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Article

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Are supply shocks a key driver of global Inflation? Evidence from CPI and GDP deflator analysis

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ABSTRACT

This study investigates the main drivers of inflation measured by CPI inflation and GDP deflator across 20 advanced and emerging economies over the yearly span from 2014 to 2023. Using Principal Component Analysis and Panel Vector Autoregression, the research examines the roles of supply-side shocks, fiscal and monetary indicators, and trade openness. The findings indicate that supply-side factors, particularly food and oil price shocks as well as supply chain disruptions, are the primary contributors to both CPI and GDP deflator inflation. Fiscal and monetary factors exhibit limited short-term effect, while trade openness gains significance over time, especially for the GDP deflator, reflecting its broader economic impact. Variance decomposition reveals the persistent influence of supply-side factors, while trade openness plays an increasingly significant role in driving inflation in the long run. These findings provide a comprehensive understanding of inflation dynamics, emphasizing the need for tailored policy and cooperated interventions to mitigate external shocks, strengthen fiscal and monetary frameworks, and enhance global trade resilience.

Introduction

Inflation is a phenomenon that consistently demands investigation due to its pervasive impact on economic stability and growth. It significantly affects people's welfare by reducing real incomes, distorting rational economic decisions, and exacerbating inequality through income redistribution. Over the last three decades, there has been a growing consensus among monetarists that achieving price stability should be the primary objective of monetary policy to ensure sustained reductions in inflation. Conventional instruments, however, have often proven inadequate in addressing inflationary pressures, particularly in the aftermath of economic and health crises. The persistence of these pressures, even amid recent tight monetary policies, highlights the critical importance of understanding their underlying drivers.

In a globalized world, where supply chains are deeply interconnected and economies are increasingly exposed to external shocks, identifying the drivers behind inflation is vital for designing effective policies. In this context, as globalization continues to deepen and economies become more interconnected, the factors influencing inflation have become more complex. The question to raise here is how has globalization amplified the drivers of inflation, and what implications does this have for effective policymaking in an increasingly interdependent world?

The existing literature identifies several drivers of inflation, among these are external supply-side shocks, fiscal and monetary measures, and international trade openness. External supply-side shocks, such as changes in food and oil prices, are well-documented as critical contributors to inflation (Eickmeier & Hofmann, 2022; Diaz et al., 2024). For instance, Cao et al. (2024) emphasize the role of oil price volatility in shaping inflation, particularly in oil-dependent economies. Similarly, food prices exert a significantly strong influence on inflation, often exacerbating global food insecurity in emerging markets, where food constitutes a significant share of household consumption (Ben Hassen & El Bilali, 2022).

In addition, fiscal and monetary fundamentals play a crucial role in driving inflation, as changes in government spending, taxation, monetary policies, and exchange rate directly influences price levels. Fiscal deficits, for instance, can trigger inflation (Sargent & Wallace, 1981) by increasing aggregate demand beyond the economy's optimal output level, especially when financed through money creation or as inflation tax (Bordo & Levy, 2021). Conversely, tight fiscal policies can mitigate inflationary pressures by reducing excess demand. Monetary policies, particularly in the form of interest rate changes and money supply adjustment, are key tools to control inflation, with well-anchored inflation expectations acting as a stabilizing signalling device. The effectiveness of these policies, however, depends significantly on the

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fiscal and monetary relationships. For instance, countries with robust monetary frameworks and independent central banks can effectively manage inflation through effective inflation-targeting regimes (Ha et al., 2019). On the other hand, weak fiscal discipline or excessive reliance on monetization can undermine these efforts, creating a feedback loop that exacerbates inflationary pressures (Eita et al., 2021; Win, 2019) especially during high inflation episodes and crisis times (Lin & Chu, 2013). Recent studies argue that in open economies, the fiscal consolidation and monetary framework could control inflation (Sethi & Mishra, 2024; Ha et al., 2019; Stojanovikj & Petrevski, 2021). This raises questions about whether fiscal-monetary dynamics remain significant drivers of inflation in contemporary monetary settings or whether their influence is replaced by other factors, such as external shocks and globalization.

Indeed, the growing role of global trade and openness adds another layer of complexity to inflation dynamics. While it is suggested that trade openness reduces inflation (Romer, 1993; Bowdler & Malik, 2017), recent studies confirm a positive relationship between openness and inflation (Chhabra & Alam, 2020) and highlight increases in inflation rates caused by supply chain disruptions and imported inflation (Diaz et al., 2024).

The literature thus presents conflicting views on the role of trade openness, particularly in its interaction with other drivers like supply-side shocks and fiscal stance. Furthermore, limited empirical research has directly compared how international trade openness influence CPI and GDP deflator inflation, leaving a gap in understanding the broader implications of trade openness. In addition, gold prices have been considered as an indicator that leads inflation trends, reflecting market expectations of future price levels (Oloko et al., 2021) and thus serves as a proxy for inflation expectations.

Despite these advances, significant research gaps persist in capturing the dynamic relationships among these inflation drivers and their relative importance for different inflation measures. Specifically, existing studies often focus on one measure of inflation, typically CPI, while overlooking the GDP deflator's broader scope, which includes trade and investment dynamics. Additionally, while individual drivers like supply shocks, money supply or trade openness are well-studied, less is known about their relative contributions and interactions over time, especially in the context of variance decomposition and feedback effects.

Furthermore, the COVID-19 pandemic and the Russia-Ukraine war served as significant supply-side triggers over the past decade, causing unparalleled disruptions in global supply chains and redefining inflationary trends worldwide. These events destabilized supply networks, leading to increased costs for businesses, which were passed onto consumers, leading to high inflationary pressures.

This study addresses a significant gap in the literature by identifying and quantifying the role of key inflation drivers: supply-side shocks, fiscal stance, money growth, gold price and trade openness, through a rigorous analysis of their contributions to CPI inflation and GDP deflator inflation. Using panel econometric models of Factor Analysis, Principle Component Analysis and Panel VAR, it provides a comprehensive framework to evaluate the distinct and overlapping roles of these drivers across inflation measures, their loadings, feedback mechanisms, and their dynamic relationships. By comparing the two measures, the research explores whether the broader scope of the GDP deflator captures additional dynamics, such as trade-related inflation, that are less apparent in CPI. Furthermore, the study examines the persistence of inflation and feedback effects, highlighting how inflation itself influences its drivers. The findings contribute to the ongoing debate about the primary drivers of inflation and provide detailed insights into how external and domestic factors shape price levels in an interconnected global economy.

This study demonstrates that supply-side shocks are the dominant medium-run drivers of both CPI and GDP deflator inflation. While factors like trade openness, money growth have limited effects, their growing influence over time, particularly for GDP deflator inflation, highlights the complex nexus between domestic and global dynamics in shaping inflationary trends.

The remainder of the article is organized as follows: Section 2 reviews the empirical literature, Section 3 outlines the data, key drivers selection and methodology, Section 4 presents the results, and Section 5 discusses the implications and concludes.

2. Literature review

Research extensively explores inflation dynamics, emphasizing the increasing integration of global markets and the interplay of domestic and external factors. Lane (2020) provides a foundational perspective on the international synchronization of inflation across advanced and emerging economies from 1997 to 2019. The study highlights global shocks, such as commodity price volatility in energy and food markets, as critical drivers of inflation. Structural factors, including digitalization, aging populations, and the expansion of global value chains, add to inflationary trends by influencing wage-setting mechanisms and price transmission.

