicile factors.

To analyse the contribution of global, regional and domicile factors to annual inflation rates in Montenegro, we used annual changes in the inflation rate by months from 2011 to September 2022, for 37 global countries. The sample of countries that we included in the analysis covers the European Union countries, Great Britain, the United States of America, regional countries and Türkiye (detailed description of the countries is given in Annex I). As a measure of the annual inflation rate, we used the harmonised index of consumer prices, and the data source was provided from the Eurostat and MONSTAT databases.

The results of the obtained analysis indicate that the first principal component explains about 83% of the total variance (results can be found in Annex II). The vector values for the first component are relatively similar for all observed countries, except for Great Britain, Iceland, Norway, and Serbia where they are higher in the case of the third main component. These findings indicate that the majority of observed countries were included in the calculation of the first main component, with similar weights.

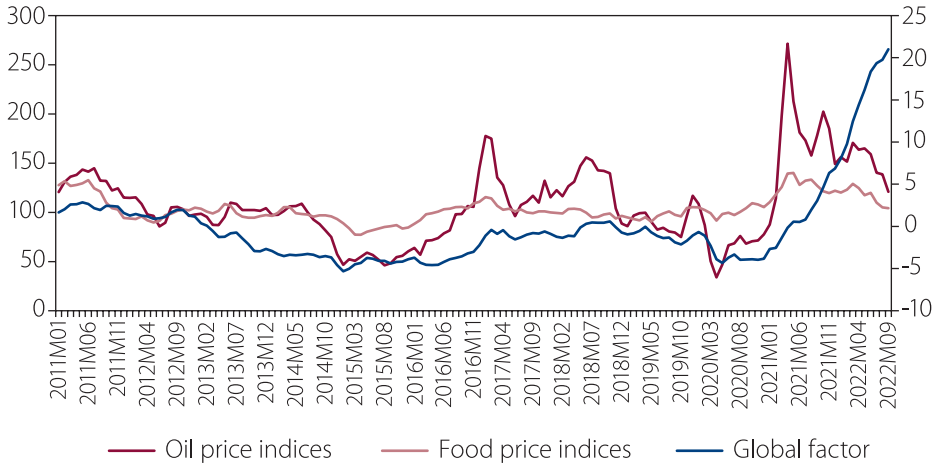
Graph 12 – Values of the first principal component for the observed countries



Source: Author's calculations

The weights which these components are included with in the calculation of the global factor are the individual percentages that explain the total variance. The rated global factor is shown in the graph 13. Since oil and food prices are most often mentioned as the global factors that have impact on inflation growth, we compared the price developments of these products with the global factor trend. What we can conclude by observing graph 13 is that the global factor follows the price developments of these products.

Graph 13 – The global factor and oil and food prices trend



Source: Author's calculations

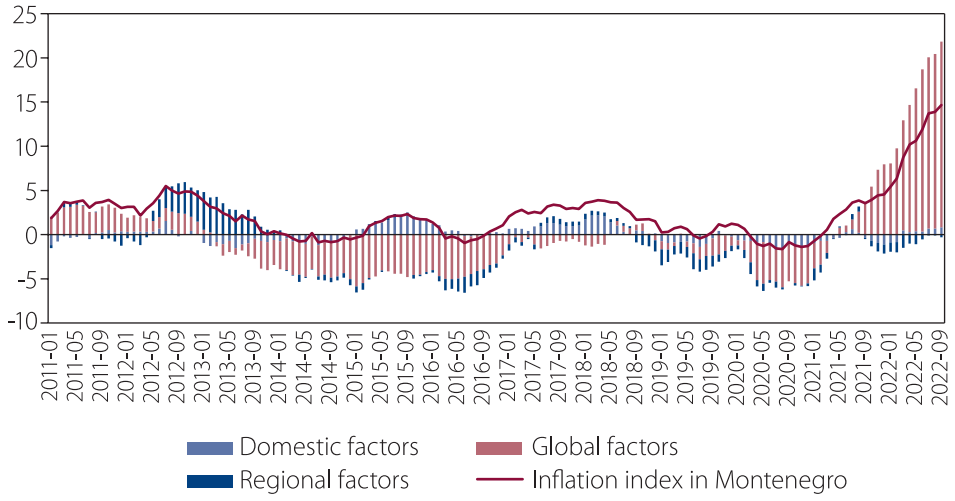
After calculating the global factor, a regression was made of the annual inflation rate for countries in our region (Croatia, Serbia, North Macedonia, and Bosnia and Herzegovina), including Montenegro, on the estimated global factor. We then applied the principal components analysis to the series of rated residuals, in order to calculate the contribution of the regional factor. The results of the application of principal components analysis are shown in the table. We again retained the first principal component as it explains close to 70% of the total variance.

In the final step, we regressed the annual inflation rate in Montenegro on estimated global and regional factors and obtained the contribution of dommicile factors.

The obtained results indicate that inflation in Montenegro is under the prevailing influence of global factors related to the prices trend, primarily of raw materials, food and oil, which are presented in graph 13. Our analysis shows that the global factor is higher than the average for some 45% in 2022, which is understandable as it "drags" inflation to Montenegro. Furthermore, the analysis indicates that the impact of the regional factor is small, which is understandable because it is "absorbed" by the global factor. What is a special challenge for economic policy makers is the assessment of impact of the domicile factor. The analysis shows that in times of increased fiscal burdens, the domicile factor had a significant impact on price developments, and the level of in-

flation in Montenegro was above the average inflation in the euro area, which was explained in section 1.1.

Graph 14 – Presentation of global, regional and domicile impact on the inflation rate



Source: Author's calculations

The analysis shows that in the first quarter the domicile factor passes from a negative to a positive zone, which indicates the impact of the fiscal reform at the beginning of the year ("Europe Now!" programme). However, the global factors development further dampened that impact.

It is also interesting to point out developments in the second and third quarters of 2022. Namely, fiscal burdens were reduced in June in order to protect the living standard of the population. A number of measures were adopted with the aim of temporarily lowering the price of fuel, reducing the rate of value added tax on basic groceries and other inputs in production[3]. However, the impact of the domicile factor was not reduced but rather increased. Based on this, it can be concluded that the effect of inflationary expectations appears in the creation of prices, especially in the service sector (graph 3a, the later reaction of the service sector is noticeable).

