# The Causal Relationship between Harmonized Consumer Price Index, Producer Price Index and Gross Domestic Product: Evidence from Kosovo

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### Abstract

The authors have conducted an empirical study of the relevant relationship based on the assumption that the consumer price index (CPI) and producer price index (PPI), respectively, have an impact on the gross domestic product (GDP), the economic growth of a country, and vice versa. They also examined the development trend of these significant macroeconomic indicators in Kosovo as a developing country. Uddin and Rahman (2022) have shown that the emerging nations should address the issue of inflation by maintaining the inflation rate in single digits; this would lead to economic progress. The study was prepared based on quarterly time series data from 2010: Q1 to 2022: Q3. The data were analyzed using EViews ver10. The model was examined using the ADF test, Johansen cointegration test, VECM estimation, and Granger causality test. Several statistical techniques were applied to examine the existence of causal linkages, stationarity, and Received: 29.10.2023 Available online: 31.03.2025

long-term relationships among the model's variables.

Positive results from the analysis imply that the model is stable. The results of the ADF test specifically show that GDP, HICP, and PPI remain stationary when the initial difference is considered. The Johansen cointegration test also supports a long-term relationship between these variables. The Granger analysis results demonstrate a bilateral relationship between GDP and HICP and that the alternative hypothesis is accepted. The findings for GDP and PPI indicate that there is no meaningful causal or unilateral relationship between them.

This research complements prior studies in the disciplines of finance and macroeconomics by emphasizing that the findings of this study show that the government of Kosovo should try to control the influence of the consumer price index and the producer price index on GDP.

**Keywords:** Harmonized Consumer Price Index (HCPI), Producer Price Index (PPI) and Gross Domestic Product (GDP), Relationship. **JEL:** O11, F62, F63, E20, E31, and E39.

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## 1. Introduction

his study endeavors to empirically investigate determinants pivotal governing governmental decision-making Harmonized processes concerning the Consumer Price Index (HCPI), the Producer Price Index (PPI), and the Gross Domestic Product (GDP). Extensive scholarly inquiries have been undertaken to scrutinize inflation, production prices, and economic growth. yielding divergent and sometimes conflicting findings. Nevertheless, a majority of research endeavors, spanning both developed and developing economies (Malenković, N., 2022; Koulakiotis, Lyroudi, and Papasyriopoulos, 2012), have consistently demonstrated a discernible linkage between fluctuations in consumer prices, production prices, and GDP. Consequently, economists remain spurred to engage in ongoing investigations to elucidate the intricate interplay among these variables. As a burgeoning economy, Kosovo has exhibited substantial shifts in HCPI, PPI, and GDP in recent years, providing impetus for this study's examination of the reciprocal influence between HCPI and PPI and their interconnectedness with GDP. This inquiry draws upon a three-month time series dataset from 2010:Q1 to 2022:Q3, encompassing 51 observations.

The GDP is one of the most important indicators of a country's economic progress, and according to Gonzalez, Llanto, and Manapat (2022), some factors can lead it to either increase or decrease. According to Yeoman (2022), prices are the subject mentioned the most in consumer research. "Consumer Price Indices (CPIs) are index numbers that measure changes in the prices of goods and services purchased or otherwise acquired by households and used directly or indirectly by households to satisfy their own needs and desires" (World Bank, 2022). The Consumer Price Index (CPI) is an essential economic metric for monitoring changes in the costs of products and services people use, buy, or pay for overtime (CPI). Gjika-Dhamo, Puka, and Zaçaj (2018) claim that the CPI is a crucial indicator that enables decision-makers, economists, and market analysts to evaluate the effects of monetary and fiscal policies on the health of households and the general stability of the economy. Spotting inflationary or deflationary forces is feasible by tracking CPI variations over time. It allows policymakers to make well-informed decisions about interest rates, employment, investment, etc. An accurate and timely inflation assessment is essential to establish policies to pave the road to economic recovery (Jaravel and O'Connell, 2020). The evolution of consumer prices in the last two years has greatly changed: the COVID-19 pandemic and the war in Ukraine in 2022 have contributed to this situation. Due to the impact of the coronavirus epidemic, Angelache and lacob (2020) suggest that prices may rise during this period, particularly for agricultural items and even services. The study by Akter (2020) provides the first empirical proof of food price inflation as an unintended effect of pandemic COVID-19 control efforts in one of the most afflicted continents. Carstens (2022) believes that the epidemic and the unprecedented governmental reaction paved the way for a swift and intense recovery of demand for commodities that supply could not completely meet and that the conflict in Ukraine further disrupted supply, particularly of goods.

Although price indices are generated for many reasons, the consumer price index (CPI) and the producer pricing index (PPI) stand out as two of the most significant price indices in economics and international

finance (Demir, 2022). Thus far, we have supplied the definitions for CPI and inflation; now, we will present the authors' definitions for PPI. Akcay (2011) demonstrates that the causal relationship between PPI and CPI remains contested in empirical investigations. According to him, there are three types of empirical evidence regarding the link between PPI and CPI: unidirectional, bidirectional, and no indication of causation. Gao, An, and Zhong (2013) demonstrate that price indexes are crucial for inflation and economic growth. The government impacts commodity prices through several market-stabilizing regulatory actions. According to the Kosovo Agency of Statistics, the Producer Price Index (PPI) is a relative indicator that assesses the rate of change in the prices of industrial products and services across certain time intervals. According to the production method as a statistical measure, it is particularly relevant as a gross domestic product deflator" (Kosovo Agency of Statistics -KAS, 2022).

The gross domestic product or GDP measures the market value of all finished products and services produced in a nation over a year. The primary indicator used to assess a nation's economic condition over time or compared to other nations is often its real GDP per capita (adjusted for inflation). So, the GDP is linked to social well-being or even seen as synonymous with it (Van den Bergh, 2007). According to the (International Monetary Fund- IMF, 2022), "gross domestic product" (GDP) is the total monetary worth of finished products and services produced in a nation during a certain period, usually a quarter or a year. The final goods that the consumer purchases are considered while calculating GDP. According to this definition, a nation's GDP represents its whole economic production, which includes all commodities The Causal Relationship between Harmonized Consumer Price Index, Producer Price Index and Gross Domestic Product

and services generated inside its boundaries, whether those goods and services are used locally or exported to other nations. As a result, politicians, investors, and analysts frequently use GDP as a crucial indicator of a country's economic health to determine the strength and growth of a country's economy. It includes all production generated within the borders of a country. GDP consists of commodities and services generated for sale on the market and certain nonmarket outputs such as government-provided defence and education services. The Gross Domestic Product (GDP), which measures a nation's economic performance over a specific period, is the main economic indicator in the system of national accounts, according to the (Kosovo Agency of Statistics- KAS, 2022).