In addition, Bańbura et al. (2023) examine core inflation in the Euro Area during the post-pandemic period, focusing on supply-side disruptions. Using Bayesian VAR models, the study identifies energy shocks and supply chain bottlenecks as significant contributors to inflation increases, revealing the vulnerability of advanced economies to external shocks. These insights align with Kamber et al. (2020), who analyse inflation dynamics across 47 countries from 1996 to 2018. Their findings highlight that while advanced economies are more influenced by domestic demand factors, emerging markets are particularly more sensitive to external shocks, including exchange rate volatility and foreign output gaps. Together, these studies emphasize the dual role of global and domestic factors in inflationary pressures in advanced and developing economies. Asadollah et al. (2024), demonstrate that supply chain disruptions remain the dominant long-term drivers of headline, core, and food inflation. Their findings show that oil price shocks predominantly drive energy inflation, while geopolitical risks only impact inflation in the short term, with no significant long-term effects. Similarly, Ha et al. (2023), who analyse global oil price shocks across 55 countries, demonstrate that oil shocks account for up to 9 % of inflation variance in advanced economies and 8 % in emerging markets after 2001. In addition, Cao et al. (2024) confirm the significant inflationary pressures faced by energy-importing G20 economies due to oil price shocks, using panel VAR models to identify heightened vulnerabilities among these countries. These regional and global analyses illustrate the critical role of commodity markets in shaping inflation outcomes, especially for developing and oil-dependent economies. In addition, Yilmazkuday (2024) investigates the role of global geopolitical risks and energy uncertainty, finding that geopolitical risk shocks increase global energy uncertainty without directly impacting energy prices. However, energy uncertainty shocks reduce global energy prices and economic activity. The study highlights varying domestic effects depending on whether economies are oil-producing or oil-importing, providing significant insights into energy security strategies.

Furthermore, Diaz et al. (2023) analyze the effects of global supply chain disruptions and commodity price shocks on U.S. inflation from 1995 to 2021, using a Structural VAR model. The findings reveal that commodity price shocks have a significant but temporary impact on inflation, peaking within six to twelve months and while supply chain disruptions create short-run inflationary pressures their long-run deflationary effects reduce demand and industrial activity. Energy commodities were the primary drivers of inflation during crises, while agricultural and raw materials dominated during stable periods.

After COVID-19 pandemic, supply-side factors have become even more prominent. Diaz et al. (2024) identify supply chain disruptions as a major driver of inflation in advanced economies, alongside lagged significant impacts of commodity price. This finding is reinforced by Eickmeier and Hofmann (2022), who analyse inflation in the U.S. and Euro Area using structural factor models. While demand-side factors initially contributed to inflation surges, supply constraints, particularly during the pandemic, gained prominence. The connection of supply and demand factors, as seen in these studies, highlights the complexity of inflationary dynamics in the world after COVID. Similarly, Ha et al. (2024) emphasize the dominance of oil price and global demand shocks in shaping global headline CPI inflation over the past five decades, with these forces intensifying post-pandemic. In contrast, global supply shocks have become less significant for headline CPI but remain the primary driver of core CPI inflation.

In Sub-Saharan Africa, Abaidoo and Agyapong (2024) provide a region-specific analysis by investigating how commodity price fluctuations, such as those of oil, gold, and cocoa, influence inflation and inflation uncertainty across 32 countries from 1996 to 2019. While rising prices for these commodities significantly drive inflation, higher cotton prices reduce it, reflecting the varied impact of commodity prices.

In South Asia, particularly in India, Joshi and Acharya (2011) highlight the increasing influence of global commodity price movements, especially in the non-food manufacturing and fuel sectors, on domestic inflation since 2000. The relationship between inflation and asset markets has been highlighted by many studies. Białkowski et al. (2015) demonstrate gold's role as a reliable hedge against inflation, especially during financial crises, while Kumar and Gautam (2019) confirm gold's effectiveness in mitigating inflation and exchange rate volatility in India. Extending this analysis to the COVID-19 pandemic, Sadiq et al. (2022) find that gold retained its safe-haven status, while oil prices showed strong co-movement with equity markets, reflecting their sensitivity to demand shocks. These studies highlight the dual nature of global assets like gold and oil in stabilizing or exacerbating inflationary pressures. The findings of Ahmad and Sahar (2023) also reveal a significant inverse relationship between gold and oil prices, highlighting gold's ability to act as a hedge against fluctuations in oil prices and economic uncertainty during the pandemic.

The role of fiscal and monetary policies is another critical dimension in understanding inflation dynamics. Kocoglu (2023) examines Turkey's inflation, identifying fiscal deficits and exchange rate depreciation as major drivers, while also noting the asymmetrical effects of oil price changes. Similarly, Gebremeskel (2020) analyses Ethiopia's inflation trends from 1997 to 2020, finding monetary expansion and structural constraints, such as low agricultural productivity, as key inflation drivers. These findings echo Win (2019), who emphasizes the importance of domestic factors, such as budget deficits and money supply, in shaping Myanmar's inflation, with minimal influence from oil prices or GDP growth. In advanced economies, Verheyen (2010) highlights that the significance of commodity prices has declined for U.S. CPI inflation post-1984, attributing this to structural reforms in monetary policy frameworks.

Structural reforms and globalization also play a central role in mitigating inflation volatility. Ha et al. (2019) demonstrate how robust monetary frameworks and inflation-targeting regimes have stabilized inflation in emerging markets since the 1980s, particularly through globalization and trade openness. Expanding on this point, Ha et al. (2020) explore exchange rate pass-through to inflation across 55 countries. They demonstrate that the magnitude of pass-through is larger for monetary policy shocks compared to global demand and supply shocks, and that countries with credible monetary policies and flexible exchange rates experience lower inflationary pressures. This finding reflects the importance of structural and institutional factors in managing the inflationary effects of external shocks. During post-pandemic and crisis periods, however, studies by Diaz et al. (2024) and Helbling et al. (2008) highlight that supply-side shocks, such as disrupted supply chains and rising commodity prices, play a dominant role in driving inflation compared to other factors.

Our study contributes to the literature by exploring the feedback mechanisms and persistence of inflation driven by various factors, highlighting how inflation itself impacts its underlying drivers. This dual approach, using two inflation measures, considering external, e.g., supply side- shocks, trade openness, gold prices, and domestic factors, provides a significant understanding of the inflationary trend. Comparing between the two inflation measures, the research explores whether the broader scope of the GDP deflator provides additional insights into trade-related and structural dynamics that may be less evident in CPI inflation.

3. Data and methodology

3.1. Data sources and key drivers selection

This study utilizes a comprehensive annual panel dataset covering 20 countries over the last decade from 2014 to 2023, capturing both advanced and emerging economies. The annual dataset incorporates a wide range of macroeconomic and price-related variables. The Food Price Index, a key measure of global food price movements, is sourced from the Food and Agriculture Organization. Data on exports/GDP and imports/GDP, as well as indicators such as GDP growth and the real effective exchange rate (REER), are obtained from the World Bank database. To measure inflation, two indicators are considered: CPI and the GDP Deflator, both of which are also retrieved from the World Bank Database. CPI measures the average change in the prices paid by consumers for a representative basket of consumer goods and services over time, while GDP Deflator is the monetary value of all final new, domestically produced, goods and services in an economy over a specific period.

