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Mr. Sc. Besa Ramadani Mehmedi

University of Tetova, Faculty of Business Administration, Kumanovo, Republic of North Macedonia

Correspondence concerning this article should be addressed to Besa Ramadani Mehmedi, at the e-mail address: besa.ramadani@unite.edu.mk

Mr. Sc. Besa Ramadani Mehmedi

Abstract

The Western Balkan countries have experienced significant economic fluctuations in recent years. Among the primary contributors to these fluctuations is the volatility of energy prices. Energy, being a fundamental input in both production and consumption, has a direct and often disproportionate impact on inflation trends. Therefore, this study analyzes how energy prices have contributed to inflation in the Western Balkan (WB) countries in the period 2002 and 2022. The panel regression models, such as the fixed and random effects model as well as the Least Square Dummy Variables (LSDV), have been employed. The results reveal that there is a positive and significant relationship between energy prices and inflation. Variations in energy dependency, domestic energy policies, and economic structures lead to different inflationary responses across the Western Balkan countries. Countries with higher dependence on imported energy tend to experience more pronounced inflationary pressures.

Keywords: Inflation, energy prices, WB, panel regression, LSDV.

BALKAN JOURNALS

Introduction

It is well known that inflation has often caused significant social disturbances and hot debates among economists and policymakers throughout history. Its causes have always been in the center of discussions and research. Jerome Powell, the head of the US Federal Reserve in 2021, has recently stated that "Inflation expectations are terribly important." Inflation expectations are observed by governments for extended periods of time. Why are these expectations so crucial? The usual policy approach holds that one of the primary functions of policy institutions is making economic predictions, which can be assisted by inflation expectations helping central banks and other institutions estimate future inflation rates (Weber et al., 2022). Thus, the current global surge in prices has not been unexpected. Governments considered many measures and fiscal stimuli to protect their populations from the consequences of COVID-19, however, there have been debates among economic experts regarding whether these measures would trigger a spiral of inflationary pressures (Ferguson and Storm, 2023). In 2022, inflation became widespread worldwide, but it was mostly attributed to Russia-Ukraine war that triggered the energy crisis, which in turn made huge pressures on the overall level of prices. The World Bank reported that it impacted all developed countries and 87% of emerging markets and developing economies. More than half of advanced economies and just over half of emerging markets experienced higher inflation than that predicted for 2021. This has led to higher interest rates and tightening of monetary policies, but with the rising costs of borrowing, there is a risk of occurrence of an upcoming financial crisis (Munteanu & David, 2023).

Western Balkans have faced abundant challenges in maintaining resilience and reducing the consequences of the energy crisis in their economies, in the last couple of years. The beginning of the conflict in Ukraine, witnessed an intensification of inflationary pressures in these countries. The price of all energy sources, including electricity, increased significantly. The electricity sector was particularly strained in 2021 due to low production from renewable sources (World Bank, 2022b). In response to the rising inflation, each country in the Western Balkans has enacted measures to limit its rise. Nevertheless, the sharp increase in energy prices has disproportionately affected Serbia, North Macedonia, and Kosovo. These countries are particularly vulnerable due to their heavy dependence on imported energy sources (World Bank, 2022). Thus, this study has been aimed at examination of the impacts of escalating energy prices on inflation rates within this region.

Literature Review

The impact of energy price shocks on inflation has consistently been a focal point of research interest. Several authors have carried out research utilizing different econometric models to empirically estimate how energy prices affect inflation, however, less studies have been conducted specifically for the economies of the Western Balkans.

