EUNOMIA 1(109)/2025

Afrore Berdyna Mazreku
ORCID https://orcid.org/0009-0004-5545-965X
Faculty of Economy, Department of Marketing, University 'St.Kliment Orhidski Bitola'Prilep

Adem Qorolli
Faculty of Economy, Department of Finance, University of Tetovo

Ruzhdi Matoshi
ORCID https://orcid.org/0000-0002-6966-4433
Faculty of Economy, Department of Marketing, University of Tetovo

THE RELATIONSHIP BETWEEN PRODUCTION PRICES, CONSUMER PRICES AND IMPORT PRICES OF AGRICULTURAL PRODUCTS – EVIDENCE FROM KOSOVO

Abstract: This paper examines the relationship between harmonized CPI which means Consumer Price Index, agricultural producer price index (APPI) and import prices for agricultural products in Kosovo. The data utilized in this study were sourced from the Kosovo Agency of Statistics, comprising monthly time series data spanning from January 2015 to December 2022. The research employed various statistical techniques, including unit root tests, cointegration analysis, and a vector error correction model. These methods were applied to analyze the interrelationships among three variables: the Agricultural Producer Price Index (APPI), the Harmonized Consumer Price Index (HCPI), and import prices for agricultural products. Additionally, a Granger causality analysis was conducted to assess any potential causal relationships among these variables. The results showed that HCPI causes APPI, but APPI does not cause HCPI; import causes APPI but APPI does not cause import. Finally, import does not cause HCPI, but HCPI causes import. The paper concludes with relevant policy recommendations.

Keywords: consumer price index, producer price index, import, agricultural products, inflation

ZWIĄZEK MIĘDZY CENAMI PRODUKCJI, CENAMI KONSUMPCYJNYMI I CENAMI IMPORTOWYMI PRODUKTÓW ROLNYCH – DANE Z KOSOWA

Streszczenie (abstrakt): W niniejszym artykule zbadano związek między zharmonizowanym wskaźnikiem CPI, który oznacza wskaźnik cen konsumpcyjnych, wskaźnikiem cen producentów rolnych (APPI) i cenami importowymi produktów rolnych w Kosowie. Dane wykorzystane w tym badaniu pochodzą z Kosowskiej Agencji Statystycznej i obejmują miesięczne szeregi czasowe w okresie od stycznia 2015 r. do grudnia 2022 r. W badaniu zastosowano różne techniki statystyczne, w tym testy pierwiastka jednostkowego, analizę kointegracji i wektorowy model korekty błędem. Metody te zostały zastosowane do analizy wzajemnych powiązań między trzema zmiennymi: wskaźnikiem cen producentów rolnych (APPI), zharmonizowanym wskaźnikiem cen konsumpcyjnych (HCPI) i cenami importowymi produktów rolnych. Dodatkowo przeprowadzono analizę przyczynowości Grangera w celu oceny potencjalnych związków przyczynowych między tymi zmiennymi. Wyniki pokazały, że HCPI powoduje APPI, ale APPI nie powoduje HCPI; import powoduje APPI, ale APPI nie powoduje importu. Wreszcie, import nie powoduje HCPI, ale HCPI powoduje import. Artykuł kończy się odpowiednimi zaleceniami politycznymi.

Słowa kluczowe: wskaźnik cen konsumpcyjnych, wskaźnik cen producenta, import, produkty rolne, inflacja

1. Introduction

The indices of agricultural products developed by FAO, which stands for the Food and Agriculture Organization, track the yearly average fluctuations in the prices that are received by farmers themselves for their products, which are typically sold either at the farm–gate or at the initial point of sale (FAO, 2020). The Consumer Price Index (CPI) simply can be defined as a measure of average prices for a basket of goods commonly purchased by consumers. To determinate whether the general prices are high, low or stable over the time, we use CPI. It also helps with calculating annual rate of inflation and to convert nominal values to real. After CPI, also important is PPI, that stands for The Producer Price Index, it measures the average prices for a basket of inputs commonly purchased by producers. The PPI has two main functions: (1) to provide price indices for use in the deflation of gross domestic product data, and (2) to provide a general measure of inflation. Economists have argued over the subject that the PPI can be a really useful indicator of future consumer inflation, as changes in prices paid by producers (changes in costs) often precede changes in prices paid by consumers (Kocatepe, 2011). The CPI is a monthly report that enables the tracking of changes over time in the prices of a particular group of goods and services consumed by households residing in a specific urban location (Riofrío et al., 2020).

The objective of this research is to investigate the correlation between the harmonized consumer price index (HCPI), agricultural producer price index (APPI), and import prices for agricultural products in Kosovo. APPI or Agricultural producer price index is amongst the most important indiciators of agricultural development sectore and is highly affected by consumer price index and import pricess.