The relationship between commodity price fluctuations and customers' prices for goods and services is obvious. Increasing prices connected commodity are with increased consumer price inflation (Kliesen, 2021). According to Giles (2022), the surge in inflation and the accompanying spectre of stagflation are troubling financial markets, worrying central bankers, and causing significant economic hardship for low- and middle-income households, which are experiencing sharp declines in their real incomes and expenditures as a result of sharp price increases, especially for energy and food. However, relying on macroeconomic thinking is not very helpful in understanding how to respond to the forces driving inflation during COVID-19 and the war in Ukraine (Storm, 2022). Huawei (2022) argues that oil is a key energy source for the world's developed and emerging economies since it satisfies the energy requirements of each country's industry and households to promote economic progress. Yang et al. (2021) also

demonstrate the connection between oil prices and GDP growth.

Examining this subject provides us with important lessons about the environment of a developing country. Even though the relationship between inflation, producer prices, and GDP has been extensively studied in the literature, it is still important to monitor inflation, producer price changes, and how they affect GDP.

In alignment with the overarching research objectives, the primary aims of this study encompass the following: (i) The systematic evaluation of causal linkages existing between the Harmonized Index of Consumer Prices (HCPI) and the Index of Producer Prices (PPI) in conjunction with the Gross Domestic Product (GDP); (ii) The delineation of causality directionality, involving the determination of whether alterations in HCPI and PPI exert influence upon variations in GDP, or conversely, whether fluctuations in GDP impact HCPI and PPI dynamics within the context of Kosovo; (iii) The meticulous scrutiny of the causal interconnections between HCPI, PPI, and GDP, coupled with an exploration of the temporal dimensionality characterizing these relationships, discerning between short-term and long-term effects. Notably, this investigation represents a pioneering foray into the nuanced discourse about Kosovo's developmental trajectory. Following the research mentioned earlier objectives, the ensuing section introduces the core research inquiries as follows:

- 1. Is Kosovo's inflation and GDP substantially associated with it?
- 2. Is there a relationship between Kosovo's producer prices and GDP?
- 3. Is there a relationship between the CPI and the PPI?

The paper is structured as follows: The literature review is presented in Section 2. The strategy is described in Section 3. In Section 4, the analysis's empirical findings are fully outlined. Section 5 contains the discussion. The last section then comes.

## 2. Literature Review

Numerous academics have shown that the one-way relationship between inflation and GDP has positive and negative implications. Adaramola and Dada (2020) have demonstrated that inflation has a negative effect on economic growth. Pollin and Zhu (2006) found that, up to an inflation threshold of roughly 15 to 18 percent, higher inflation is associated with a modest increase in GDP growth; however, these findings vary depending on income level. According to Kasidi and Mwakanemela (2013), inflation impacts economic expansion. Karabulut (2019) discovered a unidirectional causal relationship between growth and inflation. According to Taghizadeh-Hesary, Rasoulinezhad, and Yoshino (2019), nations with a high growth rate tend to raise the price of natural resource items. According to Ahmad and Joyia (2012) and Mkhatshwa, Tijani, and Masuku (2015), economic growth and inflation are unidirectional. Denbel, Ayen, and Regasa (2016) discovered that economic expansion negatively and substantially affects inflation.

Barro (1995) carried out an analysis to determine how inflation affects economic performance. The results of his research show that for every 10% annual average increase in inflation rates, real GDP growth rates decline by 0.20 to 0.30 percent. This study emphasizes high inflation rates' drawbacks and stresses the importance of controlling inflation to foster economic progress. Fischer's (1993) study conclusions show a strong negative

relationship between inflation and economic growth. It also contributed to the literature researching the long-term relationship between inflation and economic growth. Extremely high inflation correlates to reduced economic development in highly developed and small open economies with inflation objectives (Nasir, Huynh, and Vo 2020). Vladi and Hysa (2019) demonstrate that a rise in the inflation rate enhances GDP and improves the economic standing of nations. Idris and Suleiman (2019) found a substantial negative link between economic growth and inflation over the long term. In their study evaluating the association between inflation and the exchange rate, Onwubuariri, Oladeji, and Bank-Ola (2021) found that inflation and the exchange rate had a detrimental impact on the growth of the Nigerian economy. According to Karki, Banjara, and Dumre (2020) research, there is a causal link between inflation and economic growth but not between economic growth and inflation. Umaru and Zubairu (2012) demonstrate that inflation benefits economic growth by boosting production and productivity and affecting the rise of total factor productivity. It can be inferred from Macovei's (2020) analysis that the CPI significantly affects GDP.

The purpose López-Villavicencio of and Mignon's (2011) study is to investigate rising inflation's effects in industrialized and developing countries. The authors' analysis aims to distinguish and contrast the macroeconomic impacts of inflation on these two different categories of nations. They seek to shed light on the variables affecting the performance of various economies and the potential effects of inflation on general economic stability by examining the link between inflation and economic growth. Overall, this study thoroughly examines inflation's The Causal Relationship between Harmonized Consumer Price Index, Producer Price Index and Gross Domestic Product

effects on industrialized and developing countries, providing insightful information on the intricate dynamics of macroeconomic systems. The data prove that the relationship between inflation and economic growth is not linear. Specifically, there exists a threshold at which inflation has a detrimental impact on economic growth. This inflation rate threshold varies significantly across developed and developing countries, with estimates ranging from 2.7% for industrialized nations to 17.5% for underdeveloped nations. In addition, the link between inflation and growth is favourable in industrialized nations with an inflation rate of around 3 percent, whereas it is inconsequential in developing nations with an inflation rate below 17.5 percent.

Some authors have found a reciprocal causal relationship between inflation and GDP, with positive and negative results. In their analysis of 145 nations, Ghosh and Phillips (1998) looked at the relationship between inflation and economic growth and found that when inflation rates are low, there is a positive correlation between inflation and economic growth. However, the relationship between inflation and economic growth turns out to be adverse when inflation rates reach a high level. According to the analysis of Mallik and Chowdhury (2001), for four Asian countries, inflation and domestic income arowth show a long-term and positive relationship. These results highlight the significance of adequately controlling inflation to support long-term, steady economic growth and how complicated and dynamic the link between inflation and economic growth is.