An early empirical study of Bruno and Sachs (1985) thoroughly inquires the forces of aggregate demand and supply that determine the output, the employment, and the price level in the main industrialized countries. Among other findings, they argue that deterioration of the major economies during that period resulted from the supply shocks of the 1970s because of OPEC oil-price increases, and from the undertaken policies to decrease demand in response to inflationary pressures. Yıldırım et al. (2013) investigated weather inflation persisting in energy prices using panel unit root tests and analyzed the energy prices on an unbalanced panel for 34 OECD countries, between the period 1979Q1 and 2012Q1. They found that inflation was not uniformly persistent for all OECD countries. Nevertheless, independent testing verifies the assumption that countries such as the United Kingdom, Korea, Poland, Slovak Republic, Belgium, Czech Republic, Estonia, France, Germany, Italy, and Korea show a persistent inflation in energy commodities, whereas there is no persistent inflation in the total amount of energy commodities in the United States, Austria, Canada, Finland, Luxembourg, Norway, and Sweden. In 2022, Casoli et al. built a Bayesuan Structural VAR (SVAR) model to examine how the European inflation dynamics interacts in various energy shock types. They analyzed two energy markets, oil and natural gas, together with two important macroeconomic variables that measured inflation expectations and realized headline inflation. The results showed that shocks to energy prices especially referring to natural gas have had greater impact on the inflation in the Euro Area. Vlieghe (2024) investigated how rising costs of energy affected non-energy products and services pricing, or how increased energy prices indirectly affected inflation. The analysis was done for 38 OECD members by using two distinct approaches. Firstly, cumulative inflation was used throughout the relevant time to do basic cross-country regression that provided evidence on the long-term effects. The research paper of Munteanu & David (2023) reveals that direct influence of energy prices on inflation appears to be minimal, which reflects the relatively low proportion of energy expenses in the overall consumption basket. Furthermore, public perception reinforces this notion, given the significant increase in prices of essential food items in

daily consumption, while energy companies continue to report substantial profits. This discrepancy has led to calls for higher taxation of these companies. Despite the recognition of the energy crisis as a primary contributor to inflation, academic research has largely overlooked the actual impact of energy price shocks on inflation. Bigerna (2023) analyzed the impact of exchange rates, energy prices and inflation in the economies of 15 countries in the G20 Group, for the data spin from January 2010 until December 2021, using nonlinear VAR estimation. Their results suggest designing of a prudent monetary policy for understanding the movements in long-term inflation, which is the consistent rise in prices over time that respond to sudden changes in oil prices.

Moving to the Balkan region, Minasyan et al. (2023) investigate the inflation dynamics in the Western Balkans, using two empirical approaches such as the Phillips curve and the structural VAR model, considering quarterly data for the period of 2007Q1-2022Q3 for six economies of the WB. The approaches are adapted to the data availability and country specificities of the region. The study reveals that headline, core, and inflation predictions are all affected by global food prices. In the Western Balkans, aggregate demand shocks were due to the influence of global inflation, however, it was not only dependent on external shocks. Despite persistent high inflation, these findings suggest policies that may be used to limit the immediate and complete transmission of international food prices to domestic prices. Another study on the Western Balkan countries is that of Obradović and Lojanica (2022) where they analyzed the unit root properties of inflation and the existence of structural breaks and nonlinearity, from the first quarter of 2006 until the second quarter of 2020, in six Western Balkan Countries. The results showed that inflation manifested a nonstationary process and structural break in Montenegro and Albania. The inflation fluctuations in Bosnia and Herzegovina and Serbia are characterized by nonlinear mean reverting behavior. Kraja et al. (2022) investigated six Western Balkan countries from 2010 to 2020, evaluating the effects of macroeconomic parameters on economic development. Their analysis consisted of use of the Ordinary Least Squares (OLS) model to test the correlations. The results indicated that GDP was significantly influenced by inflation and unemployment. Petrovska and Nikolov (2018) analyzed the factors that influence core inflation in North Macedonia. Their empirical investigation underscores that the principal contributors to the cumulative core inflation are the underutilization of labor, as manifested by the prevalence of spontaneous part-time employment, alongside fluctuations in the headline unemployment rate.

Research Methodology and Data

The research methodology of this article consists of a quantitative research approach, specifically applying a panel regression analysis. Initially, both fixed and random effects will be examined, with Hausman's test used to identify the most suitable and consistent model for the Western Balkan countries. Additionally, the Least Squares Dummy Variable (LSDV) model will be applied to include country-specific dummy variables, enabling estimation of country intercepts, and capturing unobserved heterogeneity that could differentially impact inflation across the Western Balkan countries. The analysis was conducted within a period of 21 years, from year 2002 to year 2022, and the data were mainly provided from the World Bank, except the data on the non-household electricity prices that were provided from Eurostat. The following table represents the description of the variables that were used in the model, their abbreviations, unit of measurement and source.