Finally, it is important to note that the impact, dynamics and intensity of the influence of global, regional and domicile factors on inflation in Montenegro, based on the principal components

[3] *Due to the rise in the prices of basic groceries, the Amended Law on Value Added Tax adopted in May reduced the VAT rate on flour and sunflower oil (from 7% to 0%) and salt (from 21% to 7%), and then additional amendments to that Law in June, which implied a reduction of VAT on bread from the then 7% to 0%. During the third quarter, the prices of flour and other cereals decreased by 1.8%, and the prices of oils and fats by 4.1%.*

In order to maintain the conditions for preserving stability of the prices of oil derivatives, validity of the Decision amending the Decision on reducing the amount of excise duties for the sale of unleaded gasoline and gas oils was extended until 3 January 2023. The reduction of the mentioned excise duties went up to 50% from June to November.

The Decision supplementing the Decisions on temporary measures to limit the prices of products of special importance for people's life and health and the list of products, which limits the price of pellets, was adopted in August.

analysis, cannot be clearly determined. In order to identify which factors, global and domestic, determine inflation in Montenegro, we will expand the analysis with the models presented in the following chapters. In the next chapter, we will examine the econometric assessment of the link between inflation in the euro area and the one in Montenegro, and once this being done, we will econometrically quantify the impact of global and domestic factors that determine the inflation rate in Montenegro.

3. Model analysis of the impact of euro area inflation on inflation in Montenegro

In this part of the working paper, we opted for the ARDL (AutoRegressive Distributed Lag) model approach for estimating the impact of inflation in the euro area on inflation in Montenegro. We will use the available data on the annual inflation rate in Montenegro and the euro area from January 2009 to September 2022 in this analysis. The source of data for inflation in Montenegro is MONSTAT, while data on inflation in the euro area are downloaded from the Eurostat website.

The ARDL model is used to analyse cointegrating time series to examine long-term and short-term dynamics, when the observed variables may be stationary I(0), integrated of order I(1) or even only partially integrated. Pesaran (1997), Pesaran, Smith and Shin (2001) and Pesaran et al. (2001) proposed approaches to testing the ARDL model limits, where the variables include a mix of stationary and non-stationary time series. This methodological approach has a number of features that many researchers believe give it some advantages over conventional cointegration testing.

In order to apply the ARDL approach, we will first use the Augmented Dickey-Fuller (1979, 1981) tests to check the stationarity of the time series we plan to include in the model. If the tests show that the time series is stationary, the values of its distribution (expected value and variance) do not change, that is, they are constant during the analysed period. The given series arbitrates around a certain value and does not have a defined development trend. Otherwise, the series is non-stationary, and has a certain defined development trend.

The Augmented Dickey-Fuller (ADF) stationarity test indicates that the INF_EU series is a non-stationary one. Namely, the null hypothesis of the ADF test is that the series INF_EU has a unit root, that is, it is non-stationary. The impossibility of rejecting this hypothesis (p value>0.05) confirms that the series is non-stationary. Also, the result of the ADF test when it comes to the INF_MNE series shows the same, that is, the INF_MNE series is also non-stationary. We will solve the issue of non-stationarity by differentiating these two series.

Table 4 – Stationarity tests

Time series	I(0)	I(1)
INF_EU	P= 1.0000	P= 0.0000
INF_MNE	P=0.9959	P= 0.0000

Bearing in mind the results of the ADF test, which shows that both variables INF_MNE and INF_EU are non-stationary, i.e. integrated of the first order (I (1)), we opt for the ARDL model, which allows the use of time series of the I(1) order of integration, in order to examine long-term relationship between these variables.

The basic form of the ARDL regression model is:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=1}^{q} \alpha_i X_{t-i} + \varepsilon_t$$

or

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + ...+ \beta_p Y_{t-p} + \alpha_0 X_t + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + ... + \alpha_q X_{t-q} + \varepsilon_t \quad (1)$$

From the form of the generic ARDL model given in equation (1) above, we can see that these models are characterised by the lag of the dependent variable as well as the lag (and possibly the instantaneous value) of the independent variables.

In our example, there are two variables that we are interested in modelling: the dependent variable and the other variable that explains it, so the abbreviated form of this model will look like this

$$\Delta y_t = \beta_0 + \Sigma \beta_i \Delta y_{t-i} + \Sigma \gamma_j \Delta x_{1t-j} + \varphi z_{t-1} + e_t \quad (2)$$

Here z, "error correction term" (ECM), represents a series of OLS residuals from a long-term "cointegration regression",

$$y_t = \alpha_0 + \alpha_1 x_{1t} + v_t \quad (3)$$

The ECM links the long-term equilibrium implied by cointegration with a short-term dynamic adjustment mechanism that describes how variables react when they are moved from long-term equilibrium.

In order to determine the long-term relationship between inflation in Montenegro and inflation in the euro area using the ARDL model, we first calculated the F-statistic of the Bound test and compared it with the critical values given in the table below.

Table 5 – Bound test results

F-Bounds Test	Null hypothesis: No levels relationship
Test Statistic	Value
F-statistic	6.370070

	10%		5%		1%	
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Asymptotic	3.020	3.510	3.620	4.160	4.940	5.580

** I(0) and I(1) are respectively the stationary and non-stationary bounds.*

The results of the F-test of 6.37 indicate a stable long-term relationship between the dependent and independent variables, i.e. the inflation rate in Montenegro and inflation in the euro area, having in mind that the obtained value of the F-test is significantly higher than the lower and upper limit values of 5 percent. Therefore, we can conclude that there is a cointegration relationship between these two series.

The results of the short-term relationship between inflation in Montenegro and inflation in the euro area are shown in the table 6:

Table 6 – ECM Regression

Dependent Variable: MNE_AN
Method: ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
MNE_AN(-1)	0.896134	0.029613	30.26143	0.0000
EU_AN	0.768119	0.134494	5.711198	0.0000
EU_AN(-1)	-0.281169	0.205487	-1.368302	0.1731
EU_AN(-2)	-0.261904	0.146481	-1.787967	0.0757
C	-0.127281	0.059206	-2.149783	0.0331

R-squared	0.966865	Mean dependent var	2.218182
Adjusted R-squared	0.966036	S.D. dependent var	2.966752
S.E. of regression	0.546748	Akaike info criterion	1.660179
Sum squared resid	47.82942	Schwarz criterion	1.754298
Log likelihood	-131.9647	Hannan-Quinn criter.	1.698385
F-statistic	1167.178	Durbin-Watson stat	1.855974
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent test results do not account for model selection.