Commodity price data plays a significant role in the analysis. The global price of Brent Crude Oil is sourced from the FRED, while gold prices are obtained from Bloomberg Data Stream. Monetary variables such as broad money supply are extracted from the IMF International Financial Statistics. Fiscal measures, including the budget deficit or surplus as a percentage of GDP, are sourced from the World Economic Outlook database. Additionally, the Global Supply Chain Pressure Index (GSCPI) is taken from the New York Federal Reserve, providing a measure of global supply chain disruptions. The index is a composite indicator measuring disruptions and pressures in global supply chains and integrating 27 variables across different supply chain dimensions.

Several variables were transformed into growth rates to reflect their dynamic changes. The price indexes for oil, food, and gold, as well as broad money, were calculated as growth variables using log differences. Openness, an indicator of trade intensity, is calculated as the ratio of the sum of exports and imports to GDP (Openness = (Exports + Imports) / GDP).

The panel includes a diverse set of countries to provide a broad perspective on inflation dynamics across different economic structures, with the selection of countries also constrained by data availability. Advanced economies in the panel include Australia, Austria, Belgium, Canada, Italy, Korea, Norway, Spain, Sweden, the United Kingdom, the United States, and France. Emerging economies such as Brazil, China, Chile, Mexico, Russia, Saudi Arabia, Tunisia, and Turkey are also included.

The variables included in the analysis are informed by both theoretical foundations and empirical evidence, ensuring a robust exploration of inflation's drivers.

Fiscal stance, a key macroeconomic variable, play a central role in shaping inflation dynamics. Persistent deficits often exert upward pressure on inflation by increasing aggregate demand or leading to the monetization of debt (Sargent & Wallace, 1981). This relationship becomes particularly significant in economies where fiscal policy dominates monetary policy, necessitating adjustments in the price level to ensure fiscal solvency, as explained by the Fiscal Theory of the Price Level (Fakher, 2016). During the COVID-19 pandemic, fiscal stimulus tools in many countries resembled wartime strategies, characterized by significant increases in government spending without corresponding tax increases (Bordo & Levy, 2021). These responses, combined with increases in monetary bases and broad money growth, reinforced the link between fiscal deficits, money supply and inflationary pressures (Levy, 2020). Some studies have found that deficit is one primary cause of inflation, namely post COVID crisis (e.g. Barro & Bianchi, 2023; Giannone & Primiceri, 2024). Recent studies have quantified this relationship, with Hazell and Hobler (2024) estimating that a 1 % deficit-to-GDP shock raised the price level by 0.18 %, contributing significantly to post-pandemic inflation.

The growth in the money supply, guided by the Quantity Theory of Money, underscores how sustained monetary expansion drives inflation (Friedman, 1956). Monetarization of deficits amplifies these effects, as seen during the pandemic when central banks supported fiscal stimulus efforts. Mukhtar (2010) highlights the strong connection between money supply growth and inflation in economies where fiscal policy dominates monetary policy, further reinforcing this relationship. This monetary expansion often aligns with inflation expectations, which can also be reflected in financial markets. Gold, for instance, serves as a hedge against inflation and tends to rise in value during periods of monetary and fiscal expansion (Naser, 2017). Its dual role as a store of value and a signalling device for inflation expectations highlights the nexus between monetary dynamics and market sentiment (Vigne & Lucey, 2015).

Commodity prices, particularly oil, also play a critical role in inflation dynamics. Changes in oil prices directly impact production costs and, consequently, consumer prices, especially in oil-dependent economies. The interaction between oil prices and exchange rate further exacerbates inflationary pressures, as exchange rate depreciation raises the cost of imported oil (Sek et al., 2015). Álvarez et al. (2011) note that the direct effects of oil price increases on inflation are often more significant than indirect effects, particularly in advanced economies. An increase in international oil prices can similarly trigger this process, as it lowers potential GDP and widens the output gap (Ferreira et al., 2025). The inflationary impact of oil prices has been further amplified by geopolitical shocks, such as the Ukraine-Russia conflict, which disrupted global energy markets and supply chains.

Food prices add another layer of complexity, especially in emerging and low-income economies where food constitutes a significant share of household expenditure (Pourroy et al., 2012). External shocks, such as the Ukraine-Russia conflict, disrupted global wheat and corn supplies, driving up food prices and intensifying inflation. Rising food prices are further compounded by higher transportation costs, often linked to oil price increases, creating a feedback loop that magnifies inflationary pressures. Studies have shown that food price inflation disproportionately affects welfare in lower-income households, reflecting its importance as a driver of inflation (LaBelle & Santacreu, 2022).

Trade openness influences inflation in both direct and indirect ways. Greater openness can reduce inflation through increased competition and efficiency, as suggested by Romer (1993). However, conflicting findings suggest that openness may expose economies to imported inflation during periods of global price instability (Mukhtar, 2010; Samimi et al., 2012; Zakarıa, 2010). Martinez and Iyer (2014) highlight that the relationship between openness and inflation depends on economic structures and trade compositions, with Balakrishnan and Lopez-Salido (2002) noting that openness amplifies the effects of exchange rate fluctuations.

Exchange rate, captured by the real effective exchange rate, influence inflation through cost-push mechanisms (Izatov, 2015). Depreciation raises the cost of imported goods and inputs, which translates into higher consumer prices. This effect is particularly pronounced in economies with significant import dependency (Balakrishnan & Lopez-Salido, 2002). Furthermore, the REER interacts with trade openness and global commodity prices, generating a sophisticated set of drivers that underpin inflation dynamics. Global supply chain disruptions, exacerbated by the COVID-19 pandemic and geopolitical conflicts, have added a structural dimension to inflationary pressures. Bottlenecks and delays in global supply chains have increased production costs and reduced the availability of goods, further amplifying inflation pressures. These disruptions often intersect with oil price volatility, as rising energy costs escalate transportation and logistics expenses, feeding into higher consumer prices. For open economies heavily integrated into global value chains, the impact of supply chain disruptions has been particularly pronounced, highlighting the interconnectedness of these variables in driving inflation (Platitas & Ocampo, 2024).

3.2. Methodology

The study employs a robust econometric methodology to explore the factors driving CPI inflation and GDP deflator inflation over the last decade from 2014 to 2023. The methodology combines panel data techniques and dynamic models to capture both cross-sectional and temporal variations.

Before proceeding with the econometric models, the stationarity of the variables was tested using the Levin-Lin-Chu (LLC) panel unit root test. This test examines that the variables: GDP growth, REER, trade openness, money supply growth, fiscal deficit-to-GDP, GSCPI, and the growth rates of oil and gold prices, included in the analysis are stationary and suitable for panel data modelling.

Principal Component Analysis (PCA) was applied to address multicollinearity and reduce the dimensionality of the data (Kyriazos & Poga, 2023) by consolidating multiple correlated macroeconomic variables into a smaller set of uncorrelated latent factors. Therefore, PCA was conducted on standardized independent variables, including growth rates of prices (oil, food, and gold), broad money growth, trade openness as a percentage of GDP, GSCPI, and a fiscal indicator as a percentage of GDP, to generate uncorrelated factors (principal components). These variables capture demand-side, supply-side, and trade-related dynamics influencing inflation.