Table 1

Definition of variables and description of data

Variable	Definition	Unit	Source
INFL	Inflation, as measured by the consumer price index that reflects the annual percentage change	*(Annual* (%)	World Bank
RGDPG	The annual percentage change in Gross Domestic Product per capita, reflecting the overall economic activity	(Annual %)	World Bank
INTR	Real interest rate, which influences borrowing costs and inflation expectations	*(%)*	World Bank
UNEMP	The percentage of the labor force that is unemployed, affecting consumer spending and wage pressures	*(%)*	World Bank
RENERGY	Renewable energy supply (% of total energy supply).	*(%)*	World Bank
ENPRICES	Non-household electricity prices as a proxy variable for energy prices	*(Annual % change)*	Eurostat

Source: Author's source

The specified econometric model is designed to analyze the impact of energy prices alongside other macroeconomic variables. The econometric model is specified as follows:

$$INFL_{it}=\beta_0+\beta_1 ENPRICES_{it}+\beta_2 RGDPG_{it}+\beta_3 INTR_{it}+\beta_4 UNEMP_{it}+\beta_5 RENERGY_{it}+u_i$$

where:

$INFL_{it}$ represents the inflation rate in country i, at time t, measured as the annual percentage change in the Consumer Price Index (CPI).

β0 - is the intercept term, capturing the baseline level of inflation when all explanatory variables are zero.

β1, β2, β3, β4, β5 are the coefficients for the individual independent variables, respectively, quantifying their impact on inflation. Whereas, is the error term capturing the unobserved factors affecting inflation. Energy Prices are used as the first independent variable representing the cost of energy, proxied by non-household electricity prices. These prices reflect the cost businesses incur for electricity, which can be a significant input in production processes. Energy prices are a critical determinant of inflation because they directly influence the cost of goods and services. Higher energy costs can lead to increased production costs, which businesses may pass on to consumers in the form of higher prices. The expected effect is positive, indicating that an increase in energy prices leads to higher inflation. This reflects the cost-push inflationary pressures arising from higher energy costs. The annual per capita growth rate of the real Gross Domestic Product (GDP) is the second explanatory variable, indicating the economic performance and the overall activity within a country that affect inflation through demand-pull mechanisms. Strong economic growth typically leads to higher demand for goods and services, which can push prices up. The expected sign is positive, suggesting that higher real GDP growth is associated with increased inflation, as higher economic activity boosts aggregate demand. The interest rate represents the policy rate set by the Central Bank, which influences the cost of borrowing and the return on savings within the economy. Interest rates are a tool for controlling inflation. Higher interest rates can reduce inflation by lowering consumer spending and business investment, while lower rates can stimulate economic activity and potentially increase inflation. The expected effect could be negative, implying that higher interest rates are associated with lower inflation. The unemployment rate influences inflation through the Phillips curve relationship, where lower unemployment can lead to higher inflation due to increased wage pressures and higher consumer spending. It is expected to be

negative, indicating that higher unemployment is associated with lower inflation. This relationship suggests that higher unemployment reduces demand pressures and wage growth, thereby reducing inflation. Renewable energy supply can influence inflation by stabilizing energy prices and reducing reliance on volatile fossil fuel markets. It can also lower the long-term cost of energy, contributing to more stable production costs and consumer prices. The expected effect is negative, suggesting that an increase in renewable energy supply is associated with lower inflation. This reflects the potential of the renewable energy to provide a more stable and sustainable energy cost structure, reducing inflationary pressures.

Results and Discussion

This section presents the regression results for the three models. Table 2 presents the regression results for analyzing the factors influencing the inflation rates across Western Balkan countries using three different models: Random Effects (RE), Fixed Effects (FE), and Least Squares Dummy Variable (LSDV). Each model provides insights into how variables such as energy prices, real GDP growth, real interest rates, unemployment, and renewable energy supply impact inflation. Additionally, the LSDV model includes country-specific effects to capture the unique influence of each country on inflation.

Across all three models, energy prices show a positive and significant effect on inflation. Specifically, in the Fixed Effects (FE) and LSDV models, the coefficients are both statistically significant with t-statistics close to 1.96. This implies that higher energy prices, proxied by non-household electricity prices, lead to higher inflation rates. The Random Effects (RE) model also supports this finding with a slightly higher coefficient (0.92790). This positive relationship aligns with the concept of cost pushing inflation, where rising energy costs increase the overall price level of goods and services.The impact of real GDP growth on inflation is positive in all models but is not statistically significant, as indicated by t-statistics, below the critical value of 1.96. This suggests that, within the studied period and countries, economic growth does not significantly drive inflation once other factors are controlled. This might indicate that the growth levels in these countries do not reach a threshold that generates substantial inflationary pressures.