According to experiments conducted by Gokal and Hanif (2004), there is a slight negative link between inflation and growth; however, the change in the output gap has a considerable effect. The direction of causation

between the two variables was from GDP growth to inflation. For both measures of inflation, Özyilmaz (2022) provides evidence of a bidirectional causal relationship between inflation and growth and between growth and inflation. In their findings, Khan and Khan (2018) demonstrate that inflation and growth rate have a substantial and negative connection, that economic growth responds negatively to inflation, and that inflation is detrimental to economic growth. Koulakiotis, Lyroudi, and Papasyriopoulos (2012) demonstrate through their findings that inflation significantly impacts the economic growth of industrialized nations. The link between inflation and GDP indicates that, at the 5% significance level, inflation causes GDP; at the 10% level of relevance, GDP causes inflation. Thus, the two examples have a 10% significant two-way influence. Uddin and Rahman (2023) discovered that GDP per capita positively correlates with inflation, government performance, and the rule of law.

Conversely, in their study, Onifade et al. (2020a) observed an inverse correlation between public expenditure and economic growth. They specifically posited that current government expenditure and the accumulation of public debt exerted substantial adverse effects on economic growth. In contrast, their findings indicated that government capital expenditure exhibited a positive impact. albeit statistically insignificant. when analyzed over longer time horizons. Kryeziu and Durguti (2019) conclude that inflation has had a positive and statistically significant effect on the Eurozone's economic growth rate from 1997 to 2017. The empirical findings of Azam (2020) indicate that energy has a considerable beneficial influence on economic growth, demonstrating that energy, together with human and physical capital, is an essential element of production. In their scholarly investigation, Anyars and Adabor (2023) have elucidated the profound impact of fluctuations in oil prices on the economic landscape. Their findings underscore a crucial political imperative wherein policy formulation becomes imperative for maintaining inflation stability. Specifically, these policies must be designed to mitigate the destabilizing repercussions of oil price shocks.

The next section presents the research describing the relationship between the PPI and the CPI. Using data from Finland, France, Germany, the Netherlands, and Sweden, Akcav (2011) investigates the causal link between the producer pricing index (PPI) and the consumer price index (CPI). The study's findings indicate that whereas the PPI and CPI have a unidirectional causal association in Finland and France, they have a bidirectional causal correlation in Germany. Yet, there is no proof that the two indexes in the Netherlands and Sweden are causally related. Liping, Gang, and Jiani (2008) used monthly data to investigate the relationship between PPI and CPI in China.

According to their research, there is a oneway causal relationship between CPI and PPI, which suggests that changes in consumer prices have a big impact on producer prices in China. These results provide information about the economic dynamics of China and shed light on the elements causing inflation there. Empirical research by Ozpolat (2020) shows that PPI and CPI have a consistent and reciprocal relationship in Central and Eastern European countries. Ghazali, Yee, and Muhammad (2008) researched the connection between Malaysia's producer pricing index (PPI) and consumer price index (CPI). Their study used monthly data from January 1986 to April 2007, enabling a thorough examination of the long-term correlation between these

two variables. Through their investigation, the authors hoped to shed light on Malaysia's inflation dynamics and the factors influencing price increases. The authors aimed to provide insights into the macroeconomic forces influencing Malaysia's economic environment by investigating the link between PPI and CPI.

The results of both methods indicate a unidirectional causal relationship between PPI and CPI in Malaysia. In addition, Su et al. (2016) investigate the causal link between the producer pricing index (PPI) and the consumer price index (CPI) in Slovakia and discover unidirectional causation from PPI to CPI. Khan et al. (2017) investigate the bidirectional causation between PPI and CPI, suggesting that PPI contributes more to CPI. In their research, Tiwar et al. (2014) looked at the connection between the producer pricing index (PPI) and the consumer price index (CPI). They discovered a two-way relationship between the CPI and PPI, demonstrating the importance of changes in consumer prices for producer prices and vice versa. The authors used data from several locations to support their findings and offer insights into the macroeconomic processes driving inflation in different nations. Overall, their findings underline the necessity for more investigation into this crucial economic indicator by demonstrating the complexity of the link between CPI and PPI. CPI impacts PPI over short periods (1 to 7 months), but PPI is the most influential variable over more extended periods (scale of 8 to 32 months). Sun et al. (2021) believe there is a two-way transmission mechanism between CPI and PPI, such as the transmission from PPI to CPI and the transmission from CPI to PPI.

In contrast, Rajcaniova and Pokrivcak (2013) analyzed the link between PPI and CPI using the threshold cointegration approach

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and concluded that there was no long-term association between PPI and CPI. As per the findings of Onifade et al. (2020b), it is observed that, in the long run, a discernible adverse association exists between domestic investment and the confluence of inflation and unemployment. Meanwhile, the influence of real GDP per capita on unemployment, while negative in direction, does not attain a statistically significant level.

# 2.1. Gross Domestic Product (GDP), Harmonized Consumer Price Index (HCPI), and Producer Price Index (PPI) in Kosovo

Gross Domestic Product (GDP) - Kosovo is a tiny, developing nation in the Balkans. The main engine of its economy is the services sector, followed by the industrial and agricultural sectors. Kosovo's GDP was \$7.14 billion in 2020, with a real GDP growth rate of -5.3% (World Bank, 2022). The COVID-19 epidemic significantly negatively influenced Kosovo's economy and caused a slowdown in business activity. This matter is further linked to the research conducted by Zhang et al. (2023), wherein the authors underscore the elevated levels of inflation during the years 2008 and 2018, coinciding with the onset of global economic crises, as well as in 2021 in the aftermath of the COVID-19 pandemic. Additionally, the findings of Ha et al. (2023) accentuate the resemblance between the descent in inflation observed in advanced economies during the global recession triggered by COVID-19 in 2020 and similar trends witnessed during preceding global economic downturns.