The first three principal components (Factor1, Factor2, Factor3) were retained based on the eigenvalues and their contribution to explaining the total variance. Although additional components, such as the fourth or fifth, capture more variability in the data, the rate of contribution diminishes significantly. Retaining three components is considered sufficient, prioritizing interpretability and parsimony. According to the scree plot presented in Fig. 1, components with eigenvalues greater than 1 are considered significant. In this case, the first three components meet this criterion, supporting the decision to keep only three components. Furthermore, the elbow in the scree plot appears

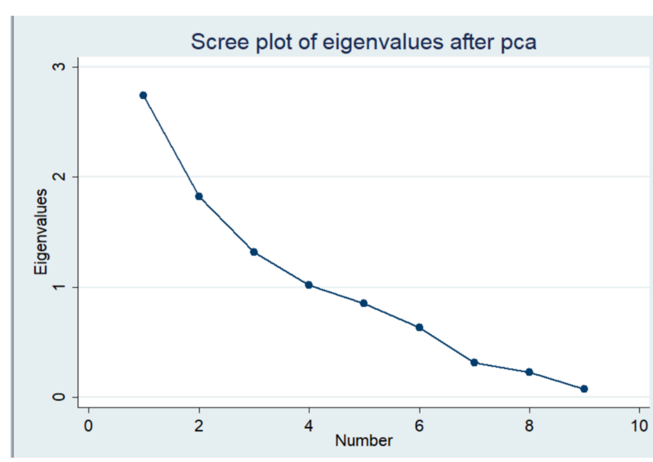

Fig. 1. Scree plot of Eigenvalues. Note: This scree plot represents the eigenvalues of the principal components derived from the PCA analysis. The components are ordered by their explained variance, with the steep decline indicating that the first three components capture most of the variance in the dataset. Based on the “eigenvalue > 1″ criterion, only the first three components are retained, as they account for the most substantial portion of the total variance, while the remaining components contribute minimally and so they are excluded from the analysis.

after the third component, indicating that the first three components explain most of the variability, while additional components contribute diminishingly.

The three factors serve as explanatory variables in subsequent regressions. However, since variables, included in the PCA, such as GDP growth, exchange rate, and GSCPI are measured on different scales, they were standardized to ensure comparability of variables as follows:

$$Z_{Xi} = \frac{X_i - \mu_i}{\sigma}$$

where Z_{Xi} is the standardized variable of X_i, X_i is the original value, μ_i is the mean and σ is the standard deviation.

Then the total variance, explained by each component, was assessed to determine the number of factors to retain. Therefore, scores for Factor1, Factor2, and Factor3 were computed for each observation using the loading matrix, representing the composite measures of the underlying dimensions captured by the three components, as follows:

$$score = \sum_{k=1}^{p} loading_{ik} \times z_{kj}$$

where i is the component, k is the variable and z_{kj} is the standardized value of variable k for order j.

A Panel Vector Autoregression (PVAR) model was estimated to explore the dynamic interactions between inflation and the PCA-derived factors. The PVAR framework allows for endogenous relationships, treating all variables as potentially dependent. The PVAR model captures the temporal dynamics and feedback mechanisms between inflation and the explanatory factors. The general model is specified as:

$$y_{it} = A_1 y_{i,t-1} + \cdots + A_p y_{i,t-p} + \aleph_i + \varepsilon_{it}$$

where y_{it} is a vector of endogenous variables [$inflation_{it}$, $Factor1_{it}$, $Factor2_{it}$, $Factor3_{it}$], $A_1 to A_p$ are coefficient matrices, $\aleph_i$ represents country-specific fixed effects, and ε_{it} is the error term.

The system PVAR can be represented as follows:

$$inflation_{it} = \alpha_1 + \gamma_{11} inflation_{i,t-1} + \gamma_{12} Factor1_{i,t-1} + \gamma_{13} Factor2_{i,t-2} + \gamma_{14} Factor3_{i,t-1} + \epsilon_{1,it}$$

$$Factor1_{it} = \alpha_2 + \gamma_{21} inflation_{i,t-1} + \gamma_{22} Factor1_{i,t-1} + \gamma_{23} Factor2_{i,t-2} + \gamma_{24} Factor3_{i,t-1} + \epsilon_{2,it}$$

$$Factor2_{it} = \alpha_3 + \gamma_{31} inflation_{i,t-1} + \gamma_{32} Factor1_{i,t-1} + \gamma_{33} Factor2_{i,t-2} + \gamma_{34} Factor3_{i,t-1} + \epsilon_{3,it}$$

$$Factor3_{it} = \alpha_4 + \gamma_{41} inflation_{i,t-1} + \gamma_{42} Factor1_{i,t-1} + \gamma_{43} Factor2_{i,t-2} + \gamma_{44} Factor3_{i,t-1} + \epsilon_{4,it}$$

where γ_{ij} are the coefficients reflecting the relationship between the variables in the system. $\epsilon_{j,it}$ are the disturbance term for each equation in the system. The optimal lag length was selected based on model fit criteria, and the PVAR was estimated using the GMM (Generalized Method of Moments) with robust standard errors to address potential endogeneity.

To assess the impact of shocks to the factors on inflation, Impulse Response Functions (IRFs) were derived from the PVAR model. IRFs provide a graphical representation of how inflation and the extracted factors respond to a one-standard-deviation shock in one of the system's variables over a specified horizon (10 periods). This analysis provides insights into the persistence and magnitude of inflationary shocks driven by the explanatory factors.

Finally, a Forecast Error Variance Decomposition (FEVD) was conducted to quantify the contribution of each factor to inflation. FEVD breaks down the variance of the forecast error for inflation into components attributable to shocks in each of the endogenous variables. This analysis identifies the relative importance of the factors in explaining inflation dynamics.

A Fixed Effects (FE) regression model was employed to identify the static relationship between the inflation measures (CPI and GDP deflator) and the PCA-derived factors. The FE model accounts for unobserved heterogeneity by controlling for time-invariant characteristics specific to each country. This approach isolates the within-country variations in inflation over time, focusing on the dynamic effects of each factor on inflation. The model specification is as follows:

$$inflation_{it} = \alpha + \gamma_1 Factor1_{it} + \gamma_2 Factor2_{it} + \gamma_3 Factor_{it} + u_i + \varepsilon_{it}$$

where $inflation_{it}$ is the inflation measure (CPI or GDP deflator) for country i at time t, $\gamma_1, \gamma_2 and \gamma_3$, are the coefficients capturing the contributions of each of these factors to inflation measure. $Factor1_{it}$, $Factor2_{it}, Factor3_{it}$ are the PCA-derived factors, α is the intercept term, u_i represents country-specific fixed effects, and $\varepsilon_{it} is the error term.$ Robust standard errors were used to account for heteroscedasticity and within-panel autocorrelation.

The methodology was applied separately for CPI inflation and GDP deflator inflation to identify similarities and differences in their determinants. This dual approach highlights whether the same set of factors drive both measures of inflation or if unique dynamics exist for each.

4. Results

4.1. Results of preliminary analysis: stationarity testing and principal factor derivation

All variables considered in the analysis (GDP growth, REER, openness, food prices growth, oil prices growth, gold prices growth, broad money supply growth, CPI inflation, GDP deflator inflation, and GSCPI) were tested for unit roots. Results of LLC test presented in Table 1 indicated stationarity at the level for all the variables.

The PCA offers a structured approach to uncovering the underlying economic dynamics. Using the eigenvalue > 1 criterion, it consolidates related variables into three distinct components, collectively accounting for 65.37 % of the total variance in CPI inflation, as shown in Table 2. Component (Factor) 1, which accounts for 30.48 % of the variance, is predominantly driven by food growth (loading: 0.5688), oil prices (loading: 0.5364), and global supply chain pressures (loading: 0.5160),

Table 1
Stationary test.