Table 2.

Panel regression results

Variables	RE		FE		LSDV	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat
ENPRICES	0.92790**	2.11	0.5697**	1.95	0.5608**	1.96
RGDPG	0.06044	1.10	0.07115	1.44	0.07109	1.43
INTR	-0.95230***	-16.56	- 0.8698***	-14.2	- 0.8691***	-14.1
UNEMP	0.27713***	6.23	0.3023***	6.67	0.3023***	6.65
RENERGY	-0 .16001**	-2.08	-0.00805	-1.22	-0.00805	-1.20
Constant	1.45120	1.62	0.08843	0.39	0.0935	0.84
Albania	-	-	-	-	-	-
Bosnia&Herzeg.	-	-	-	-	-2.7314**	-2.76
Kosovo	-	-	-	-	1.094382	1.41
North Macedonia	-	-	-	-	-2.3168**	-2.21
Montenegro	-	-	-	-	-3.1221**	-2.56
Serbia	-	-	-	-	-.83969	-0.61
Hausman Test			0.0432			
Prob > F	0.0000		0.0000		0.0001	
R^2	0.88		0.79		0.82	
N	102		102		102	

t statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01

Source: Author's calculations

The real interest rate shows a strong negative and highly significant effect on inflation across all models. The coefficients are -0.9523 (RE), -0.8698 (FE), and -0.8691 (LSDV), all with very high t-statistics. This consistent negative relationship supports the idea that higher real interest rates, which reflect tighter monetary policy, effectively reduce inflation by cutting the aggregate demand and discouraging borrowing and spending. The unemployment rate has a positive and statistically significant impact on inflation in all models. This positive relationship is somewhat counterintuitive, as higher unemployment typically reduces inflation through reduced demand. However, in the context of the Western Balkans, this could indicate structural economic issues where high unemployment does not suppress inflation due to inefficiencies or other economic dynamics. The effect of renewable energy supply on inflation varies across models. In the RE model, the coefficient is -0.16001 and is statistically significant (t-statistic -2.08), suggesting that an increase in the supply of renewable energy might reduce inflation. However, in the FE and LSDV models, the coefficients are not statistically significant. This implies

that, while renewable energy might have a stabilizing effect on energy costs and, consequently, inflation, this effect is not robustly supported across different modeling approaches. The LSDV model provides additional insights into country-specific influences on inflation. The coefficients for Bosnia & Herzegovina (-2.7314), North Macedonia (-2.3168), and Montenegro (-3.1221) are negative and statistically significant, suggesting that these countries have lower average inflation rates compared to the reference country, Albania. Kosovo has a positive but not significant coefficient (1.094382), indicating a higher average inflation rate relative to Albania, though this is not statistically robust. Serbia's coefficient is negative but not significant (-0.83969), indicating no substantial difference in average inflation compared to Albania.

The Hausman test result (p-value = 0.0432) indicates that the Fixed Effects model is preferred over the Random Effects model, suggesting that the fixed effects are correlated with the explanatory variables, making FE and LSDV models more appropriate for interpretation. The high R^2 values indicate that these models explain a substantial portion of the variance in inflation. The overall models are statistically significant, as reflected by the Prob > F values being close to zero across all models.

Conclusion

This empirical study highlights the significant role of energy prices in shaping inflationary trends in the Western Balkans. It reveals that energy prices, real interest rates, and unemployment rates are significant determinants of inflation in Western Balkan countries. The chosen Fixed Effects and LSDV models highlight the importance of accounting for country-specific factors. The positive relationship between energy prices and inflation supports the cost-push inflation theories, while the negative relationship with real interest rates emphasizes the effectiveness of tight monetary policy in controlling inflation. The unexpected positive impact of unemployment on inflation suggests unique economic dynamics in the region that requires further investigation.Understanding this dynamics is crucial for formulating effective economic policies to stabilize prices and foster sustainable economic growth in the region. The findings suggest the need for Western Balkan countries to develop appropriate energy policies and diversify energy sources to mitigate the inflationary impact of volatile energy prices. Policymakers should also consider minimizing the dependency on imported energy as well as designing responsive and long-term policies.

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