The Harmonized Consumer Price Index (HCPI) is a crucial economic indicator used in Kosovo to monitor changes in household spending on goods and services. This index tracks changes in the cost of a selection

of items and services used by households nationwide, giving information about the country's general inflation rate over time. Policymakers and economists can better understand Kosovo's economic environment, including trends in consumer spending, inflation. and other important variables affecting the nation's economic growth and stability, by monitoring changes in the HCPI. The HCPI in Kosovo increased by 2.2% in 2020 compared to 2019, according to the (Kosovo Agency of Statistics- KAS, 2022). Food and non-alcoholic drinks, housing, water, energy, gas, and other fuels, and health were the main causes of this increase.

Kosovo tracks changes in the prices that local producers are paid for their goods and services using the **Producer Price Index (PPI)**, a major economic indicator. This index evaluates the typical variation in prices producers receive for their work, giving information about the general well-being and profitability of the nation's industrial sector. Policymakers and economists can better understand producer price trends by tracking variations in the PPI over time. Several variables, such as shifts in the price of raw materials or shifts in demand across the globe, can contribute to these changes. Overall, the PPI is useful for assessing Kosovo's industrial sector's performance and predicting changes in the larger economy.

According to the Kosovo Agency of Statistics, Kosovo's Producer Price Index (PPI) increased by 2.8% in 2020 compared to 2019. The main causes of this increase were expansions in the production of electricity, gas, steam, and air conditioning, as well as mining and quarrying. It shows that prices paid to domestic manufacturers of various products and services increased yearly. These findings shed light on Kosovo's industrial sector's performance and broader economic trends.

Below, we present the table for GDP data from 2010 to 2021.

From Figure 1, we see that GDP has had a continuous increase from 2010 to 2019, while from 2019 to 2020, there was a decrease in GDP due to COVID-19, and from 2020 to 2021, economic growth has started to feel clear. GDP for Q3 2022 has recorded a real increase of 2.07% compared to Q3 2021, KAS (2022).



Fig. 1. Gross Domestic Product expressed in monetary value from the period Q1:2010 to Q3:2022 Source: The Kosovo Agency of Statistics



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Source: The Kosovo Agency of Statistics https://ask.rks-gov.net/sq/agjencia-e-statistikave-te-kosoves/add-news/indeksi-i-cmimeve-te-prodhimit-icp-tm3-2022

The data are presented graphically, expressed in %, from 2022 to 2010. According to the Kosovo Agency of Statistics (2022), the annual inflation rate measured between October 2022 and October 2021 was 12.7%.

The Kosovo Agency of Statistics reports that between the second and third quarters

of 2022, the overall index of production prices in Kosovo rose by 11.3%. Likewise, manufacturing prices increased by an average of 17.2% in Q3 2022 compared to the same quarter a year prior. These statistics shed light on Kosovo's production sector's broad patterns and productivity, pointing to a

general rise in the cost of goods and services produced there.

# 3. Data and Methodology

Following an exhaustive survey of the extant literature, the research embarks upon a rigorous analytical journey that encompasses a comprehensive scrutiny of quarterly time series data concerning Gross Domestic Product (GDP), the Harmonized Consumer Price Index (HCPI), and the Producer Price Index (PPI). Cointegration and ECM (Error Correction Model) modeling techniques are ideal for examining short- and long-run relationships between variables.

Cointegration analysis serves to discern the presence of a long-term equilibrium relationship among the variables mentioned above. Concurrently, the ECM approach is advantageous in addressing short-term deviations from this equilibrium, thereby facilitating the rectification of model inaccuracies and enhancement of forecasting analytical precision. These techniques provide valuable insights into the dynamic interactions among GDP, HCPI, and PPI over time, thereby enriching our comprehension of these variables' economic dynamics and equilibrium dynamics.

Additionally, performing the unit root test to verify the stationarity of the variables is a standard procedure in time series analysis. This examination ascertains the stationarity of the time series data employed in the analytical process, a crucial prerequisite in time series analysis. Stationarity is of paramount significance in this context, as it engenders the stability of statistical properties over time, thereby enhancing the resilience and credibility of the analysis. Furthermore, verifying stationarity through this diagnostic procedure mitigates the potential

hazards associated with erroneous regression outcomes, which, if left unchecked, could culminate in erroneous inferences concerning the interrelationships among the variables under scrutiny.

Granger causality and impulse response functions are commonly emploved in econometric analysis to investigate the visual shocks causation and between variables. Granger causality analysis facilitates the examination of causal associations among variables, ascertaining whether a given variable can prognosticate alterations in another variable. Converselv. impulse response analysis is a valuable tool for elucidating the repercussions of perturbations or modifications in one variable on a set of other variables across the temporal spectrum. In doing so, it aids in explaining the temporal lag and the extent of the responses between the variables in question. Subsequently, identifying causal relationships and visualizing responses provide a foundation for deriving pertinent policy implications.

Furthermore, the model's robustness was diagnosed, including examining the data's residual normality, autocorrelation, and heteroscedasticity. Finally, Granger causality was used to investigate the relationship between the variables' causes and effects. The impulse response function was the final method for demonstrating the visual shocks between the variables. The study utilized the ARDL approach to cointegration since it is robust to different orders of integration and enables a smaller sample size. The findings suggest that GDP, HCPI, and PPI in Kosovo have a long-term association. The ECM is well-defined and reliable, showing a considerable short-term link between GDP, HCPI, and PPI. According to the Granger causality test, there is no causal relationship

between HCPI and GDP, although there is a unidirectional relationship between PPI, GDP, and HCPI.

Examining the impulse response function demonstrates that a shock to HCPI positively affects PPI, ultimately affecting GDP. A shock to PPI has a favorable effect on GDP, but a shock to GDP does not affect HCPI or PPI. Overall, the study's findings point to a considerable short-term association between GDP, HCPI, and PPI in Kosovo and a longterm relationship between them. The results imply that HCPI is a significant PPI driver that eventually affects GDP. As policymakers should take into account the impact of HCPI on PPI and GDP when developing economic policies, these findings could have significant policy consequences for Kosovo.

#### 3.1. Test the unit root

We ran unit root tests to validate the variables' stationarity condition. We used the Augmented Dickey-Fuller (ADF) as the most

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common test. The results are presented in Appendix 1. The results of the ADF test show that GDP, HCPI, and PPI are not stationary at this level. To determine stationarity, we retested the initial difference for the three variables. The three variables started to become stationary at the first difference. In other words, there are no unit roots in the first difference.