Variable	Unadjusted t	Adjusted t*	P-Value	Stationarity (Significance)
Inflation CPI	−11.270	−4.180	0.000	Stationary (*** Significant)
Inflation GDP Deflator	−6.993	−1.284	0.090	Weak Stationarity (*)
GDP Growth	−15.727	−10.261	0.000	Stationary (*** Significant)
REER	−9.015	−4.693	0.000	Stationary (*** Significant)
Openness	−12.067	−6.066	0.000	Stationary (*** Significant)
GSCPI	−15.289	−9.897	0.000	Stationary (*** Significant)
Fiscal Deficit	−10.474	−6.305	0.000	Stationary (*** Significant)
Broad Money Growth	−9.261	−3.542	0.000	Stationary (*** Significant)
Food Price Growth	−19.133	−12.747	0.000	Stationary (*** Significant)
Gold Price Growth	−16.693	−12.587	0.000	Stationary (*** Significant)
Oil Price Growth	−25.102	−20.680	0.000	Stationary (*** Significant)

Table 2
PCA results.

Variable	Comp1	Comp2	Comp3	Explanation
z_gdpgrowth	0.2919	0.4681	−0.369	Economic growth contributes most to Comp2
z_reer	−0.0453	0.358	0.4774	Exchange rate is significant in Comp2 and Comp3
z_openness	0.0404	0.122	0.3517	Trade openness contributes moderately to Comp3
z_gscpi	0.516	−0.2271	0.1689	Commodity prices dominate Comp1
z_Fiscal Deficit	0.0886	0.3136	0.1538	Fiscal deficit plays a key role in Comp2
z_Broad Money Growth	0.1601	−0.3213	−0.5511	Money supply is inversely significant in Comp3
z_Food Price Growth	0.5688	−0.1108	0.1531	Food price growth drives Comp1
z_Gold Price Growth	0.0087	−0.59	0.3638	Gold prices inversely dominate Comp2 and moderately Comp3
z_oil Price Growth	0.5364	0.156	0.023	Oil prices are strongly linked to Comp1

Note: Where Z_X_i is the standardized variable of X_i. Comp: Component. To ensure the robustness and stability of the extracted factors, a correlation analysis is conducted. The results confirm that the principal components (factors) are orthogonal to each other. The factors (factor1, factor2, factor3) are zero-centred (i.e., 8.64e-10, −5.69e-10, and 2.29e-09, respectively), as expected in PCA, ensuring their means are effectively 0. Additionally, the standard deviations align closely with the square roots of the corresponding eigenvalues, verifying that the variance explained by each component is consistent with the PCA results. The ranges of the factor scores indicate variability in the data along each principal component, with larger ranges reflecting greater spread.

with smaller contributions from GDP growth (loading: 0.2919) and fiscal deficits (loading: 0.0886). This component reflects broad inflationary pressures, where commodity price shocks, particularly from food and oil, dominate. These supply-side factors are further amplified by global supply chain disruptions, contributing to rising inflation. The positive nexus with GDP growth suggests that economic expansion adds to demand-side inflationary pressures, while fiscal deficits play a minor supporting role. In essence, Component 1 captures the macroeconomic dynamics of inflation driven by supply shocks and growth-related pressures and presents the dominant role of supply-side shocks in driving inflation

Component (Factor) 2 explains 20.23% of the variance, which shifts the focus to macroeconomic stability and global financial pressures. It is strongly influenced by GDP growth (0.4681), real effective exchange rate (0.3580), and fiscal deficits (0.3136). Interestingly, gold prices (−0.5900) exhibit a pronounced inverse relationship with this component, highlighting their role as a hedge against economic instability. The positive loadings for GDP growth and REER suggest that economic and exchange rate stability support a strong macroeconomic environment. However, the role of fiscal deficits introduces a layer of complexity, as they can undermine stability if left uncontrolled. The negative correlation with gold prices underscores the tendency for gold to lose its appeal as a safe asset in stable, growth-driven economic conditions. Component 2, therefore, captures the interplay between macroeconomic stability, fiscal stance, and gold's role in financial markets.

The Component (Factor) 3, contributing 14.65 % to the total variance, highlights the relationship between trade openness and monetary policy. It is primarily shaped by trade openness (0.3517) and gold prices (0.3638), with money supply (−0.5511) playing an opposing role. The positive loadings for trade openness and gold suggest that as global trade activities increase, gold remains a valuable hedge against uncertainties associated with economic integration. However, the negative loading for money supply indicates its offsetting impact, reflecting monetary policy's stabilizing influence in response to financial shocks or reducing structural and trade pressures. This component emphasizes the sophisticated relationship between structural globalization, financial stability, and the tools of monetary policy.

4.2. CPI inflation dynamics: PVAR, IRFs, variance decomposition, and fixed effects.

4.2.1. Results of PVAR estimation

The PVAR approach is utilized to investigate the dynamic interrelationships among CPI inflation and the three extracted factors (Factor1, Factor2, Factor3). The results provide dynamic insights into the interplay between inflation (measured as CPI) and the three principal components derived from PCA, which were specified with one lag based on standard lag-selection criteria. Using GMM estimation with robust standard errors, the results reveal the relative importance of each factor in explaining inflationary dynamics and their effects, as summarized in Table 3.

The inflation CPI equation captures the impact of current inflation on its own lag and the lagged effects of the three factors. Lagged CPI inflation appears statistically insignificant indicating that past inflation does not strongly predict current inflation within this model. The results for Factor1, which reflects commodity price movements, food growth, and oil prices, highly significantly influence inflation by 1.39%. This result suggests that inflationary pressures in these economies are primarily driven by external and structural factors rather than persistent inflationary inertia. The large and significant coefficient indicates that increases in these supply-side drivers cause substantial and persistent upward movements in inflation. This reflects the immediate impact of external shocks on CPI dynamics and highlights their role as dominant inflationary drivers.

Factor 2 and Factor 3 have negative but statistically insignificant

Table 3
PVAR estimation results.

Dependent Variable	Independent Variable	Coefficient	z-Statistic	P-Value
Inflation CPI	Inflation CPI	0.428 (0.419)	1.020	0.307
	Factor1	1.390 (0.325)	4.280	0.000
	Factor2	−0.5431 (0.9831)	−0.550	0.581
	Factor3	−0.637 (2.629)	−0.240	0.809
Factor1	Inflation CPI	−0.0625 (0.133)	−0.470	0.640
	Factor1	0.420*** (0.129)	3.240	0.001
	Factor2	0.289 (0.969)	0.300	0.766
	Factor3	3.347 (2.103)	1.590	0.111
Factor2	Inflation CPI	−0.047 (0.043)	−1.11	0.268
	Factor1	0.034 (0.054)	0.64	0.523
	Factor2	0.227 (0.309)	0.73	0.463
	Factor3	−0.031 (0.711)	−0.04	0.965
Factor3	Inflation CPI	−0.087** (0.040)	−2.17	0.030
	Factor1	0.0301 (0.045)	0.67	0.502
	Factor2	−0.193 (0.171)	−1.13	0.260
	Factor3	−0.257 (0.427)	−0.6	0.547

Note: Robust Standard Errors are in parentheses.

effects on inflation CPI. These results suggest that while macroeconomic stability factors, such as GDP growth and exchange rate stability, and structural factors like trade openness may have an inverse relationship with inflation, their impact is neither significant nor immediate.