Dependent Variable: D(MNE_AN)
Method: ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.103866	0.023612	-4.398760	0.0000
D(EU_AN)	0.768119	0.131401	5.845625	0.0000
D(EU_AN(-1))	0.261904	0.143279	1.827922	0.0694

R-squared	0.367404	Mean dependent var	0.055152
Adjusted R-squared	0.359594	S.D. dependent var	0.678988
S.E. of regression	0.543363	Akaike info criterion	1.635936
Sum squared resid	47.82942	Schwarz criterion	1.692408
Log likelihood	-131.9647	Hannan-Quinn criter.	1.658860
F-statistic	47.04373	Durbin-Watson stat	1.855974
Prob(F-statistic)	0.000000		

* p-values are incompatible with t-Bounds distribution.

Looking at the results from the ECM model, we can notice that the results of these cointegrated series suggest that a short-term increase in inflation in the euro area of 1 percent will lead to an increase in inflation in Montenegro by some 0.77 percentage points. The key coefficient for this analysis, the Error correction term - CointEQ(-1), shows us the speed of adaptation to the equilibrium (i.e. the pace of adjustment from the short-term to the long-term). The value of this coefficient, as a rule, must be negative and less than zero, in order to correct deviations from the long-term equilibrium. This coefficient simply represents the proportion of error in the adjustment of these rates that is corrected each month.

The error correction coefficient, CointEQ (-1), which is a measure of the average speed of convergence to long-term equilibrium, is -0.10 and is statistically significant at all conventional levels. It has the expected negative sign, which implies that the deviation from the long-term equilibrium exerts pressure on inflation in Montenegro by adjusting 10 percent of the resulting imbalance in each observed period (month).

Diagnostic tests of the model (Annex III) indicate that the model is well specified, that the residuals are normally distributed and that there is no heteroscedasticity in the model (Breusch-Pagan-Godfrey test). Also, tests show that the model has no problems with serial correlation (Breusch-Godfrey Serial Correlation LM Test), with the stability of coefficients (Cusum Test), or functional form (Ramsey Reset test).

4. Impact of global and domestic factors on inflation – SVAR model

In recent empirical literature, the global nature of inflation has increasingly been pointed out (Borio and Filardo, 2007; Mumtaz and Surico, 2012; Henriksen, Kidland and Sustek, 2013, Kamber and Wong, 2018). Laseen and Sanjani (2016), using a large number of variables, also show that external variables provide the best conditional forecast of the U.S. inflation in the Great Recession. Peneva and Rudd (2017) find little evidence of labour cost passing to price inflation in the U.S. Using the example of Asian countries, Kamber and Wong (2018) show that the prices of primary products on the global market have a greater influence on the deviation of inflation from the trend than on the inflation trend itself. However, Conti et al. (2015) find that the joint contribution of monetary shocks and demand shocks in euro area countries is as important as the contribution of oil price trend to the deviation of inflation from the trend line. The results of the research by Bobeica and Jarocinski (2019) indicate that during the period of the great recession, inflationary trends in the euro area were not fully explained by the oil and other goods price developments, and global trends in real activity. These authors show that it were the domestic factors that significantly had impact on inflationary trends in that period. Analysing inflation in developing countries, Ha et al. (2019) pointed to the dominant influence of domestic factors on inflation in developing countries, while global factors are more significant in developed countries.

In the second year of the pandemic, the ECB professional forecasters, as well as U.S. forecasters (Meier et al., 2021), were surprised by the extent of inflationary pressures created by supply-side bottlenecks and rising input costs. Analysing supply and demand factors in the U.S. over the past five decades, Eickmeier and Hoffman (2022) show that the rise in inflation since mid-2021 was driven by a combination of extremely expansive demand conditions and tight supply. The same authors, conducting the same analysis for the euro area, pointed to a somewhat greater role of the supply factor, i.e. of global energy price shocks on inflation in the euro area relative to the U.S., given the greater exposure to these costs of the euro area. However, Goncalves and Koester (2022) decomposed the euro area HICP inflation, suggesting that the increase in inflation was initially largely supply-driven, but that the importance of demand factors gradually increased over time. Namely, their analysis shows that, supply and demand factors have played a largely similar role in the HICP inflation index since June 2022.

In this section, we want to examine the dynamics of influence of the selected factors from the global and domestic market on the development of inflation in Montenegro. In order to examine the dynamics of these factors, we will apply the SVAR model, which is commonly used to analyse the dynamic impact of random disturbances on a system of variables. In our model, we will use six variables to look into the role of different factors in the movement of inflation.

As mentioned earlier, developments and changes in price levels in the Montenegrin economy are greatly influenced by developments from the external environment. There are numerous reasons

for the aforementioned tendencies: the size and openness of the Montenegrin economy, high import dependence, and the use of the euro as the legal tender. To examine the external environment impact, we will use the following variables: inflation rates in the euro area (HICP index), oil prices (IMF spot crude price) and food prices (IMF food price index) on the international market.

Also, price changes are influenced by factors from the domestic market. Bearing in mind the significant changes in the time series of wages caused by the new tax reform programme and the impossibility of separating this impact, we decided to use the variable "household demand". This variable was created using the Central Bank's methodology for estimating total aggregate demand. Houdehold demand is obtained as the sum of paid wages, paid pensions, payment of frozen foreign currency deposits, net compensation to the population minus net savings of the population (savings - approved loans). Also, when analysing the influence of factors from the domestic market, we will also analyse the "public spending" variable. We obtain this variable by deducting paid pensions, wages paid from the budget and net government savings from public spending (Deposits - Loans – Treasury bills).

Before proceeding to the evaluation of the VAR model, we will check the stationarity of the series. In general, it is known that the concept of stationarity is of fundamental importance in the analysis of time series, and that if this principle is violated, consistent evaluations of the model cannot be expected. The results of the unit root test for the consumer price index in Montenegro (CPI) and most of the other variables that we use in the model show that the mentioned series are non-stationary. In other words, the p-values of these tests point to the conclusion that the null hypothesis of the existence of a unit root can be rejected. However, by differentiating the series, we solved this issue and obtained stable stationary series (p-value = 0.00).

Considering the results of previously conducted tests on stationarity, it is possible to assess the VAR model, in which the six previously analysed variables are endogenous, and the exogenous variables are: a constant and a time artificial (dummy) variable. Namely, by observing and analysing the series, certain deviations from the dynamics were noticed, with a particularly characteristic deviation in the first quarter of 2022. We decided to introduce an artificial variable in order to remove obvious extraordinary deviations, thereby contributing to a more precise assessment of the controlled factors.