#### 3.2 .Cointegration test

After the stationarity test, we examined whether the variables were cointegrated in the short or long run. The trace statistics and maxeigen values in Appendix 2 show a long-run relationship between GDP, HCPI, and PPI at the three levels. It suggests the three variables are coupled in equilibrium over the long term. For this reason, Vector Autoregression (VEC) modeling was appropriate to test this relationship. The hypotheses are presented below:

$$\Delta \ln GDP_{t} = \sigma_{1} + \sum_{k=1}^{n} \alpha_{1i} \Delta \ln HCPI_{t-k} + \sum_{k=1}^{n} \beta_{1i} \Delta \ln PPI_{t-k} + \sum_{k=1}^{n} \gamma_{1i} \Delta \ln GDP_{t-k} + \rho_{1}ECT_{t-k} + u_{1t}$$

$$\Delta \ln HCPI_{t} = \sigma_{2} + \sum_{k=1}^{n} \alpha_{2i} \Delta \ln HCPI_{t-k} + \sum_{k=1}^{n} \beta_{2i} \Delta \ln PPI_{t-k} + \sum_{k=1}^{n} \gamma_{2i} \Delta \ln GDP_{t-k} + \rho_{2}ECT_{t-k} + u_{2t}$$

$$\Delta \ln DPI_{t-k} = \sigma_{1} + \sum_{k=1}^{n} \alpha_{2i} \Delta \ln HCPI_{t-k} + \sum_{k=1}^{n} \beta_{2i} \Delta \ln PPI_{t-k} + \sum_{k=1}^{n} \gamma_{2i} \Delta \ln GDP_{t-k} + \rho_{2}ECT_{t-k} + u_{2t}$$

$$\Delta \ln PPI_{t} = \sigma_{3} + \sum_{k=1}^{n} \alpha_{3i} \Delta \ln HCPI_{t-k} + \sum_{k=1}^{n} \beta_{3i} \Delta \ln PPI_{t-k} + \sum_{k=1}^{n} \gamma_{3i} \Delta \ln GDP_{t-k} + \rho_{3}ECT_{t-k} + u_{3t}$$

Δ is the first difference operator, and u<sub>t</sub>'s are white noise disturbance terms. GDP<sub>t</sub>, HCPI<sub>t</sub> and PPI<sub>t</sub> are GDP, HCPI, and PPI at period t. ECT<sub>t-k</sub> is the lagged error correction term. In terms of VECM of Equations (1), (2), and (3), HCPI<sub>t</sub> and PPI<sub>t</sub> Granger cause GDP<sub>t</sub>, of some of α<sub>1</sub> and β<sub>1</sub> coefficients, i=1,2,3,...,n-1 are not equal to zero, and the error coefficient ρ<sub>1</sub> in the equation of HCPI and PPI flows is significant at convention levels. Similarly, PPI and GDP<sub>t</sub> Granger cause HCPI<sub>t</sub> if some of the  $\beta_2$  and  $\gamma_2$  coefficients, i=1,2,3,...,n-1 are not equal to zero, and the error coefficient  $\rho_2$  in the equation of PPI and GDP flows is significant at convention levels. Finally, HCPI<sub>t</sub> and GDP<sub>t</sub> Granger cause PPI<sub>t</sub> if some of  $\alpha_3$ and  $\gamma_3$  coefficients, i=1,2,3,...n-1 are not equal to zero, and the error coefficient  $\rho_3$  in the equation of HCPI and GDP flows is significant at convention levels.

#### 4. Results

The Johansen cointegration test suggested that the variables have a longterm relationship. To proceed with further analysis, we performed a VAR lag order test to determine the lag number. The lag suggestion using each test is shown with an asterisk symbol (\*). The results are shown in Appendix 3. Criteria SC suggested three lags, but other criteria, such as LR, FPE, AIC, and HQ, suggested five. Therefore, the number of lags was fixed at five because most criteria suggested this quantity.

## 4.1. VECM estimation and analysis

Cointegrating Eq:	CointEq1
ΔGDP(-1)	1
ΔHCPI(-1)	-4,418.053 [-0.70717]
ΔPPI(-1)	-11,761.92 [-2.064]
С	-11,510.43

Table 1. VECM estimation results

VECM Estimation and Analysis. The negative coefficient of HCPI (-1) indicates the inverse relationship between GDP and HCPI. Thus, a rise in the HCPI will lead to a decrease in the GDP, which aligns with economic theory and past empirical studies. According to the coefficient value of -4,418.053, GDP will fall by €4,418.053 for every percentage point increase in the HCPI while holding all other variables constant. Similarly, the negative coefficient of PPI (-1) indicates the inverse link between GDP and PPI. According to economic theory, a rise in PPI will result in a fall in GDP. With all other factors held constant, the coefficient value of -11.761.92 indicates that for every percentage point increase in PPI, GDP will fall by €11,761.92. As the constant term, C is statistically significant and negative (-11,510.43), it suggests that the model does not account for all the variables that affect GDP. These elements might consist of outside modifications shocks. to governmental regulations, or other unmeasured variables that affect the economy. Overall, the cointegration equation reveals that GDP, HCPI, and PPI in Kosovo have a long-term relationship and that changes in HCPI and PPI considerably impact GDP.

The cointegration equation can be written as:

# GDP<sub>i-1</sub> = −11,510.43 −4,418.053HCPI<sub>i-1</sub>− 11,761.92PPI<sub>i-1</sub>

Table 2 summarizes the VECM results for the GDP, HCPI, and PPI relationship. The model estimation is satisfactory because  $R^2$  is greater than 0.5, and the AIC and SC criteria values are both low.