2. Literature review

Based on the experience of numerous countries, it has been observed that consumer prices have an impact on Agricultural Production Prices (DAAPI). Similarly, agricultural production prices (DAAPI) can influence consumer prices. Additionally, imports can affect agricultural prices (DAAPI). However, agricultural prices do not typically have a direct impact on imports. These findings have prompted economists to conduct further investigations to determine the nature and extent of these relationships. It is suggested that policymakers should prioritize stabilizing consumer prices and reducing their impact on agricultural production prices, as well as on imported products. Now the real question lies on the causal relationship between PPI and CPI, do they have anything in common? What is one of them doing that the other one is not?! Do production prices cause consumption prices or do consumption prices cause production prices. Kocatepe (2011) shows that there are two basic approaches regarding the PPI and CPI causality relationship, 1) the supply side and 2) the demand side. Based on the supply-side approach, there is a relationship between the Consumer Price Index (CPI) and the Producer Price Index (PPI) due to their connection within the production chain. Advocates of the supply-side approach argue that raw materials are utilized as inputs for the production of intermediate goods, which, in turn, are used as inputs for the production of final goods. Therefore, any fluctuations in the prices of raw materials need to be transmitted to the prices of intermediate and final goods, ultimately affecting consumer prices. The examination of the relationship between the Consumer Price Index (CPI) and the Producer Price Index (PPI) has been a focal point for numerous research studies. Understanding this link is crucial for policymakers as it enables them to forecast future inflation by utilizing the PPI. By analysing the findings presented in this study, policymakers can enhance their preparedness in order to prevent or reduce the adverse effects of inflation. These findings also highlight the significance of relying on the connection between the CPI and the PPI, and suggest that changes in the PPI can be used to predict changes in the CPI. (Pagar, 2008). According to a study conducted by Clark (1995), economic logic indicates that the production chain should establish a connection between fluctuations in producer prices and subsequent variations in consumer prices. This implies that changes in producer prices have an impact on input prices and, ultimately, on consumption. However, it is important to note that this type of analysis overlooks the intricate nature of pricing decisions made by firms, as well as the construction methodology behind producer price and consumer price indices. As per the findings of Tokarick's (2006) research, import tariffs implemented in many developing countries have the effect of impeding their export capabilities. The imposition of import tariffs indirectly impacts the prices of exported goods in relation to domestically produced goods, which can be either non-tradable or goods intended for the domestic market. When import tariffs increase the price of imports, consumers tend to shift their consumption from more expensive imported goods to domestic goods. If these two types of goods are substitutes, this shift in consumption patterns leads to a price rise of domestic goods. Consequently, the tariff on imports results in a drop in the relative price of exports compared to non-tradable goods. This appreciation of the real exchange rate redirects production away from exports and towards non-tradable goods. In an earlier study conducted by Yates and Strzepek (1998), a quadratic programming sector model was employed to assess the comprehensive effects of climate change on Egypt's agricultural economy. The findings indicated that climate change scenarios generally had limited impacts on the overall economic welfare, measured as the sum of consumer and producer surplus (CPS). The study observed a maximum decrease of approximately 6 percent in CPS. However, in certain climate change scenarios, CPS showed minor improvement or remained unchanged. In these situations, consumers tended to benefit more than producers. The income-generating ability of

Egyptian agricultural exporters was diminished due to global market conditions, but at the same time, import costs were lowered. In their work Aviral, Suresh, Mohamed and Frederik (2014) investigated the causality between the indices of production prices and consumer prices as an important topic in the analysis of inflation and the formulation of monetary policies as it helps in concrete implication in central banks to target inflation. According to their analysis, causality can go from PPI to CPI, as well as from CPI to PPI. The causality running from PPI to CPI illustrates cost-push inflation. The cost-push nature of inflation indicates that alternations in producer prices at the initial stage of the supply chain will be transmitted subsequently to the later stages and ultimately impact consumer prices. In their work Mouyad, Zouhair and Abdulnasser (2020) demonstrated the effect of the exchange rate (ERPT) on import prices and domestic consumer prices for monetary policy makers who want to determine the factors driving inflationary pressure. In this paper, the authors introduced the import cost indicator as an external mechanism through which fluctuations in exchange rates and changes in foreign prices are transmitted to affect domestic consumer prices. According to them, consumer price inflation can be derived from internal and external factors. In this particular context, factors such as food prices, oil prices, and prices of other imported inputs are considered as external elements that possess the potential to significantly influence domestic price inflation.

In their analysis, Juha and Korhonen (2012) investigated the concept of Exchange Rate Pass-Through (ERPT), which specifically examines the impact of exchange rate fluctuations on import prices and inflation within a country. The researchers have deduced that having a comprehensive understanding of the extent to which the exchange rate influences the economy is vital for the formulation of effective monetary policies and accurate inflation predictions. According to them, monetary authorities should have a clear understanding of how previous changes in the exchange rate have affected import prices currently, and how potential exchange rate movements will affect future inflation. This recognition allows central banks to make informed decisions about monetary policy and exchange rate policy, which are important for economic stability. Production prices exhibit some degree of variability, but they tend to be more rigid compared to consumer prices, as Goldberg and Hellerstein (2011) tried to explain in their analysis. This means that changes in producer prices are more difficult to implement and slower than changes in consumer prices. In most cases, production prices do not change frequently and do not immediately adjust to changes in production costs. This conceptualization of producer prices as more rigid than consumer prices is important for understanding resource allocation and market mechanisms in the economy. According to a report by the World Bank on Kosovo, the per capita income in the country has shown remarkable growth in the past 25 years. It has increased more than tenfold, rising from approximately $400 in 1995 to over $4,000 in 2022. These figures highlight substantial advancements in the economic development of Kosovo. However, even after this increase, the income per capita in Kosovo is still relatively low compared to the average of the member states of the European Union, They are only 12 percent of the average of EU member states or 20 percent of the average of aspiring peers and this shows that there are major challenges in terms of improving the standard of living and increasing income in Kosovo (World Bank, 2022). Considering Kosovo's status as a small country and its declaration of independence in 2008, it went through a significant transitional period, reforming national policies to align with EU requirements. Being heavily reliant on imports, Kosovo experiences the influence of global market prices on domestic goods, leading to inflation. In 2017, inflation increased to 1.5% following a period of price stagnation in 2016, primarily due to the rise in food and energy prices in international markets. While Kosovo has achieved stable economic growth over the past decade, it started from a low base. However, this growth has not been sufficient to generate adequate employment opportunities, particularly for women and youth, and address the persistently high levels of unemployment in the country (Rositsa, 2019).