Factor 1, which captures external price pressures, shows strong persistence over time. The coefficient for its lagged value is positive and significant, indicating that external price shocks tend to sustain themselves across periods. This persistence underscores the enduring nature of global price volatility, such as oil and food price fluctuations. CPI inflation, however, does not significantly influence Factor 1 dynamics, as evidenced by the statistically insignificant coefficient. Expectedly, this suggests limited feedback effects from domestic inflation to global price conditions, implying that inflation in the domestic economy does not strongly impact external price systems.

Factor 2, representing GDP growth, REER and fiscal stance, shows weak temporal persistence, with a lagged coefficient of 0.2269. Its own past values have limited influence on its current dynamics, reflecting the short-run nature of such shocks. Inflation CPI also fails to exert a significant impact on Factor 2. Factor 3, which represents monetary, gold and openness indicators, similarly exhibits weak impacts, as indicated by a statistically insignificant lagged coefficient of −0.2570. This suggests that openness and monetary adjustments are not strongly influenced by their previous values, possibly due to adaptive policy responses.

Interestingly, CPI inflation has a significant and negative effect on Factor 3, with a coefficient of −0.0872. This implies that rising inflation generates monetary adjustments aimed at stabilizing the economy, reflecting a reactive policy stance to inflationary pressures. The negative coefficient suggests that inflationary pressures may lead to tight monetary conditions to curb inflation. The negative sign also suggests that domestic inflation adversely impacts openness, as high inflation reduces competitiveness.

4.2.2. Results of IRFs

The IRFs derived from the PVAR provide a visual representation of the dynamic relationships between CPI inflation and the three principal components to one standard deviation shocks over a ten-period horizon, as illustrated in Fig. 2. It is found that inflation exhibits a positive and persistent response to shocks in Factor 1. The response starts immediately and remains significant over the entire 10-period horizon, with a gradual decline over time. This highlights the medium-run influence of supply-side factors, such as food price growth, oil prices, and global supply chain disruptions, on inflation dynamics. The results reaffirm the significant role of external shocks in driving CPI inflation and emphasize the persistence of cost-push pressures.

Inflation shows a negative response to shocks in Factor 2 during the early periods, which diminishes and stabilizes close to zero by the 7th to 10th periods. Although Factor 2 includes elements like GDP growth, fiscal stance, and exchange rate stability, its impact on inflation is deflationary and short-lived. This suggests that these factors primarily act as stabilizing mechanisms, potentially reflecting the effects of fiscal or exchange rate adjustments in controlling inflationary pressures.

Inflation initially responds positively to shocks in Factor 3, peaking around the second period, and then gradually diminishes over time. Factor 3, representing money growth and trade openness, appears to exert mild inflationary pressure in the short term. However, the response remains weak and statistically insignificant in later periods, indicating limited long-run influence on inflationary dynamics.

4.2.3. Results of variance decomposition

The FEVD analysis quantifies the share of forecast error variance attributable to inflation CPI and the three PCA factors. This allows us to assess the relative importance of each factor in explaining the variability of inflation CPI and the PCA factors over different time horizons. Table 4 shows that at the immediate horizon (Horizon 1), 100 % of inflation CPI's variance is explained by its own shocks, with no contributions from external factors. Over the short term, the dominance of inflation CPI's own shocks declines, from 83 % at Horizon 2 to approximately 57 % at Horizon 5. Factor 1 emerges as an important contributor, increasing its share of variance explained from 15.9 % at Horizon 3 to 12.9 % at

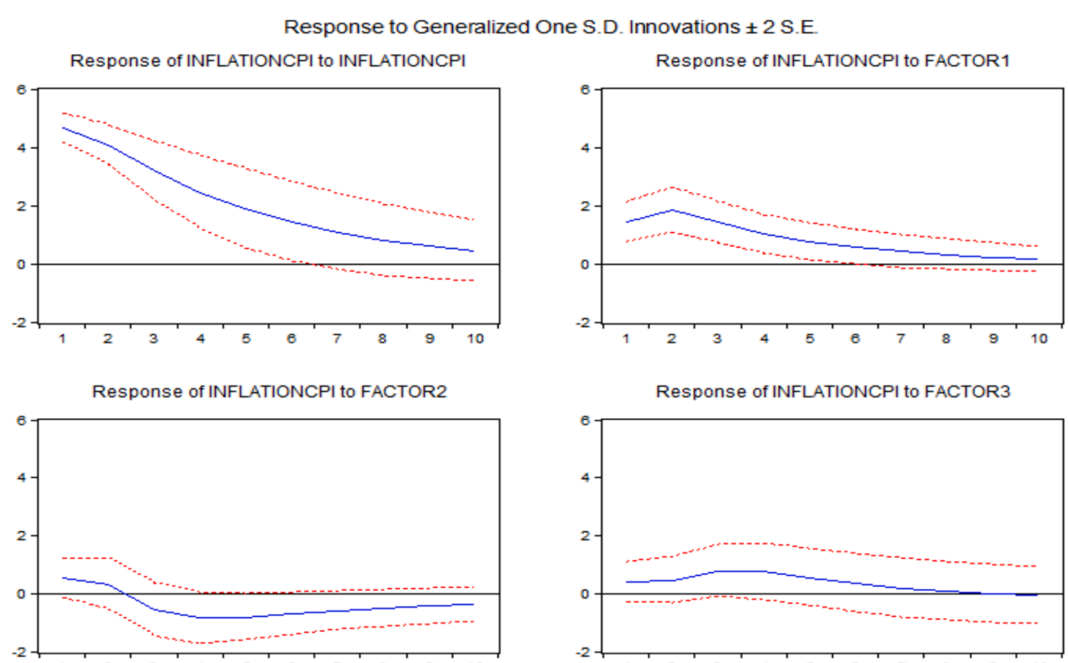

Fig. 2. IRFs for CPI inflation. Note: The above figure illustrates the generalized impulse response functions of InflationCPI to one standard deviation shocks to itself, Factor1, Factor2, and factor3. The red dashed lines indicate the ±2 standard error confidence intervals. Generalized impulses were used instead of Cholesky decomposition because the causal ordering of variables cannot be assumed a priori, making the generalized approach more robust and less dependent on subjective assumptions. The results remain consistent across different response standard error methods, such as Monte Carlo and analytic approaches and at different horizons. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 4
Forecast error variance decomposition for CPI inflation.

Table 4: Variance Decomposition for CPI inflation				
Horizon	Inflation CPI (%)	Factor1 (%)	Factor2 (%)	Factor3 (%)
0	100	0	0	0
1	100	0	0	0
2	83.03	15.96	0.59	0.41
3	62.2	15.63	6.2	15.97
4	56.38	14.77	11.29	17.56
5	57.28	12.99	11.72	18.02
6	58.56	13.4	10.92	17.12
7	56.72	14.64	11.25	17.40
8	54.82	14.08	12.15	18.95
9	55.37	13.6	12.37	18.66
10	55.86	13.83	12.09	18.22

Horizon 5. Contributions from Factor 2 and Factor 3 remain minimal, jointly accounting for less than 2 %. In the long term, inflation CPI's own shocks stabilize at around 55.8 % of the variance by Horizon 10. Factor 1 continues to play a significant role, explaining 13.8 % of the variance by Horizon 10. Contributions from Factor 3 increase to 18.2 %, reflecting the growing importance of monetary policy and trade openness dynamics in driving inflation. Factor 2′s role remains limited, contributing only 12.1 % by Horizon 10. The analysis shows that in the short term, inflation is entirely self-driven, with external factors having no immediate impact. By horizon 2, Factor1 emerges as the primary external factor, maintaining a moderate impact over time. As inflation increases, Factor3 gains importance, peaking at 18.95 % by horizon 8, making it the most significant long-term driver. Factor2 starts with minimal influence but steadily increases, reaching 12.37 % by horizon 9, indicating a delayed but important effect. This suggests that Factor3 should be the primary focus for long-term inflation control, while Factor1 requires earlier intervention to mitigate medium-term inflationary pressures.