Error Correction:	ΔGDP	ΔΗCPI	ΔΡΡΙ	
CointEq1	-3.406349 [-4.63888]	1.79E-05 [ 1.80795]	1.76E-05 [ 0.84856]	
Δ(GDP(-1))	2.299088 [3.63622]	-1.52E-05 [-1.78696]	-1.15E-05 [-0.64505]	
Δ(GDP(-2))	1.772622 [3.00327]	-1.22E-05 [-1.52853]	-7.47E-06 [-0.44907]	
Δ(GDP(-3))	0.927991 [ 2.18502]	-6.54E-06 [-1.14203]	-5.89E-06 [-0.49200]	
Δ(GDP(-4))	0.951538 [ 3.68896]	-4.65E-06 [-1.33829]	-1.10E-06 [-0.15163]	
Δ(GDP(-5))	0.392416 [ 1.94713]	-1.85E-06 [-0.67964]	-2.98E-06 [-0.52463]	
Δ(HCPI(-1))	21342.76 [ 1.47505]	-0.215825 [-1.10622]	-0.138034 [-0.33868]	

Table 2. Results of VECM about causal nexus between GDP, HCPI, and PPI

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#### Articles

Error Correction:	ΔGDP	ΔΗCPI	ΔΡΡΙ
Δ(HCPI(-2))	26933.63 [ 1.50365]	-0.430885 [-1.78401]	0.751862 [ 1.49019]
Δ(HCPI(-3))	37399.58 [ 2.12021]	0.033916 [ 0.14259]	-0.357293 [-0.71910]
Δ(HCPI(-4))	-8600.297 [-0.46992]	-0.043009 [-0.17428]	0.238171 [ 0.46201]
Δ(HCPI(-5))	16536.63 [ 1.21474]	-0.182526 [-0.99436]	-0.086405 [-0.22534]
Δ(PPI(-1))	-36308.58 [-3.61659]	0.217029 [ 1.60321]	-0.667233 [-2.35949]
Δ(PPI(-2))	-34788.96 [-2.90420]	0.133618 [ 0.82724]	-0.531662 [-1.57569]
Δ(PPI(-3))	-21705.03 [-1.89394]	0.267196 [ 1.72909]	-0.346866 [-1.07453]
Δ(PPI(-4))	-16061.50 [-1.59008]	0.085752 [ 0.62959]	-0.100184 [-0.35212]
Δ(PPI(-5))	-9214.242 [-1.13726]	0.100816 [ 0.92280]	-0.401279 [-1.75831]
С	8520.132 [ 0.97562]	0.087807 [ 0.74567]	0.111035 [ 0.45138]
R-squared	0.981027	0.724528	0.626112
F-statistic	87.25284	4.438348	2.825883
Log-likelihood	-532.0359	-38.61958	-71.03294
Akaike AIC	24.95618	2.528163	4.001497
Schwarz SC	25.64552	3.217509	4.690843

# 4.2. Model diagnostic

#### Table 3. LM test for independence of error terms

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	6.933553	9	0.6440	0.768916	(9, 53.7)	0.6452
2	14.94885	9	0.0924	1.782102	(9,53.7)	0.0933
3	8.424970	9	0.4920	0.946849	(9,53.7)	0.4934
4	12.52002	9	0.1856	1.459956	(9,53.7)	0.1869
5	10.01255	9	0.3495	1.141423	(9,53.7)	0.3510

#### Table 4. Results of a normality test

Component	Jarque-Bera	df	Prob.
GDP	91.43531	2	0.0000
HCIP	13.87241	2	0.0010
PPI	1.502167	2	0.4719

# Table 5. Heteroscedasticity test results

Chi-sq	Df	Prob.	
206.3966	192	0.2264	

between variables using the LM test. The statistics are greater than 0.5, indicating

In Table 3, we tested the autocorrelation | probability values for the LRE and Rao F

that there is no autocorrelation in the model. The results of the normalcy test are shown in table 4. Of the three variables, only PPI follows the normal distribution, according to Jarque-Bera's results. GDP and HICP do not follow the normal distribution. As for the variance distribution, the results of the heteroscedasticity test  $\chi 2=22.64$ , p > 0.05 (table 5) show sufficient evidence to accept the null hypothesis. In other words, the model is free of heteroscedasticity, and the variances are equally distributed.

## 4.3. Granger causality test

Test for Granger Causality. Table 6 shows the outcomes of the Granger causality test based on the Vector Error Correction model. According to the first null hypothesis, inflation does not contribute to GDP. The null hypothesis cannot be supported, as indicated by the F=2.72 and p0.05 values. Therefore, inflation causally influences GDP. According to the second null hypothesis, there is no Granger effect on inflation due to GDP. F=4.64, p<0.05 opposes this hypothesis and argues in favor of accepting the alternative hypothesis. That is, GDP also Granger causes inflation. It means that there is a bilateral relationship between GDP and HCPI. The next null hypothesis states that PPI does not Granger GDP. The values F=1.34, p > 0.05 cannot oppose the null hypothesis. Like the first null hypothesis,

the second claims GDP does not cause PPI. The null hypothesis cannot be opposed by the values of F=1.02, p > 0.05. These findings indicate that there is no causal connection between GDP and PPI. The conclusion states that PPI does not Granger induce HCPI, which is the null hypothesis. The null hypothesis is accepted (F=2.28, p>0.05). The last null hypothesis states that HCPI does not Granger cause PPI, and this hypothesis cannot be opposed according to F=0.71, p>0.05.

Impulse Response Function. Figure 4 summarizes the results of the impulse response function based on the eight-period using the VECM. The upper part of the chart shows the GDP's responses to the HICP and PPI. In the first period, GDP responds positively to inflation, but after the third and fifth periods, there is a negative shock due to inflation. After the sixth period, this shock recovers and moves to the positive side but experiences a downward trend after the eighth period. The PPI shock to GDP is smaller but remains on the positive side. GDP has responded positively to PPI shocks, with a downward trend after the eighth period. The second part of the figure shows HCPI responses to GDP and PPI shocks. Inflation has increased in response to disruptions to GDP. This growth has continued in all periods and has been positive. The PPI had small shocks in the consumer price index. Until the

Null Hypothesis:	F-Statistic	Prob.
HCPI does not Granger Cause GDP	2.72005	0.0359
GDP does not Granger Cause HCPI	4.64131	0.0025
PPI does not Granger Cause GDP	1.34652	0.2688
GDP does not Granger Cause PPI	1.02183	0.4203
PPI does not Granger Cause HCPI	2.28021	0.0685
HCPI does not Granger Cause PPI	0.71925	0.6135

Table 6. Granger causality results based on VECM

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Fig. 4. Impulse response function Source: The Kosovo Agency of Statistics

second period, the shocks are zero, and only after this period are there significantly low negative and positive shocks. The last part of the figure shows the responses of PPI to GDP and HICP shocks. PPI has responded positively to GDP shocks in all periods. In other words, as GDP has increased, so has PPI. Similarly, the PPI has responded positively to shocks to the consumer price index, albeit with a more volatile trend.