According to Richard Beilock's (2015) study, Kosovo is described as a country with abundant fertile land, arable land, and a favourable climate suitable for the production of staple grains and high-value agricultural commodities like fruits, nuts, vegetables, and livestock. Approximately 90 to 95 percent of arable agricultural land, 30 percent of pasture land, and 37 percent of forest land in Kosovo are privately owned. The agricultural sector plays a significant role in the overall economic activity of the country. In 1995, primary agricultural production–including crops, livestock, orchards, and vineyards–accounted for 30 percent of GDP. When the forestry and food processing sectors were included, the total contribution rose to 35 percent of GDP. Before the conflict in 1999, the agricultural sector employed around 60 percent of the province's workforce.

As a small market, Kosovo relies on agricultural imports to meet domestic demand, particularly for cereals, meat, and dairy products. Agricultural imports make up approximately 22–25 percent of total imports. Since domestic prices are closely linked to import prices, these imports have a significant influence on local market prices.

This is the result of the liberalized trade regime and the high dependence on imports to meet the food demand in Kosovo. Due to import dependence and the impact of import prices, food security in Kosovo may depend on developments in the world market, changes in trade policies and international prices of agricultural products. Kosovo needs to develop its agricultural sector and encourage local production in order to reduce dependence and ensure domestic sources of food. (ARCOTRASS, 2006; MTI, 2009). Therefore, import prices have a significant impact on food security in Kosovo (Braha, et al, 2019).

It is true that Kosovo still depends on remittances to cover the costs of vital imports and support the economy. Remittances, which are financial contributions sent by Kosovars living abroad. To improve economic sustainability, it is important that Kosovo develops its competitive export sector. A competitive export sector would help diversify sources of income and reduce dependence on imports and remittances. This can be achieved through supporting the development sectors of education, innovation, technology and the production of value-added products that have the potential to be competitive in international markets. In addition, investments in infrastructure, energy and tourism can also help in economic diversification and improve the sustainability of Kosovo's economy. This would help create jobs, increase productivity and improve the country's ability to meet the costs of imports and increase exports (James and Korovilas, 2010). In January 2022,

the Harmonized Index of Consumer Prices (HICP) recorded a monthly inflation rate of 0.9%. When comparing January 2022 with January 2021, the annual inflation rate was measured at 7.1%. The increase in consumer prices during this period was primarily driven by several COICOP subgroups. Specifically, there were price increases observed in bread and cereals (1.2%), meat (1.3%), milk, cheese, and eggs (1.5%), edible oils and fats (1.7%), vegetables supply and miscellaneous services related to the dwelling (1.4%), goods and services for routine household maintenance (1.4%), fuels and lubricants for personal transport
equipment (2.0%), transport services (2.3%), catering services (1.4%), and personal care (2.7%). Collectively, these subgroups had a combined impact of 0.9 percent on the HICP (Kosovo Agency of Statistics, 2022).

3. Data and Methodology

3.1 Vector Autoregression Analysis

The study utilized data obtained from the Kosovo Agency of Statistics, encompassing monthly time series data spanning from January 2015 to December 2022. The dataset included variables such as the Agriculture Producer Price Index (APPI), the Harmonized Consumer Price Index (HCPI), and import prices for agricultural products. To assess the stationarity of the variables, the researchers employed unit root tests, specifically the Augmented Dickey-Fuller (ADF) test. This test helped determine whether the variables exhibited unit roots, indicating non-stationarity. The subsequent step involved examining the presence of cointegration among the variables. The researchers employed the Johansen cointegration test, which allowed them to evaluate whether a long-run relationship existed among the variables. For the vector autoregression (VAR) model, the optimal lag order was determined by considering the minimum values of various criteria, including the Final Prediction Error (FPE), Akaike Information Criterion (AIC), and Hannan-Quinn Information Criterion (HQ). These criteria aided in selecting the lag order that minimized model estimation errors. Upon confirming the presence of cointegration, a Vector Error Correction Model (VECM) was employed to estimate both short-run and long-run relationships among the variables. The VECM allowed for the examination of how deviations from the long-run equilibrium were corrected over time. The VECM model allows for the modelling of both the term of error correction and the endogenous variables, providing information on the short-run and long-run dynamics of the system. In a VAR perspective, the relationship between three variables is formulated as:

$$\Delta APPI_t = \sigma_1 + \sum_{k=1}^{n} \alpha_1 \Delta HCPI_{t-k} + \sum_{k=1}^{n} \beta_1 \Delta IMPORT_{t-k} + \sum_{k=1}^{n} \gamma_1 \Delta APPI_{t-k} + \rho_1 ECT_{t-k} + u_{1t} \quad (1)$$

$$\Delta HCPI_t = \sigma_2 + \sum_{k=1}^{n} \alpha_2 \Delta HCPI_{t-k} + \sum_{k=1}^{n} \beta_2 \Delta IMPORT_{t-k} + \sum_{k=1}^{n} \gamma_2 \Delta APPI_{t-k} + \rho_2 ECT_{t-k} + u_{2t} \quad (2)$$

$$\Delta IMPORT_t = \sigma_3 + \sum_{k=1}^{n} \alpha_3 \Delta HCPI_{t-k} + \sum_{k=1}^{n} \beta_3 \Delta IMPORT_{t-k} + \sum_{k=1}^{n} \gamma_3 \Delta APPI_{t-k} + \rho_3 ECT_{t-k} + u_{3t} \quad (3)$$