A structural view of the VAR model is provided by Lutkepohl (2011):

$$Ay_t = A_1^* y_{t-1} + A_2^* y_{t-2} + \ldots + A^* y_{t-p} + Bu_t \qquad (1)$$

Where A and A^*_p are structural coefficients. A is the instantaneous influence matrix between the variables, y_t is the (n×1) vector of endogenous variables $y_t = (hrana_t^g, nafta_t^g, infeu_t^g, jp_t^d, ts_t^d, cpi_t)$. The variables are the following: food prices on the international market, oil prices on the international market, inflation in the euro area, public spending, household demand and inflation in Montenegro, measured by the consumer price index. A_t^* je ($n \times n$) the delay lenght matrix, which represents the impulse response

of the shock function to the element y_t , B is ($n \times n$) matrix that measures the linear relationships between structural shocks and those in reduced form, u_t is a (n×1) vector of structural shocks.

The specification of the starting model is given in the Annex. The optimal number of events in the VAR model was chosen based on the criteria of the Akaike and Schwartz tests, which suggest the use of one lag in the model. By analysing the residuals, through normality, autocorrelation and heteroskedasticity tests, the obtained results are satisfactory from the econometric point of view (model results in the Annex).

For the purposes of the SVAR model, we will use the following reduced form:

$$y_t = A_1 y_{t-1} + \ldots + A\, y_{t-p} + \varepsilon_t \qquad (2)$$

Where $A = A^{-1}A_t^*$ and the reduced form of the error structure $\varepsilon_t = A^{-1}Bu_t$. The vector ε_t is (n×1) vector of shocks in a reduced form, which are simultaneously interconnected. The relationship between structural shocks and reduced form shocks is also the reduced form of the error structure given as:

$$\varepsilon_t = A^{-1}Bu_t = Su_t \qquad (3)$$

Where $E(\varepsilon_t \varepsilon_t^{'}) = \Sigma_\varepsilon = A^{-1}BB^{'}A^{-1'} = SS'$ and where $S = A^{-1}B$ (4)

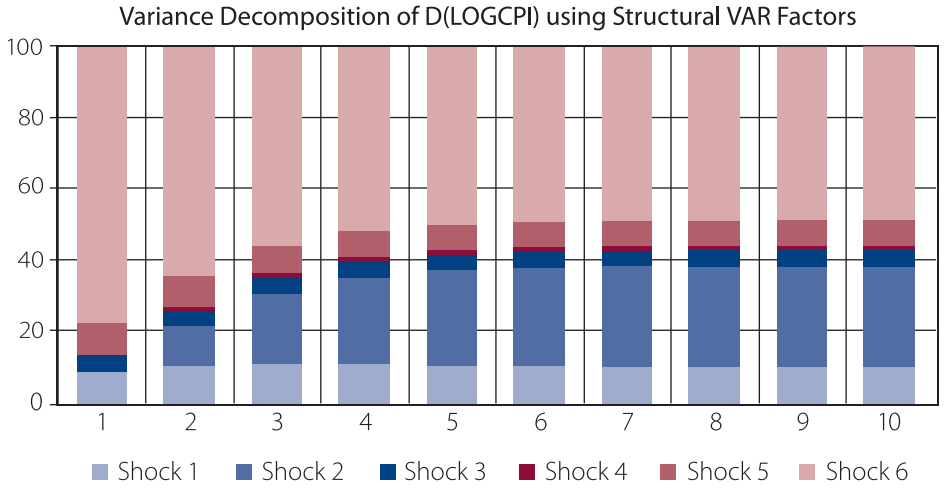
SVAR assessment uses Σ_ε estimates obtained from the reduced form of the VAR model, short-term covariance relationship and all restrictions in equation (4), and long-term restrictions on accumulated impulse reactions.

$$\begin{bmatrix} b_{11} & & & & & \\ b_{21} & b_{22} & & & & \\ b_{31} & b_{32} & b_{33} & & & \\ b_{41} & b_{42} & b_{43} & b_{44} & & \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} \end{bmatrix} \begin{bmatrix} u^g_{hrana} \\ u^g_{nafta} \\ u^g_{infeu} \\ u^d_{jp} \\ u^d_{ts} \\ u^d_{cpi} \end{bmatrix} = \begin{bmatrix} \varepsilon^g_{hrana} \\ \varepsilon^g_{nafta} \\ \varepsilon^g_{infeu} \\ \varepsilon^d_{jp} \\ \varepsilon^d_{ts} \\ \varepsilon^d_{cpi} \end{bmatrix}$$

The structural VAR models are estimated using different methods that depend on the model setting and the type of structural (identification) constraints (Lutkepoh, 2017). One of the reasons why we opted for the SVAR model is precisely the possibility of setting restrictions on the structural matrix, which allows us to better identify, evaluate and interpret shocks. A key assumption is that domestic factors do not have impact on global factors. Therefore, a restriction was set according to which the first variable in the model has impact on all other variables, while the other variables have no influence on this variable. Using this recursive form of the SVAR model, the assumption is that inflation in Montenegro reacts to changes in all variables in the model.

By analysing the decomposition of variances, we should see the most important determinants of the variability of the endogenous variables that we analysed in the SVAR model.

Graph 15 – Variance Decomposition Analysis

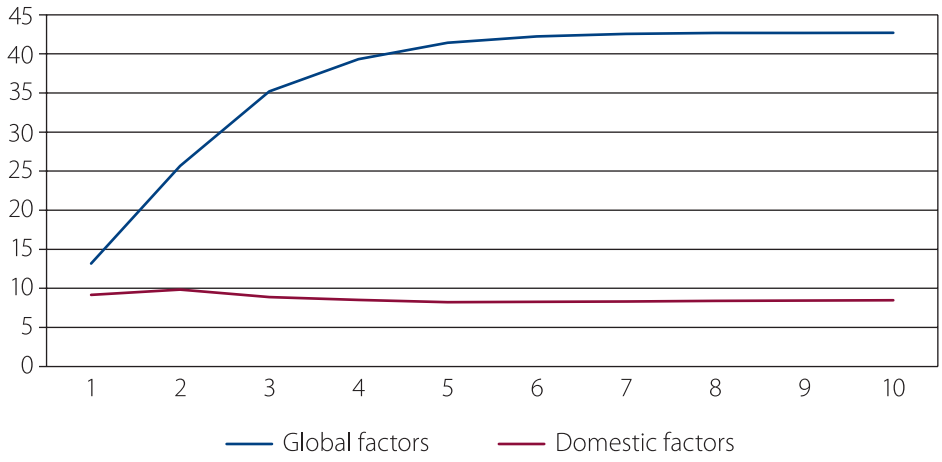


Note: Shock 1 - Oil prices, Shock 2 – Food prices, Shock 3 – Inflation in the euro area, Shock 4 - Public spending, Shock 5- Household demand and Shock 6 – Inflation in Montenegro

Source: Author's calculations

As we expected, based on the previously conducted analysis in the first section and pointing to widespread inflation in all sectors, variance decomposition estimates show that large price index fluctuations are a result of shocks in that variable alone (about 50%), while shocks in other variables together explain price volatility to the same extent. It can be noted that in the short term, prices increase mostly autoregressively. This is also confirmed by the inflation projections of the Central Bank of Montenegro, which indicate that inflation in the short term is predicted more accurately by autoregressive models, with the use of external factors as supplementary factors. Nevertheless, as time goes by, the percentage influence of other factors increases, and to the greatest extent the influence of food prices on the international market, then the oil prices, and factors that stimulate the household demand.