#### 5. Discussion and Implications

In this study, we tried to empirically analyze the relationship between HCPI, PPI, and GDP in Kosovo using quartile data from Q1: 2010 to Q3: 2022. The data were obtained from the reports of the Statistical Authority of Kosovo and included a total of 51 observations, which should be sufficient to analyze the data in short-term and long-term relationships, according to Jiying et al. (2020); Çollaku et al. (2023), who used 30 and 48 observations respectively, through which we analyzed the relationship between these three variables. Based on the model diagnostic analysis, the models seem to meet their conditions. The results support the unit root hypothesis by showing that stationarity in the first difference is obtained for the three variables. It also tested whether the variables are correlated in the short or long run. From this, we deduced that the trace statistics and max eigenvalues are correlated in long-run equilibrium, so the VEC model was best suited to test this relationship. The Johansen cointegration test suggests that the variables examined in this study (HCPI, PPI, and GDP) have a long-term relationship. The research conducted by Aboobucker and Jahufer (2018) has yielded congruent findings indicative of a protracted association between the variables mentioned above. Based on the VECM assessment and analysis, it shows that every one percent increase in HCPI causes a 4,418.053 decrease in GDP, and every one percent increase in PPI causes an 11,761.92 decrease in GDP. The Saungweme and

Odhiambo research (2021) found that inflation has a protracted detrimental effect on Kenya's economic growth.

From the Granger causality test analysis, the alternative hypothesis is accepted, and there is a bilateral relationship between GDP and HCPI. While the result between GDP and PPI shows no significant causal or unidirectional relationship, the relationship between PPI and HCPI shows that there is neither a unidirectional nor bidirectional relationship between these two variables. In light of the empirical findings, this study suggests that Kosovo's government implements responsible fiscal, monetary, and financial policies to lessen the damaging effects of inflation brought on by COVID-19 and the conflict in Ukraine on the nation's economy and welfare. According to Uddin and Rahman (2022), the emerging nations of the globe should address the issue of inflation by maintaining the inflation rate in single digits; this would lead to economic progress. Otherwise, double-digit inflation would hinder economic expansion. Before establishing policies, policymakers in our nation should evaluate the conclusions of this study. Gao, An, and Zhong (2013) claim that the relationship between price indices provides information about inflation and economic growth and helps governments frame various strategies. Specifically, implementing an accommodating monetary policy, encouraging more public sector investment, and managing inflation through sustained fiscal consolidation measures are required to foster economic growth. Olamide, Ogujiuba, and Maredza (2022) discovered that inflation and economic growth are negatively correlated. While Sohag et al. (2022) offer different policy implications for Eastern and Western Europe, based on which European policymakers should take concrete and common policy actions to combat the harmful effects of geopolitical risks and create stability in food markets, this region should also emphasize the use of unused agricultural land to grow more crops to reduce its reliance on external food sources.

Yu, Guo, and Chang (2022) demonstrate that rising demand for natural resources results in higher pricing for these commodities. Our findings show neither a one-way nor a two-way association between the PPI and the HCPI. The results of Akcay (2011), who found a two-sided relationship for some European countries (like Germany), a onesided relationship for others (like Finland and France), and no association between the two variables for the United Kingdom, support this as well. Also, Rajcaniova and Pokrivcak (2013) investigated the link between PPI and CPI and concluded that there is no long-term association between PPI and CPI. Similarly, the findings of Dorestani's (2022) empirical investigation, as derived from the cointegration analysis, indicate the absence of a sustained equilibrium relationship between the two temporal sequences, namely the Consumer Price Index (CPI) and the Producer Price Index (PPI).

#### 6. Limitations and Future Studies

Like any other study, this one has its limitations, too. Firstly, although GDP, HCPI, and PPI are three variables that are the primary focus of the study, other macroeconomic factors like import, export, foreign direct investment, technology, capital stock labor, and so on are also related to these three variables. Given the pivotal role of addressing inflationary concerns in fostering sustainable economic expansion а within nation (Girdzijauskas, S. et al., 2022), the exclusion of additional variables from the model is

undertaken to streamline its complexity. This strategic simplification enables a more profound exploration of the intricate interplay among the GDP, HCPI, and PPI variables. The primary aim is to discern lucid conclusions and ascertain the principal determinants of fluctuations in economic growth. Secondly, due to the difficulty in accessing data from official reports for longer periods (quarterly), we focused only on 2010–2022. Therefore, future researchers need to conduct other studies that address this issue over longer periods and other economic variables.

Subsequent research endeavors may encompass inquiries about the ramifications of alterations in macroeconomic policies, encompassing monetary and fiscal policies. These inquiries would scrutinize the repercussions of shifts in public expenditure and their ensuing influence on the variables germane to this study. Furthermore, prospective researchers should incorporate within their analyses a consideration of economic crises, including the unanticipated disruption wrought by the COVID-19 pandemic. It would entail examining how these three variables have been perturbed by such unforeseen events and exploring the policy interventions that local authorities have enacted to navigate these economic crises. Additionally, an avenue exists for more in-depth scrutiny concerning the influence wielded by disparate sectors of the economy on the variables under examination. Its comprehensive analysis would facilitate the identification of pivotal economic sectors and subsequently enable the formulation of requisite alterations in sector-specific policies to foster sustainable economic growth. To augment the depth of understanding, it is also prudent to undertake comparative assessments of the nation's economic performance vis-à-vis that of

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neighboring countries in the region or other international counterparts. This comparative lens can provide invaluable insights into the multifarious factors impacting GDP growth.

# 7. Conclusion and Policy Recommendation

This study aimed to assess how Kosovo, a developing nation, would fare in terms of the effects of HCPI and PPI on GDP and vice versa for the years 2010: Q1 to 2022: Q3. The results show that the consumer price index and GDP have a reciprocal relationship, and this result is statistically significant, while the other results, PPI-GDP and PPI-HCPI, do not influence each other. Therefore, the most important contribution of this study is to show how much inflation affects the GDP of Kosovo. Moreover, the findings have substantial monetary and fiscal policy implications for Kosovo, as both the GDP and the levels of HICP and PPI have varied considerably over time, particularly during the rise of the COVID-19 pandemic crisis and the recent war in Ukraine. The consumer price index and PPI increase after 2010 was not so emphasized, except for the last two years, 2021–2022, when there was a relatively unfavorable situation for the consumption basket or the citizens' standard of living in Kosovo. First, the situation with the COVID-19 pandemic and, later, during 2022, the war in Ukraine greatly impacted the occurrence of price increases, so the results for this year are not encouraging, as they influenced the decline in GDP for our country. However, the increase in the consumer price index and PPI and their impact on the decline in GDP have yet to be evaluated by the relevant institutions, and in this regard, the government must take the necessary steps to overcome this situation as soon as possible.