Where, Δ is the first difference operator and "u"s are white noise disturbance terms. APPIt, HCPIt, and IMPORTt are the variables at period t. ECTt-k is the lagged error correction term. To investigate the causal relationship between the variables, Granger causality tests were employed. These tests aimed to assess whether changes in one variable could serve as predictors for changes in another variable. The causality tests were performed using the lag length selected for the VECM. All analyses were conducted using EViews software version 10.0.

Testing for stationarity is the first step in time series analysis, which is applied for the purpose of avoiding the growth or declining trend of the data, thus making sure that the observed time series data is stationary. One of the most commonly used methods for the stationarity test, is the Dickey-Fuller test, at the augmented version (ADF). The ADF test has been the first statistical test designed to test the null hypothesis that a unit root is existing in an autoregressive model of a given time series and that the process is thus not stationary. For this purpose, we apply Augmented Dickey-Fuller test (ADF) to determine whether the various time series are integrated at the order of zero I (0). The starting point in unit root test is:

$$Y_{jt} = aY_{it-1} + \varepsilon_t; -1 \leq a \leq 1 \quad (4)$$

The null hypothesis in the Augmented Dickey - Fuller test is that the underlying process which generated the time series in non-stationary. This will be tested against the alternative hypothesis that the time-series information of interest is stationary. If the null hypothesis is rejected, it means that the series is stationary i.e., it is integrated to order zero. If, on the other hand, the series is non-stationary, it is integrated to a higher order and must be differenced until it becomes stationary (Dauti, 2009). When testing for unit root we want to find out whether in the equation (4) is equal to one. If is smaller than one, the series is stationary. If, on the other hand, is greater than one, than it would be an explosive series. Subtracting Y_(jt-1) from both sides in equation (4), we get equation (5), which is estimated by the Dickey – Fuller and Augmented Dickey – Fuller test.

$$\Delta Y_{jt} = \beta Y_{jt-1} + \varepsilon_t \; ; \quad (5)$$

Since the null hypothesis in equation (4) is that a is equal to one, in equation (5) it must be that β is equal to zero. Hence, when β is zero, there is unit root, and we have insufficient evidence to reject the null hypothesis of non -stationary. The Augmented DF Test is performed on each variable separately, on the following regression.

$$\Delta X_{jt} = \delta_0 + \delta_1 + \delta_3 X_{t-1} + \sum_{i=1}^{k} a_i \Delta X_{jt-1} + u_t \quad (6)$$

The variable ΔX_{jt-1} in equation (6) expresses the first differences with *k* lags and final u_t is the variable that adjusts the errors of autocorrelation. The coefficients $\delta_0, \delta_1, \delta_3$ and a_i are estimated. In order to test for the stationary of time series, we have to lag the variables. The analysis first starts with time series properties of the variables checked through Augmented Dickey-Fuller (ADF) unit root testing procedure. The results indicate that all series are stationary in their level, so there is no need for differencing them. When series are stationary, VAR system is an appropriate econometric examination for the analysed series. The test results are summarized in table 1.vIn this section, the results of empirical study are discussed.

Table 1: Augmented Dickey Fuller test of the selected variables in levels and first difference

Variables	Level			1st difference		
	ADF	Sig.	Result	ADF	Sig.	Result
APPI	4.329	0.838	Not stationary	–8.738	0.000	Stationary
HCPI	1.948	0.999	Not stationary	–5.194	0.000	Stationary
IMPORT	–1.154	0.691	Not stationary	–8.820	0.000	Stationary

Source: author's calculations.

Table 1 provides us the results of the unit root test for three variables, namely APPI, HCPI, and Import. The first column shows the level of the variables, and the second column shows the first difference of the variables. According to the ADF test results, the APPI variable is not stationary at the level (test statistic = 4.329, p-value = 0.838). However, when taking the first difference of the APPI variable, it becomes stationary (test statistic = -8.738, p-value = 0.000). The HCPI variable is also not stationary at the level (test statistic = 1.948, p-value = 0.999), but it becomes stationary when differenced (test statistic = -5.194, p-value = 0.000). Lastly, the import prices for agricultural products variable (not specified in the provided text) is not stationary at the level (test statistic = -1.154, p-value = 0.691). However, the ADF value of –8.820 and p–value of 0.000 shows that this variable is stationary at the first level. In conclusion, the unit root test suggests that the variables APPI, HCPI, and Import are non–stationary at the level, but they become stationary after taking their first difference. This means that these variables are prone to exhibiting trends and may require differencing to remove the trend before modelling or analysis.