Graph 16 – Global and domestic inflation factors according to variance decomposition

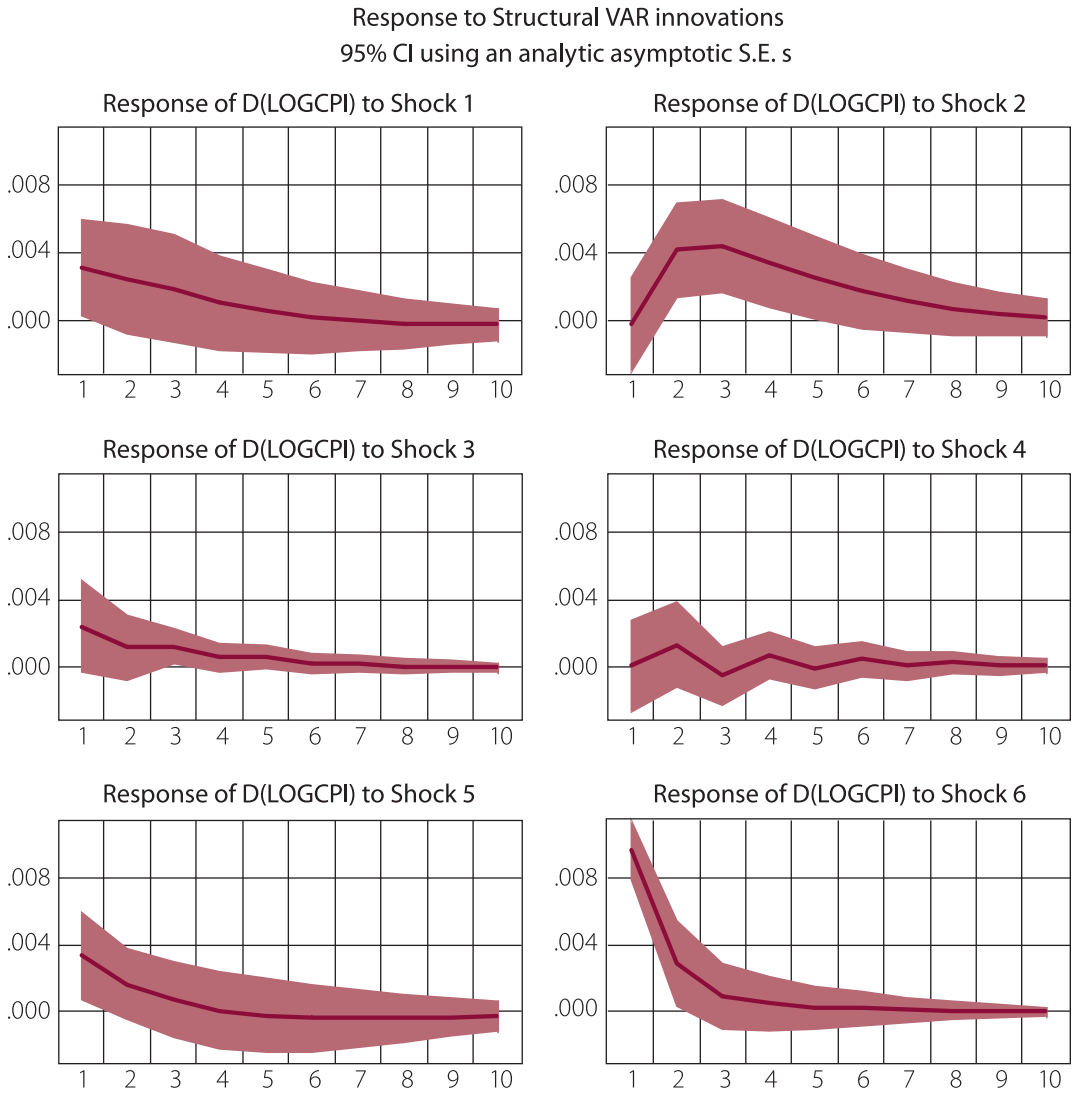


Source: Author's calculations

Based on the results of the variance decomposition, if we observe factors collectively, we could conclude that the inflation trend in Montenegro is largely explained by variations in global factors, especially after the third quarter. Domestic shocks modelled in our SVAR have a smaller impact on inflation variations and it is interesting to note that this impact gradually decreases as of the third quarter.

Based on the SVAR model estimated parameters, reactions of the variable of interest (consumer price index) to shocks (impulses) of other variables of one standard deviation were calculated. More precisely, we analyse the size of the accumulated impact of shock factors from the domestic and external environment, their significance, as well as the assessment of the duration of absorption of these shocks and the impact of individual shocks on variables, based on the impulse response function. The CPI response function to impulses in the other variables also indicates interesting conclusions about the relationships between the variables in the model.

Graph 17 – CPI response function to impulses



Note: Shock 1 - Oil prices, Shock 2 – Food prices, Shock 3 – Inflation in the euro area, Shock 4 - Public spending, Shock 5- Household demand and Shock 6 – Inflation in Montenegro

Source: Author's calculations

The direction of the consumer price index reaction to shocks at the beginning of the period is in accordance with the expected signs of the relationship between individual variables. For instance, the increase and jump in food and oil prices on the international market is reflected in the positive and significant reaction of the consumer price index in Montenegro. Inflation in the euro area has a positive but not that significant impact because the assumption is that the impact is "muffled" by global factors such as food and energy prices. Also, household demand had a positive impact on inflation in the first three quarters, and after that period the impact of this variable has gradually decreased.

Conclusion

Looking at the separate impact of supply and demand factors on inflation is a large challenge for monetary policymakers. The COVID-19 pandemic and subsequent economic recovery, increased geopolitical tensions, and the war in Ukraine fuelled the strong impact of both supply-side and demand-side factors, further complicating the authorities' response in the fight against inflation.