4.2.4. *Results of fixed effects*

The FE regression results provide a detailed analysis of the determinants of inflation, measured first by the CPI, using three principal components derived from PCA as explanatory variables. The model explains 24.53 % of the within-group variance (R^2 within), with a statistically significant overall fit. The fixed-effects approach accounts for unobserved heterogeneity across the 20 countries, isolating the within-group variation. The coefficients, their significance, and the overall implications of each factor are detailed in Table 5. The first principal component, Factor 1, has a positive and statistically significant impact on inflation CPI. This result highlights the dominant role of supply-side inflationary pressures, captured by food growth, oil prices growth, and global supply chain disruptions, in driving CPI inflation. This aligns with the PCA results, where Factor 1 primarily reflected commodity price shocks and supply-side inflation dynamics, emphasizing the sensitivity of inflation to these exogenous shocks. The second principal component, Factor 2, shows a negative but statistically insignificant relationship with CPI inflation. The third principal component, Factor 3, also exhibits a more negative but statistically insignificant relationship with CPI inflation. This factor represents the connection between monetary policy, trade openness, and gold prices. The negative coefficient implies that an increase in monetary policy tightening, or trade intensity may help reduce inflationary pressures. However, the insignificance indicates that the influence of these structural and policy related factors on inflation may be indirect.

Table 5
Fixed effects results (CPI inflation).

Variable	Coefficient	Standard Error*	t-Statistic	P-Value
Factor1	0.8249	0.255	3.23	0.004
Factor2	−1.37	1.094	−1.25	0.224
Factor3	−3.468	2.351	−1.48	0.155
Constant	4.1362	4.59E-09	9.00E + 08	0.030
Within R-squared	0.2453			
Between R-squared	0.6640			
Overall R-squared	0.4233			

Note: *Robust standard errors.

4.3. *GDP deflator inflation Dynamics: PVAR, IRFs, variance Decomposition, and fixed effects.*

4.3.1. *Results of PVAR estimation*

The GMM estimation results, presented in Table 6, for inflation measured by GDP deflator indicates that Factor 1, representing external supply-side dynamics (food price growth, oil prices, and supply chain disruptions) shows a significant positive effect of 0.894. This result shows the critical role of supply-side shocks in driving GDP deflator inflation. On the other hand, lagged inflation along with Factor 2 and Factor 3, are found to be statistically insignificant. The statistical significance suggests that an increase in Factor 1 directly and significantly contributes to higher inflation in the following period, aligning with the results of CPI inflation. The feedback loop from inflation to supply side and fiscal-monetary dynamics is weak and insignificant, further indicating that inflation and fiscal-monetary determinants are not connected in this model. However, inflation has a statistically significant negative feedback effect on Factor 3. This could indicate that rising inflation negatively impacts trade-related factors, such as reduced competitiveness in global markets. The significant positive influence of Factor 3 on Factor 1 might imply that increased global trade openness contributes to amplifying supply-side shocks.

4.3.2. *Results of IRFs*

The IRFs for GDP deflator Inflation in Fig. 3 illustrate the dynamic reactions of Inflation and the three factors to one standard deviation

Table 6
PVAR estimation results for GDP deflator inflation.

Dependent Variable	Independent Variable	Coefficient	z-Statistic	P-Value
Inflation (GDP Deflator)	Inflation	0.449 (0.542)	0.830	0.408
	Factor 1	0.894** (0.443)	2.020	0.044
	Factor 2	1.453 (2.927)	0.500	0.620
	Factor 3	5.712 (6.427)	0.890	0.374
Factor 1	Inflation	−0.052 (0.129)	−0.410	0.684
	Factor 1	0.386** (0.152)	2.540	0.011
	Factor 2	0.637 (0.968)	0.660	0.511
	Factor 3	4.199** (1.958)	2.140	0.032
Factor 2	Inflation	−0.037 (0.042)	−0.880	0.378
	Factor 1	0.026 (0.057)	0.460	0.646
	Factor 2	0.401 (0.330)	1.210	0.225
	Factor 3	0.413 (0.682)	0.610	0.545
Factor 3	Inflation	−0.062** (0.028)	−2.250	0.025
	Factor 1	0.057 (0.039)	1.440	0.149
	Factor 2	−0.084 (0.152)	−0.550	0.580
	Factor 3	0.081 (0.365)	0.220	0.825

Note: Robust standard errors are in parentheses.

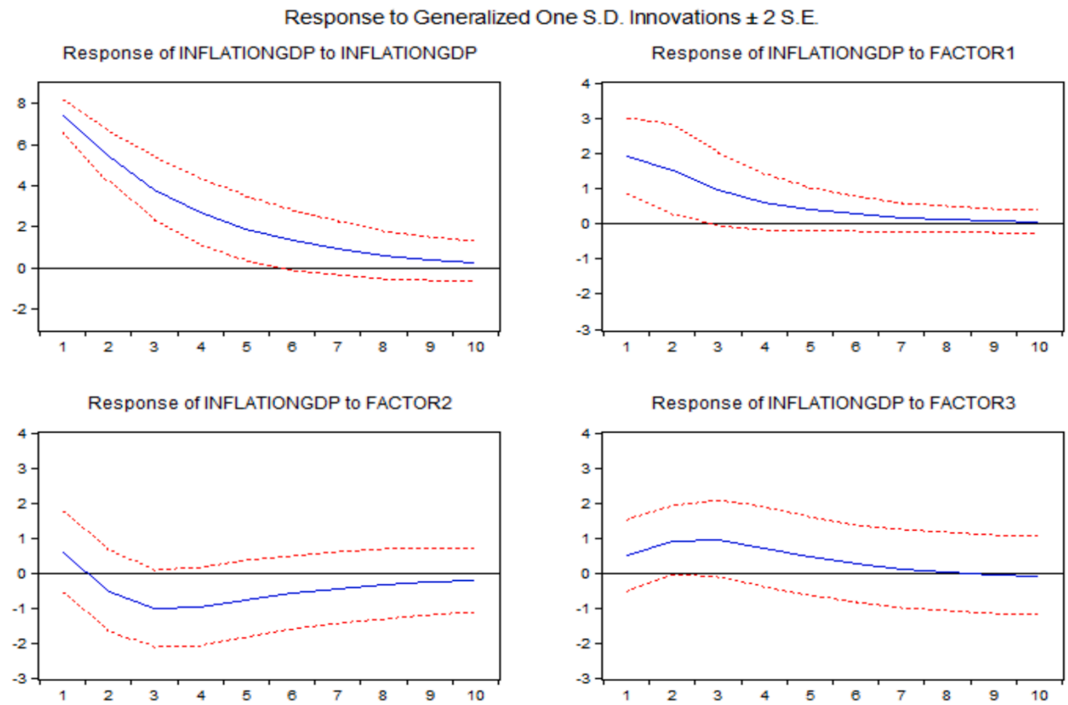

Fig. 3. IRFs for GDP Deflator Inflation. Note: The above figure illustrates the generalized impulse response functions of Inflation GDPdeflator to one standard deviation shocks to itself, Factor1, Factor2, and factor3. The red dashed lines indicate the ±2 standard error confidence intervals. Generalized impulses were used instead of Cholesky decomposition because the causal ordering of variables cannot be assumed a priori, making the generalized approach more robust and less dependent on subjective assumptions. The results remain consistent across different response standard error methods, such as Monte Carlo and analytic approaches and at different horizons. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