Table 2: Johansen cointegration test results

No. Of CE(s)	Trace Statistic	Prob.	Max Eigenvalues	Prob.
None	61.212	0.000	36.270	0.000
At most 1	24.942	0.001	20.789	0.004
At most 2	4.152	0.041	4.152	0.041

Source author's calculations.

The findings from estimating a Vector Error Correction Model (VECM) are presented in Table 3. A VECM is a multivariate time series model that combines the long–run equilibrium relationships of the variables (captured by the cointegrating equation) with short–run dynamics (captured by the error correction term). The table presents the estimated parameters and their corresponding standard errors for the cointegrating equation and the constant term. The cointegrating equation, labeled as CointEq1 in the table, shows the coefficients for the lagged values of the three variables included in the model. The variables included in the analysis are DAPPI (percentage change in industrial production), DHCPI (percentage change in the consumer price index for healthcare), and DIMPORT (percentage change in imports). The coefficient for DAPPI (−1) is 1.000000, which means that a one percent increase in the lagged value of DAPPI leads to a one percent increase in the long–run equilibrium relationship of the variables. The coefficient for DHCPI (−1) is −1.590472, which means that a one percent increase in the lagged value of DHCPI leads to a 1.59 percent decrease in the long–run equilibrium relationship of the variables. The coefficient for DIMPORT (−1) is 9.97E–05, which is very close to zero and not statistically significant at conventional levels. The standard errors and t–statistics for each coefficient are also provided in parentheses and brackets, respectively. The t–statistics indicate whether the coefficient is statistically significant or not. In this case, the coefficient for DAPPI (−1) is statistically significant and negative (t–statistic of −6.80967). The constant term (labeled as C in the table) represents the intercept of the cointegrating equation. Its value is 0.203804. This indicates that the long-run equilibrium relationship between the variables is shifted upward by this particular amount. Overall, these results suggest that there is a long–run equilibrium relationship between DAPPI and DHCPI, but not with DIMPORT. An increase in DAPPI leads to an increase in the long–run equilibrium relationship, while an increase in DHCPI leads to a decrease in the long–run equilibrium relationship. Using this information, the cointegration equation can be written. Table 5 shows the results of the cointegration equation, which measures the long–term relationship between the variables included in the model. The results show that there exists a cointegrating relationship among the variables DAPPI, DHCPI, and DIMPORT. The Error Correction term, which measures the short–run dynamics of the system, is negative and statistically significant for DAPPI, indicating that the system corrects any deviation from the long–run equilibrium at a speed of around 3.07 units per period. Similarly, the Error Correction term for DHCPI is negative and significant, suggesting that the system corrects any deviation from the long–run equilibrium at a speed of around 0.11 units per period. The Error Correction term for DIMPORT is positive but not statistically significant, indicating that this variable has a weak short–run effect on the system.

Table 3: Results of the cointegration equation

Error Correction:	D(DAPPI)	D(DHCPI)	D(DIMPORT)
CointEq1	−3.070307 [−7.96612]	−0.109778 [−1.53577]	89.69117 [0.06889]
D(DAPPI(−1))	1.577768 [5.08299]	0.068651 [1.19252]	−31.04532 [−0.02961]
D(DAPPI(−2))	1.144196 [4.83252]	0.037183 [0.84676]	−38.65671 [−0.04834]

D(DAPPI(−3))	0.543477 [3.14909]	0.047353 [1.47943]	30.74428 [0.05274]
D(DAPPI(−4))	0.154304 [1.52305]	0.015134 [0.80546]	−256.2603 [−0.74884]
D(DHCPI(−1))	−3.989530 [−4.50303]	−0.476139 [−2.89775]	1480.507 [0.49472]
D(DHCPI(−2))	−3.533143 [−4.32816]	−0.463423 [−3.06100]	3574.239 [1.29627]
D(DHCPI(−3))	−2.489848 [−3.28981]	−0.202107 [−1.43987]	2923.568 [1.14362]
D(DHCPI(−4))	−0.662418 [−0.99169]	−0.248580 [−2.00658]	7244.259 [3.21077]
D(DIMPORT(−1))	0.000258 [6.28327]	9.93E−06 [1.30328]	−1.240452 [−8.93844]
D(DIMPORT(−2))	0.000226 [4.94769]	−4.72E−06 [−0.55730]	−1.147583 [−7.44221]
D(DIMPORT(−3))	0.000221 [4.92000]	−1.44E−05 [−1.71977]	−0.816982 [−5.37319]
D(DIMPORT(−4))	7.73E−05 [2.27377]	−8.49E−06 [−1.34597]	−0.286032 [−2.49121]
C	0.319060 [0.79784]	0.013728 [0.18510]	−212.6874 [−0.15746]
R−squared	0.781146	0.324784	0.703536
Adj. R−squared	0.743710	0.209287	0.652825
F−statistic	20.86638	2.812046	13.87345
Log likelihood	−239.3655	−87.72430	−970.6129
Akaike AIC	5.630344	2.260540	21.88029
Schwarz SC	6.019204	2.649399	22.26915

Source author’s calculations.

Furthermore, the R−squared values for DAPPI, DHCPI, and DIMPORT are 0.78, 0.32, and 0.70, respectively, suggesting that the cointegrating relationship explains a substantial proportion of the variation in the three variables. Additionally, the F−statistics for DAPPI, DHCPI, and DIMPORT are statistically significant, indicating that the coefficients are not zero and the overall regression is significant. However, prior to testing the causality between variables, a diagnostic has been performed on the data.