Differentiating these types of inflationary pressures in real time when making economic decisions is difficult for both businesses and the public. For instance, households, if they believe their earnings will increase because the economy is in an expansion phase as a result of the strong growth in aggregate demand, will not reduce their consumption. Also, for example, if oil prices rise due to an increase in aggregate demand, then the costs of production itself could rise, which would affect decisions of oil production companies.

In this working paper, we analysed in detail the components of inflation in Montenegro. Also, using various statistical and econometric techniques, we examined to what extent inflation in Montenegro depends on global factors and inflation in the euro area, and how much of an influence on inflation is exerted by the domestic market factors.

To analyse the contribution of global, regional and domestic factors to annual inflation rates in Montenegro, we used annual changes in the inflation rate by month from 2011 to September 2022 for 37 global countries, including Montenegro. The obtained results indicate that inflation in Montenegro is under the dominant influence of global factors, concerning price developments, primarily of raw materials, food and oil. Also, the analysis indicates that the influence of the regional factor is small, which is expected, because its influence is "absorbed" by the global factor. When it comes to the influence of domicile factors, the Principal components analysis shows that in times of increase or decrease of tax and excise duties, the domicile factor has a significant impact on price developments.

Similar to the euro area countries, as of the second quarter of 2021, inflation growth was driven by global factors, which are linked to rising raw material prices, limited supply capacity, disruptions and interruptions in the supply chain. In the first quarter of 2022, there is a sharp increase in household demand, predominantly stimulated by the earnings paid as a result of the "Europe Now!" tax reform implementation. However, to what extent the growth in demand, caused by the new tax reform implementation, influenced the growth of inflation is difficult to separate and assess based on the available data. Namely, we can note that the increase in wages was a continuation of the already growing inflationary pressures from the external environment, which started from the second quarter of 2021, and they were stimulated, as previously stated, by disruptions in global supply chains and the growth of aggregate demand due to the opening of economies and recovery from the COVID-19 crisis. Therefore, we can conclude that the effect of this reform pro-

gramme on inflation is present but limited as other factors have absorbed this effect at the level of the economy.

Furthermore, the paper examines the persistence of a long-term relationship between the inflation rate in Montenegro and inflation in the euro area. The results of the ARDL model confirmed that there is a cointegration relationship between these two series, and that in the short-term a 1 percent increase in inflation in the euro area leads to an increase in inflation in Montenegro by some 0.77 percentage points.

Finally, in the third empirical analysis, the impulse response function and variance decomposition of the SVAR model showed how inflation reacts to different shocks in the development of global and domestic factors. The obtained results of the SVAR model, used to assess the dynamics of the influence of various factors on inflation, are similar to the results obtained based on the Principal components analysis method. Inflation in Montenegro reacts more to global shocks than to domestic ones. Particularly, the conducted econometric analysis of the reaction direction of the consumer price index to shocks confirmed that the increase and jump in food and oil prices on the international market is reflected in the positive and significant reaction of this index in Montenegro, while the impact of the household demand on the inflation index was positive in the first two quarters, and the effects of this variable gradually decreased later on. When it comes to the impact of the inflation factor in the euro area, it was assessed that it has a positive impact, however, not so significant in this model because the assumption is that the impact is "muffled" by factors such as food and energy prices. Also, an interesting conclusion of the SVAR model refers to the fact that in the short term prices grow mostly autoregressively, while over time the percentage impact of other factors increases, notably the price of food on the international market, then the price of oil, and factors that stimulate the household demand. Finally, the results show that the household demand shocks are more pronounced than government spending shocks.

The results of this paper indicate certain implications for economic policy makers. First of all, fiscal policy measures should be specifically targeted in order to mitigate inflationary pressures from the global environment, that is, to mitigate the transmission of international food and oil prices to other prices. Furthermore, dealing with inflation presumes the implementation of structural reforms in the domain of the public sector and the system of social benefits. Structural reforms are the right way to amortize the negative effects of inflation. The implementation of structural reforms in the public sector opens up space for the implementation of a flexible fiscal policy in dealing with the negative effects of inflation and protecting the living standards of the population. On the contrary, increased spending on wages and social benefits in order to amortize inflationary shocks would only mean further fuelling of inflation.

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Annex

Annex I

List of countries used for Principal Components Analysis (PCA):

1. Austria
2. Belgium
3. Bosnia and Herzegovina
4. Bulgaria
5. Czech Republic
6. Montenegro
7. Denmark
8. Estonia
9. Finland
10. France
11. Greece
12. Croatia
13. Ireland
14. Iceland
15. Italy
16. Cyprus
17. Latvia
18. Lithuania
19. Luxembourg
20. Hungary
21. Malta
22. Germany
23. Nederland
24. Norway
25. Poland
26. Portugal
27. Romania
28. The Republic of North Macedonia
29. USA
30. Slovakia
31. Slovenia
32. Spain
33. Serbia
34. Switzerland
35. Sweden
36. Türkiye
37. Great Britain

Annex II

Principal Components Analysis
Date: 01/20/23 Time: 10:21
Sample: 2011M01 2022M10
Included observations: 142
Computed using: Ordinary correlations
Extracting 37 of 37 possible components