One can argue that since we live in the sustainability era, or because of environmental issues and financial crises. conventional approaches towards the economy based on extensive market economy policies are dismissed (Hajdari and Hadzimustafa, 2023). Nevertheless, a prevailing characteristic observed within most economies is the coexistence of a blend of mechanisms encompassing robust and fragile components, comprising market-driven forces and government intervention (Aikins, 2009). This dynamic interplay between governmental authority and market forces has transformed continuously over the past century, spanning 101 years (Wang and Yi, 2022).

Therefore, based on the results obtained from the developed analyses, we will provide some general recommendations for the government.

- i) **Monitoring HCPI:** In light of extant research demonstrating the reciprocal relationship between alterations in the Harmonized Consumer Price Index (HCPI) and fluctuations in Gross Domestic Product (GDP), governmental authorities should institute a resilient surveillance framework for the HCPI. This imperative arises from recognizing that the HCPI can function as the primary barometer of economic activity and inflationary tendencies. The judicious and punctual monitoring and analysis of the HCPI are conducive to expeditious and well-informed policymaking, enabling proactive responses in the economic domain.
- ii) **Promoting Economic Growth for Inflation Control:** Given the Granger causality relationship established between Gross Domestic Product (GDP) and the Harmonized Consumer Price Index (HCPI),

it becomes imperative for governmental authorities to comprehend the attenuating impact of economic expansion on inflation. Accordingly, policymakers ought to accord precedence to endeavors to foster economic growth to maintain inflationary pressures at manageable levels, ultimately striving for diminished inflation rates and equilibrium-based cultivating а more economic milieu. It is imperative to exercise judicious regulation of inflation and exercise prudent control over economic growth to ensure a state of stable and harmonious economic performance, with interventions enacted when growth rates are suboptimal or restrained in instances of exorbitant expansion (Girdzijauskas, S. et al., 2022).

- iii) Prudent Management of PPI: Although the Predictive Power Index (PPI) may demonstrate robust forecasting not capabilities concerning fluctuations in Gross Domestic Product (GDP) or the Harmonized Consumer Price Index (HCPI), and conversely, the reciprocal relationship may not hold, the government must exercise prudent oversight of this metric. It is principally because the PPI can furnish invaluable perspectives concerning pricing dynamics within the production sector and prevailing market conditions, thus assuming a pivotal role as an economic indicator. Consequently, government entities ought to diligently monitor the trends in the PPI as part of their strategic efforts to remain attuned to market dynamics and potential inflationary pressures emanating from the supply side.
- iv) Comprehensive Approach to Economic Analysis: In the realm of prognosticating economic activity and inflation, it is incumbent upon the government to embrace a holistic approach to economic

analysis, wherein constellation а of indicators, inclusive of but not circumscribed by Gross Domestic Product (GDP), Harmonized Consumer Price Index (HCPI), and Producer Price Index (PPI), is meticulously considered. This multifarious methodology engenders a more precise comprehension of the overarching tapestry of economic activity and the nuances inherent in inflation dynamics. Moreover, it is imperative to consistently scrutinize and revise data sets and economic interdependencies through systematic analysis, as the prevailing economic milieu and the intricate correlations between pivotal variables are subject to evolution over temporal horizons.

v) Mitigating Critical Socio-economic **Issues:** In governmental policy formulation, there is a paramount imperative to accord precedence to the resolution of pivotal socio-economic predicaments. These predicaments encompass, albeit are not confined to, the efficacious management of petroleum prices to ameliorate their adverse influence on inflationary pressures; the formulation of comprehensive stratagems aimed at the retention and active engagement of the burgeoning cadre of youthful professionals within the nation; the orchestration of initiatives designed to fortify the sustained growth trajectory of the agricultural sector; the institution of remedial measures geared toward the mitigation of recurrent food price crises; the vigilant oversight and adept administration of fluctuations in exchange rates; and the systematic exploration of tactics to diminish an unwarranted reliance on imported commodities.

Through the judicious enactment of in Romania in 2019. *Revis* suitable measures and initiatives aimed at *Statistică-Supliment nr*, p. 19.

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the realization of these recommendations, by adopting a versatile approach to data management, the governing authorities can effectively establish stability while concurrently fostering sustainable economic expansion and the commensurate enhancement of the citizens' overall welfare.

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# **APPENDIX**

Variables	Level			1 <sup>st</sup> difference		
	ADF	Prob.	Result	ADF	Prob.	Result
GDP	1.243	0.998	Not Stationary	-3.184	0.027	Stationary
HCPI	1.926	0.999	Not Stationary	-3.630	0.008	Stationary
PPI	0.321	0.977	Not Stationary	-5.989	0.00	Stationary

# Appendix 1. ADF test results

#### Appendix 2. Results of the Johansen Cointegration test

No. of CE(s)	Trace Statistic	Prob.	Max-Eigen Values	Prob.	
None*	108.406	0.000	82.112	0.000	
At most 1*	26.294	0.000	22.213	0.002	
At most 2*	4.089	0.043	4.080	0.043	
* denotes rejection of the hypothesis at the 0.05 level					

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-748.4433	NA	1.37e+11	34.15652	34.27816	34.20163
1	-726.0566	40.70323	7.46e+10	33.54803	34.03462	33.72848
2	-702.2563	40.02775	3.83e+10	32.87529	33.72683	33.19108
3	-664.3416	58.59545	1.05e+10	31.56098	32.77747*	32.01211
4	-650.8054	19.07370	8.78e+09	31.35479	32.93623	31.94127
5	-635.8739	19.00375*	7.05e+09*	31.08518*	33.03157	31.80699*
6	-629.0519	7.752206	8.41e+09	31.18418	33.49552	32.04133

## Appendix 3. VAR lag order selection criteria

Notes: Lag – The number of lags to be included in the VAR model; LogL – The log-likelihood function; LR – Likelihood Ratios; FPE – Final Prediction Error; AIC – Akaike Information Criterion; SC – Schwarz information Criterion; HQ – Hannan Quinn.