Table 4: Independence of error terms: LM test

Lag	LRE* stat	df	Prob.	Rao F−stat	df	Prob.
1	8.240284	9	0.5101	0.918711	(9, 172.9)	0.5103
2	8.928345	9	0.4439	0.997382	(9, 172.9)	0.4247
3	5.254196	9	0.8116	0.580824	(9, 172.9)	0.4418
4	25.23842	9	0.0027	2.954941	(9, 172.9)	0.0415

Source author’s calculations.

Table 4 presents the outcomes of the LM test for the independence of error terms. Based on the Rao F−statistic and its probability value, the results suggest that at lags 1 to 3, the error terms are independent, as the probability values are greater than the significance level of 0.05. However, at lag 4, the probability value is less than 0.05, indicating that the error terms are not independent at this lag. This may suggest the presence of autocorrelation in the errors at lag 4. However, considering that probability values are bigger than 0.05 for most lags, we can conclude that the model is free of autocorrelation.

Table 5: Normality test results

Component	Jarque–Bera	df	Prob.
DAPPI	13.61203	2	0.0011
DHCPI	0.907739	2	0.6352
DIMPORT	66.52266	2	0.0000

Source author's calculations.

The results of the normality test for each component in the model are presented in Table 5. For component 1, the Jarque-Bera test statistic is calculated to be 13.61203, and the associated p-value is determined to be 0.0011. Since the p-value is less than the significance level of 0.05, the null hypothesis of normality is rejected at the 5% significance level. Therefore, the data for component 1 is deemed to be not normally distributed. On the other hand, for component 2, the Jarque-Bera test statistic is computed as 0.907739, and the corresponding p-value is found to be 0.6352. In this case, the p-value is greater than the significance level of 0.05, leading to the acceptance of the null hypothesis of normality at the 5% significance level. As a result, the data for component 2 is considered to be normally distributed. This suggests that the data for component 2 is normally distributed. For component 3, the Jarque–Bera test statistic is 66.52266 and the p–value is 0.0000, which indicates that the null hypothesis of normality is rejected at the 5% significance level. This suggests that the data for component 3 is not normally distributed. Figure 1 presents the autoregression roots. Despite that not all variables are not normally distributed, Figure 1 shows that the roots of AR characteristics polynomial lie inside the unit circle, which indicates that the model is stable and the forecasts generated by the model will converge to a stable mean over time.

Figure 1: Autoregression (AR) roots

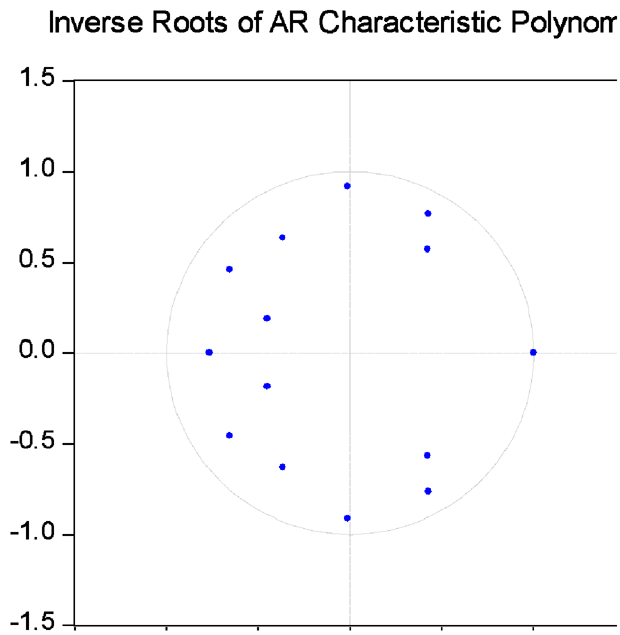

Table 6: Granger causality results based on VAR

Null Hypothesis:	Obs	F−Statistic	Prob.
DHCPI does not Granger Cause DAPPI	91	7.74862	2.E−05
DAPPI does not Granger Cause DHCPI		1.42722	0.2323
DIMPORT does not Granger Cause DAPPI	91	4.13551	0.0042
DAPPI does not Granger Cause DIMPORT		0.95472	0.4369
DIMPORT does not Granger Cause DHCPI	91	1.95120	0.1097
DHCPI does not Granger Cause DIMPORT		3.15235	0.0183

Source author’s calculations.

Table 6 displays the results of the Granger causality test. The null hypothesis tested in each case is that the first variable does not Granger cause the second variable. The table includes information such as the number of observations, the F-statistic, and the associated probability (p-value) for each test.

Based on the results, we can conclude that:

- DHCPI Granger causes DAPPI, with a very low p−value of 2.E−05 (this value is equivalent to 0.00002).
- DAPPI does not Granger cause DHCPI, as the p−value is relatively high (0.2323).
- DIMPORT Granger causes DAPPI, with a p−value of 0.0042.
- DAPPI does not Granger cause DIMPORT, with a relatively high p−value of 0.4369.
- DIMPORT does not Granger cause DHCPI, with a p−value of 0.1097.
- DHCPI Granger causes DIMPORT, with a p−value of 0.0183.

In summary, the Granger causality test results suggest that there is a causal relationship between DHCPI and DAPPI, as well as between DIMPORT and DAPPI, and DHCPI and DIMPORT.