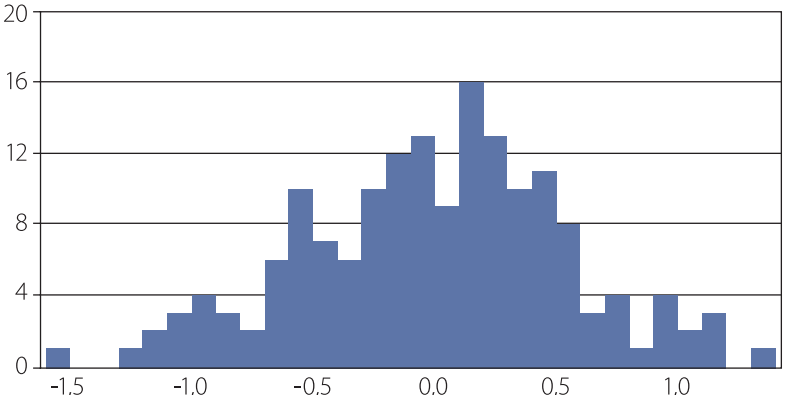
Eigenvalues: (Sum = 37, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	30.7095693...	28.5603293...	0.82998836...	30.7095693...	0.82998836...
2	2.14924004...	1.27999409...	0.05808756...	32.8588094...	0.88807593...
3	0.86924595...	0.21463874...	0.02349313...	33.7280553...	0.91156906...
4	0.65460721...	0.16511365...	0.01769208...	34.3826626...	0.92926115...
5	0.48949355...	0.08581454...	0.01322955...	34.8721561...	0.94249070...
6	0.40367901...	0.07181089...	0.01091024...	35.2758351...	0.95340095...
7	0.33186811...	0.05781621...	0.00896940...	35.6077032...	0.96237035...
8	0.27405189...	0.05371999...	0.00740680...	35.8817551...	0.96977716...
9	0.22033190...	0.09081008...	0.00595491...	36.1020871...	0.97573208...
10	0.12952182...	0.02403215...	0.00350058...	36.2316089...	0.97923267...
11	0.10548966...	0.01718262...	0.00285107...	36.3370985...	0.98208374...
12	0.08830703...	0.01114239...	0.00238667...	36.4254056...	0.98447042...
13	0.07716464...	0.00936799...	0.00208553...	36.5025702...	0.98655595...
14	0.06779664...	0.00906013...	0.00183234...	36.5703669...	0.98838829...
15	0.05873651...	0.01014608...	0.00158747...	36.6291034...	0.98997576...
16	0.04859042...	0.00782732...	0.00131325...	36.6776938...	0.99128902...
17	0.04076310...	0.00422197...	0.00110170...	36.7184569...	0.99239072...
18	0.03654112...	0.00296434...	0.00098759...	36.7549980...	0.99337832...
19	0.03357678...	0.00552219...	0.00090748...	36.7885748...	0.99428580...
20	0.02805459...	0.00242978...	0.00075823...	36.8166294...	0.99504404...
21	0.02562480...	0.00472608...	0.00069256...	36.8422542...	0.99573660...
22	0.02089872...	0.00433158...	0.00056483...	36.8631530...	0.99630143...
23	0.01656714...	0.00098354...	0.00044776...	36.8797201...	0.99674919...
24	0.01558359...	0.00143223...	0.00042117...	36.8953037...	0.99717037...
25	0.01415136...	0.00112926...	0.00038246...	36.9094551...	0.99755284...
26	0.01302209...	0.00066314...	0.00035194...	36.9224772...	0.99790478...
27	0.01235895...	0.00092580...	0.00033402...	36.9348361...	0.99823881...
28	0.01143314...	0.00205036...	0.00030900...	36.9462692...	0.99854781...
29	0.00938277...	0.00071846...	0.00025358...	36.9556520...	0.99880140...
30	0.00866430...	0.00062577...	0.00023417...	36.9643163...	0.99903557...
31	0.00803852...	0.00158712...	0.00021725...	36.9723549...	0.99925283...
32	0.00645140...	0.00054562...	0.00017436...	36.9788063...	0.99942719...
33	0.00590577...	0.00080145...	0.00015961...	36.9847120...	0.99958681...
34	0.00510432...	0.00098623...	0.00013795...	36.9898164...	0.99972476...
35	0.00411808...	0.00081147...	0.00011129...	36.9939344...	0.99983606...
36	0.00330660...	0.00054770...	8.93676286...	36.9972410...	0.99992543...
37	0.00275890...	---	7.45648932...	36.9999999...	0.99999999...

Annex III

ARDL Model diagnostic tests

1 Test: Normality of residuals



Series: Residuals	
Sample 2009M01 2022M09	
Observations 165	
Mean	-7.14e-16
Median	0.036412
Maximum	1.304131
Minimum	-1.544110
Std. Dev.	0.540040
Skewness	-0.134286
Kurtosis	2.890579
Jarque-Bera	0.578216
Probability	0.748931

2 Test: Serial correlations

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.588342	Prob. F(2,158)	0.5565
Obs*R-squared	1.219731	Prob. Chi-Square(2)	0.5434

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 12/08/22 Time: 13:19
Sample: 2009M01 2022M09
Included observations: 165
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MNE_AN(-1)	-0.001138	0.034985	-0.032522	0.9741
EU_AN	-0.012480	0.136427	-0.091474	0.9272
EU_AN(-1)	0.026064	0.207697	0.125489	0.9003
EU_AN(-2)	-0.011417	0.151146	-0.075534	0.9399
C	-0.000674	0.059395	-0.011343	0.9910
RESID(-1)	0.067087	0.086843	0.772509	0.4410
RESID(-2)	-0.059173	0.087167	-0.678850	0.4982

R-squared	0.007392	Mean dependent var	-7.14E-16
Adjusted R-squared	-0.030302	S.D. dependent var	0.540040
S.E. of regression	0.548161	Akaike info criterion	1.677001
Sum squared resid	47.47585	Schwarz criterion	1.808769
Log likelihood	-131.3526	Hannan-Quinn criter.	1.730490
F-statistic	0.196114	Durbin-Watson stat	1.960180
Prob(F-statistic)	0.977517		

3 Test: Heteroscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.992208	Prob. F(4,160)	0.0982
Obs*R-squared	7.827983	Prob. Chi-Square(4)	0.0981
Scaled explained SS	6.958039	Prob. Chi-Square(4)	0.1381

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/08/22 Time: 13:20
Sample: 2009M01 2022M09
Included observations: 165

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.288638	0.042778	6.747401	0.0000
MNE_AN(-1)	0.048678	0.021396	2.275096	0.0242
EU_AN	0.120497	0.097174	1.240016	0.2168
EU_AN(-1)	-0.270280	0.148468	-1.820456	0.0706
EU_AN(-2)	0.082643	0.105835	0.780863	0.4360

R-squared	0.047442	Mean dependent var	0.289875
Adjusted R-squared	0.023628	S.D. dependent var	0.399787
S.E. of regression	0.395036	Akaike info criterion	1.010153
Sum squared resid	24.96850	Schwarz criterion	1.104272
Log likelihood	-78.33761	Hannan-Quinn criter.	1.048359
F-statistic	1.992208	Durbin-Watson stat	2.040571
Prob(F-statistic)	0.098203		

4 Test: functional forms of the model

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: MNE_AN MNE_AN(-1) EU_AN EU_AN(-1) EU_AN(-2) C

	Value	df	Probability
t-statistic	1.254754	159	0.2114
F-statistic	1.574408	(1, 159)	0.2114
Likelihood ratio	1.625784	1	0.2023

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.468960	1	0.468960
Restricted SSR	47.82942	160	0.298934
Unrestricted SSR	47.36046	159	0.297865

LR test summary:

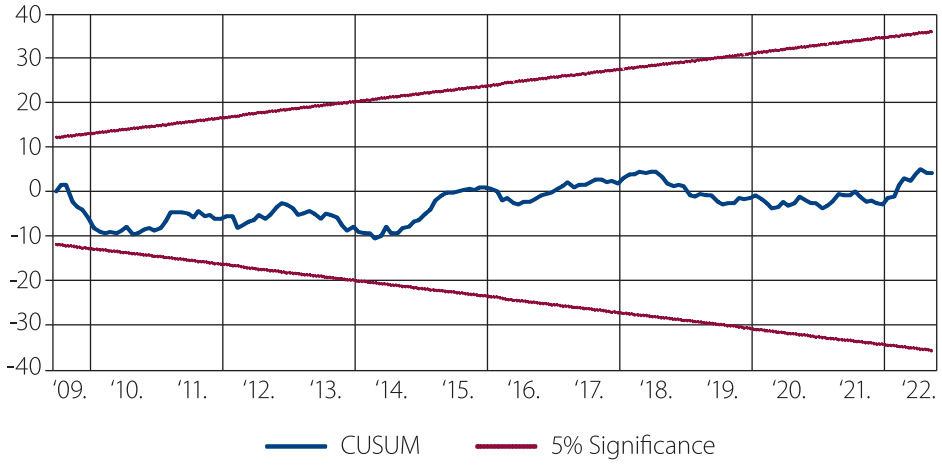
	Value
Restricted LogL	-131.9647
Unrestricted LogL	-131.1518

Unrestricted Test Equation:
Dependent Variable: MNE_AN
Method: Least Squares
Date: 12/08/22 Time: 13:20
Sample: 2009M01 2022M09
Included observations: 165

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MNE_AN(-1)	0.874026	0.034413	25.39814	0.0000
EU_AN	0.737591	0.136440	5.405995	0.0000
EU_AN(-1)	-0.267639	0.205403	-1.302996	0.1945
EU_AN(-2)	-0.271104	0.146403	-1.851772	0.0659
C	-0.079797	0.070178	-1.137063	0.2572
FITTED^2	0.003220	0.002566	1.254754	0.2114

R-squared	0.967190	Mean dependent var	2.218182
Adjusted R-squared	0.966158	S.D. dependent var	2.966752
S.E. of regression	0.545770	Akaike info criterion	1.662447
Sum squared resid	47.36046	Schwarz criterion	1.775390
Log likelihood	-131.1518	Hannan-Quinn criter.	1.708294
F-statistic	937.4093	Durbin-Watson stat	1.856570
Prob(F-statistic)	0.000000		

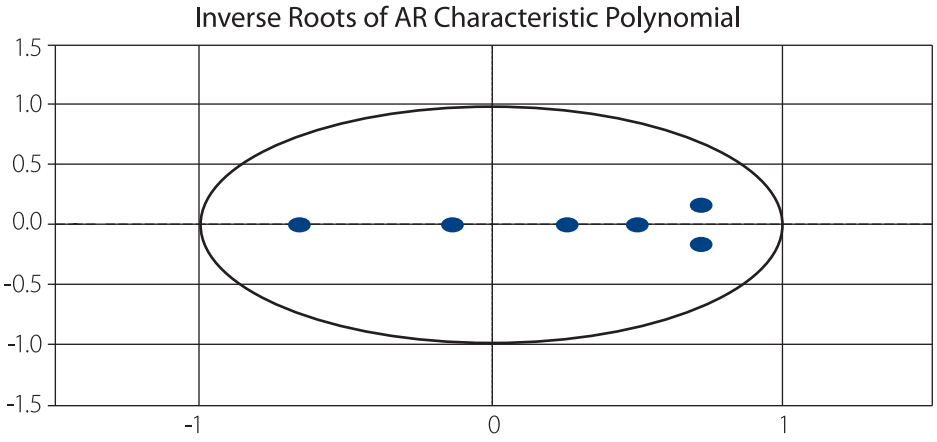
5 Test coefficient stability



Annex IV

The stability of the model is a condition for conducting further tests, so it is first checked whether the VAR model is stable.

Figure 1 - Unit circle with polynomial roots



As the roots of the polynomial lie within the unit circle, it is concluded that the VAR model is stable.

The residuals are not auto correlated, which is confirmed by the LM autocorrelation test from the table below.

Table - Autocorrelation test in the VAR model

VAR Residual Serial Correlation LM Tests
Date: 01/12/23 Time: 14:27
Sample: 2006Q1 2022Q3
Included observations: 56

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	36.2678859328583	360.456159444792044	51.010700558132177	(36, 165.2)	0.4615086749767511	
2	38.2212886187251	360.368865827898710	31.071056530735782	(36, 165.2)	0.3741890049093067	

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	36.2678859328583	360.456159444792044	51.010700558132177	(36, 165.2)	0.4615086749767511	
2	85.34658337268456	720.134609079677969	21.218785559877141	(72, 174.5)	0.1498209592227118	

*Edgeworth expansion corrected likelihood ratio statistic.

The normality test of the residuals shows that the residuals are normal for each component individually, as well as jointly:

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 01/12/23 Time: 14:30
Sample: 2006Q1 2022Q3
Included observations: 56

Component	Skewness	Chi-sq	df	Prob.*
1	-0.1685717820435476	0.2652201598791482	1	0.6065563037435912
2	0.3485054579845386	1.133589839620121	1	0.2870109129811742
3	0.5774856681270971	3.112570504327198	1	0.07769025847355989
4	0.1534501704748348	0.2197715783083881	1	0.6392140193662465
5	0.1852366288483548	0.3202510142262961	1	0.571456833647008
6	-0.7147213725635435	4.767715310391745	1	0.02899828361827379
Joint		9.819118406752896	6	0.1324789269918525

Component	Kurtosis	Chi-sq	df	Prob.
1	2.259356885539176	1.279955186995868	1	0.2579073676775243
2	3.943491631185302	2.077078402272303	1	0.1495261344287756
3	3.780592686204296	1.421758197429825	1	0.2331142290878297
4	3.278373006617717	0.1808135718979039	1	0.6706750000233709
5	3.451042667917835	0.4746921393256896	1	0.490836447786697
6	4.151502908731373	3.093904213905895	1	0.0785860444092871
Joint		8.528201711827484	6	0.2019013338967571

Component	Jarque-Bera	df	Prob.
1	1.545175346875016	2	0.4618164905370968
2	3.210668241892425	2	0.2008224447141468
3	4.534328701757023	2	0.1036055529304384
4	0.4005851502062921	2	0.8184912478817884
5	0.7949431535519858	2	0.6720170432670946
6	7.861619524297639	2	0.0196277722891528
Joint	18.34732011858038	12	0.1055444496150859

*Approximate p-values do not account for coefficient estimation

The heteroscedasticity test of the residuals shows that we cannot reject the null hypothesis of the homoscedasticity of the residuals, thus satisfying another important assumption of the econometric model.