Table 7 table shows the Variance Decomposition of DAPPI, DHCPI, and DIMPORT for 10 periods. Regarding the first part of the table, the table suggests that in the earlier periods, changes in DAPPI were largely driven by its own shocks, with minimal cross−variance effects from DHCPI and DIMPORT. However, in later periods, changes in DAPPI were more influenced by external factors, such as changes in DHCPI and DIMPORT, which together accounted for a larger portion of the variance. In the second part of the table, the results indicate that in the first period, almost all the variability in DHCPI can be attributed to DHCPI itself, with a very small contribution from DAPPI. However, as the period progresses, the contribution of DHCPI decreases, and the contribution of DAPPI and DIMPORT increases. By the ninth period, the contribution of DHCPI has decreased to 92.08%, while the contributions of DAPPI and DIMPORT have increased to 2.37% and 5.54%, respectively. The results suggest that changes in DAPPI and DIMPORT have an increasingly important role in explaining the variability in DHCPI as time progresses. In the last part of the table, we can observe that DAPPI, DHCPI, and DIMPORT explain different proportions of the variance in DIMPORT across different periods. In particular, DAPPI and DHCPI have a relatively small contribution to the variance in DIMPORT in the first period, with most of the variance (96.11%) being explained by DIMPORT itself. However, moving to later periods, the contribution of DAPPI and DHCPI to the variance in DIMPORT increases, while the contribution of DIMPORT itself decreases. By the last period, DAPPI and DHCPI together explain only about 10.56% of the variance, while DIMPORT explains about 83.81% of the variance.

Table 7: Variance decomposition for the three variables

Variance Decomposition of DAPPI:				
Period	S.E.	DAPPI	DHCPI	DIMPORT
1	3.762999	100.0000	0.000000	0.000000
2	4.233125	95.33640	2.668519	1.995082
3	4.334369	94.70304	3.392000	1.904956
4	4.538815	93.16891	5.081383	1.749711
5	5.220715	73.04768	12.18213	14.77019
6	5.260974	73.01717	12.42297	14.55986
7	5.284219	73.14683	12.33710	14.51607
8	5.294197	73.07933	12.37292	14.54775
9	5.352763	71.97266	12.10487	15.92247
10	5.509657	68.39104	15.95876	15.65020
Variance Decomposition of DHCPI:				
Period	S.E.	DAPPI	DHCPI	DIMPORT
1	0.697896	0.531115	99.46889	0.000000
2	0.859490	2.208418	97.76993	0.021656
3	0.944360	2.952578	94.01874	3.028681
4	1.036629	3.011831	91.58416	5.404007
5	1.079228	3.030439	91.61532	5.354244
6	1.125820	2.973370	92.05039	4.976239
7	1.171218	2.757610	92.34541	4.896979
8	1.234428	2.539710	91.53522	5.925066
9	1.295181	2.374314	92.08513	5.540552
10	1.346076	2.321718	92.50904	5.169246
Variance Decomposition of DIMPORT:				
Period	S.E.	DAPPI	DHCPI	DIMPORT
1	12710.54	2.589762	1.296726	96.11351
2	13117.35	2.769322	2.149449	95.08123
3	13359.42	2.836668	3.735017	93.42831
4	13756.68	2.910013	3.564606	93.52538
5	15051.05	3.864007	9.158160	86.97783

6	15287.86	3.973494	10.71394	85.31256
7	15346.04	4.148307	11.08392	84.76777
8	15941.91	3.880988	11.20490	84.91411
9	16637.18	5.638337	10.32063	84.04103
10	16732.43	5.625890	10.56317	83.81094
Cholesky Ordering: DAPPI DHCPI DIMPORT				

Source author's calculations.

4. Discussion and conclusion

The study conducted an analysis of the Granger causality among three variables – APPI (agriculture producer price index), HCPI (harmonized consumer price index), and Import – in Kosovo. The study employed unit root tests, cointegration tests, and vector error correction models to analyze the relationships among these variables. The results showed that the variables were non-stationary at the level but became stationary after taking their first difference, indicating that they exhibit trends and may require differencing to remove the trend before modeling or analysis. To address this, the first differences of the variables were taken, resulting in the creation of the differenced variables: DAPPI (the first difference of APPI), DHCPI (the first difference of HCPI), and DIMPORT (the first difference of Import). Differencing is a common method used to transform non-stationary time series into stationary ones by removing trends. The first difference operator (Δ) is applied by subtracting the value of the variable in the previous period from the current period's value. This process eliminates the trend and renders the series stationary, making them suitable for further econometric modeling, such as cointegration and Granger causality analysis**.** The Johansen cointegration test results indicated the presence of at least one cointegrating vector among the variables under investigation. To further explore the relationships among these variables, the study utilized a Vector Error Correction Model (VECM). The optimal lag order for the VAR model was determined to be 4, as it yielded the lowest values for criteria such as Final Prediction Error (FPE), Akaike Information Criterion (AIC), and Hannan-Quinn Information Criterion (HQ). Subsequently, the VECM was employed to analyze and interpret the relationship between the three variables. The results of the VECM indicated the presence of a long-run relationship among the variables, as captured by the cointegrating equation. The coefficient for DAPPI (−1) was 1.000000, indicating that a one percent increase in the lagged value of DAPPI leads to a one percent increase in the long-run equilibrium relationship of the variables. The coefficient for DHCPI (−1) was –0.392021, indicating that a one percent increase in the lagged value of DHCPI leads to a 0.392021 percent decrease in the long-run equilibrium relationship of the variables. The coefficient for DIMPORT (−1) was –0.118621, indicating that a one percent increase in the lagged value of DIMPORT leads to a 0.118621 percent decrease in the long–run equilibrium relationship of the variables. In conclusion, the study found evidence of the existence of a long-run relationship among the variables APPI, HCPI, and Import in Kosovo. Based on the outcomes of the Granger causality analysis, it is indicated that consumer prices (DHCPI) have a causal influence on agriculture producer prices (DAPPI), but agriculture produces prices (DAAPI) do not cause consumer prices (DHCPI). The study also found that IMPORT causes agriculture prices (DAPPI), but agriculture prices do not cause import. Finally, import does not cause consumer prices (DHCPI), but consumer prices (DHCPI) cause import. Based on the results of this study, policymakers in Kosovo should consider the following practical implications:

1. Addressing the impact of consumer prices on agriculture producer prices: Since consumer prices were found to have a causal effect on agriculture producer prices, policymakers could consider implementing policies to stabilize consumer prices in order to reduce their impact on agriculture producer prices. However, agriculture producer prices were not found to have a causal effect on consumer prices, which suggests that efforts to stabilize agriculture producer prices may not have a direct impact on consumer prices.
2. Monitoring and managing import prices: The study found that import prices have a causal effect on agriculture producer prices, which suggests that policymakers should closely monitor and manage import prices to ensure that they do not adversely affect agriculture producer prices.
3. Promoting agriculture production: Since agriculture producer prices were not found to have a causal effect on consumer prices, policymakers could consider promoting agriculture production to increase the supply of agricultural products and help stabilize consumer prices.
4. Encouraging import substitution: Since consumer prices were found to have a causal effect on imports, policymakers could consider implementing policies to encourage import substitution by promoting local production of goods that are currently being imported.

Supporting policies to reduce inflation: Since the study found that harmonized consumer price index (HCPI) has a negative effect on the long-run equilibrium relationship of the variables, policymakers could consider implementing policies to reduce inflation to stabilize the long-run equilibrium relationship among the variables.

5. Suggestions for future studies

While this study focused on Kosovo, future studies could examine similar relationships in other countries or regions to determine if the results are consistent across different contexts. This study only considered the relationship between APPI, HCPI, and Import. Future studies could include additional variables such as exchange rates, production costs, and other macroeconomic indicators to better understand the dynamics at play. Governments often implement policies to support agriculture production or to control inflation. Future studies could examine the impact of these policies on the relationships between APPI, HCPI, and Import. This study analysed data from 2015 to 2022. Future studies could examine data from different time periods to determine if the relationships between the variables have changed over time. This study used unit root tests, cointegration tests, and vector error correction models to analyse the relationships between the variables. Future studies could use alternative techniques such as panel data analysis, time-varying parameter models, or dynamic factor models to examine the relationships between the variables.

Bibliography

1. Beilock R, *Rethinking agriculture and rural development in Kosovo. South-Eastern Europe journal of economics*, 2005, s. 221-248.
2. Braha, K., Rajčániová, M., Qineti, A., Pokrivčák, J. and Lazorčáková, E. (2019) "Evidence of Spatial.
3. Clark T., *Do producer prices lead consumer prices*, Economic Review-Federal Reserve Bank of Kansas City 1995, 80, s. 25-25.
4. Dauti B., *Determinants of Foreign Direct Investment in Macedonia. Evidence from times series*, Proceedings of FIKUSZ ’09, Symposium for Young Researchers. Published by Budapest Tech Keleti Károly Faculty of Economics 2009, s. 41-55.
5. Goldberg P., Hellerstein, R. *How rigid are producer prices? FRB of New York Staff Report*, 2011, no 407.
6. James P., Korovilas K. *The Economic Sustainability of Post-conflict Kosovo*. Post-Communist Economies, 14:1, 2010, 109-121, DOI: 10.1080/14631370120116716.
7. Junttila J. Korhonen, M. *The role of inflation regime in the exchange rate pass-through to import prices*. International Review of Economics & Finance 2012, s. 24: 88-96.
8. Riofrío J., et al. *Forecasting the Consumer Price Index (CPI) of Ecuador: A comparative study of predictive models*. International Journal on Advanced Science, Engineering and Information Technology, 2020, 10.3, s. 1078-1084.
9. Tokarick S, *Does Import Protection Discourage Exports?*. IMF Working Paper No. 06/20, Available at SSRN: https://ssrn.com/abstract=888165, 2006. Ss.2-25.
10. Yates D., N. Strzepek, K,. M. *An assessment of integrated climate change impacts on the agricultural economy of Egypt*. Climatic Change, 1998, pp.38.3: s. 261-287.
11. Yates, D. N., and Strzepek, K. M. *An assessment of integrated climate change impacts on the agricultural economy of Egypt*”. Climatic Change, 38(3), 1998. s. 261-287.

Contact details

Afrore Berdyna Mazreku, afroremazreku01@gmail.com

Adem Qorolli, adem.qorolli@unite.edu.mk

Ruzhdi Matoshi, ruzhdi.matoshi@unite.edu.mk