shocks over a ten-period horizon. These responses offer valuable insights into how economic shocks are transmitted through the system. The response of Inflation to its own shocks is initially strong and positive, peaking in the first period. Over time, the response declines steadily and stabilizes near zero by the 8th to 10th period. This indicates that inflationary pressures are persistent in the short term but diminish in the long term, suggesting that the system is relatively self-correcting. Shocks to Factor 1 elicit a significant and positive response in Inflation. The response peaks early and gradually declines over time, remaining statistically significant for most of the 10-period horizon. This result highlights the substantial role of supply-side factors in driving inflationary trends in the GDP deflator. Shocks to Factor 2 initially result in a negative response in GDP deflator Inflation, with the strongest impact observed in the early periods. This negative effect diminishes over time, and the response stabilizes close to zero. These results suggest that Factor 2 primarily acts as a stabilizing force on inflation, likely reflecting the deflationary impact of macroeconomic adjustments like exchange rate appreciation or decrease in aggregate demand.

Shocks to Factor 3 initially cause a moderate positive response in GDP deflator Inflation, peaking around the second to third period. Over time, the response stabilizes, but its magnitude remains small. This suggests that Factor 3 exerts a marginal and short-run influence on inflation dynamics.

4.3.3. Results of variance decomposition

For the FEVD, presented in Table 7, at horizon 1, inflation GDP deflator inflation is entirely explained by its own past values, accounting for 100 % of the variance. This reflects the immediate persistence of inflation within the model. However, as time progresses, other factors begin to contribute. By horizon 2, Factor 1 explains 5.27 % of the variance, and Factor 3 contributes 9.63 %, indicating the increasing impact of external factors on inflation. The contribution of Factor 2 remains negligible at 0.35 %, suggesting that fiscal-growth effects are less immediate. Over longer horizons, such as horizon 10, the impact of Factors 1 and 3 becomes more effective. Factor 1 explains 9.08 % of the variance, while Factor 3 accounts for a substantial 19.69 %. This underscores the increasing impact of supply-side shocks, monetary and trade dynamics in shaping inflation variance. Conversely, the role of Factor 2 remains limited, contributing only 2.91 %. These findings suggest that inflation variability over time is primarily driven by external supply-side and trade-related factors, while REER, fiscal and GDP growth determinants play a relatively minor role. Therefore, Factor3 is the most significant driver, reflecting its significant and long-term effect on GDP deflator inflation. Factor1 maintains a moderate but steady influence, whereas Factor 2 remains the least significant, with a maximum contribution of just 3.03 %. These findings suggest that Factor3 should be the primary target for long-term inflation control, while Factor1 warrants attention as a secondary but essential contributor. In contrast, short-term inflation remains largely endogenous, necessitating different policy approaches based on the time horizon.

Table 7
Forecast error variance decomposition for GDP deflator inflation.

Horizon	Inflation GDP Deflator (%)	Factor 1 (%)	Factor 2 (%)	Factor 3 (%)
0	100	0	0	0
1	100	0	0	0
2	84.76	5.27	0.35	9.63
3	68.08	9.63	1.9	20.39
4	68.86	8.65	2.9	19.59
5	72.92	7.55	2.76	16.77
6	70.47	8.56	2.61	18.36
7	67.37	9.37	2.87	20.39
8	68.42	8.9	3.03	19.66
9	69.51	8.65	2.94	18.9
10	68.31	9.08	2.91	19.69

4.3.4. Results of fixed effects

The fixed-effects regression analysis explores the relationship

Table 8
The fixed effects results for GDP deflator inflation.

Factor	Coefficient	Std. Err.	t-stat	p-value
Factor 1	1.538	0.507	3.03	0.006
Factor 2	−2.175	1.404	−1.55	0.136
Factor 3	−5.025	3.048	−1.65	0.114
Within R-squared	0.2934			
Between R-squared	0.6813			
Overall R-squared	0.4203			

Note: Robust Standard Errors are in parentheses.

between inflation (measured by the GDP deflator) and the three principal components derived from PCA. The results are presented in Table 8. Factor 1 is found statistically significant of nearly 1.54. This suggests a strong positive relationship between Factor 1 and inflation, highlighting the critical role of supply-side shocks in driving inflation across countries. Factor 2 has a negative effect of around −2.18 but is statistically insignificant, possibly due to stabilization efforts or effective fiscal management. Factor 3 is largely negative but also statistically insignificant. This factor, representing trade openness and global exposure, might indicate that greater integration into global trade reduces inflationary pressures through increased competition and efficiency gains. However, the lack of significance suggests that this relationship is not robust or that its effects are overshadowed by other dominant factors, such as supply-side shocks. The between R-squared of 0.6813 indicates that these factors explain a larger share of the variation across countries, highlighting their importance in differentiating inflationary trends between sections. The overall R-squared value of 0.4203 shows a moderate fit of the model in explaining inflation dynamics.

The fixed-effects regression results align with the findings from the PCA, PVAR-GMM, emphasizing the significant role of external supply-side shocks in explaining inflation dynamics. While Growth, fiscal-monetary and trade factors may have stabilizing effects, their short-term influence appears weak within the sample.

4.4. Comparative analysis of CPI and GDP deflator inflation dynamics

CPI inflation and GDP deflator inflation differ significantly in their scope and responsiveness to key inflationary forces, reflecting the distinct economic aspects they each represent. These differences in scope shape the responsiveness of each measure to underlying inflation drivers. An empirical analysis employing PVAR, fixed-effects regression and variance decomposition underscores both the commonalities and divergences in their responses to supply-side shocks, fiscal and REER dynamics, expectations, monetary conditions, and trade openness. By comparing these inflation measures, the study provides a significant understanding of inflation dynamics and their manifestations across diverse economic and measurement frameworks.

Among inflation drivers, supply-side shocks emerge as a dominant influence on both CPI inflation and GDP deflator inflation, highlighting a critical area of convergence. In the CPI model, Factor 1 demonstrates a statistically significant positive impact, underscoring its role as a key driver of consumer level price increases. Similarly, the GDP deflator is significantly shaped by supply-side shocks, reflecting their pervasive influence across broader economic price indices. This consistency underscores the critical role of external factors, such as global commodity prices and supply chain disruptions, in shaping inflation dynamics across both measures.

Fiscal stance, REER and GDP growth dynamics exhibit limited direct influence on both CPI and GDP deflator inflation. In both cases, the coefficients are statistically insignificant, reflecting weak or lagged effects of fiscal deficits and monetary policies on inflation. While fiscal and monetary settings remain essential for long-term economic stability, their impact appears to be overshadowed by more immediate external shocks and monetary regimes. Interestingly, for the GDP deflator, the positive but insignificant coefficient suggests a slightly greater influence, possibly due to the inclusion of capital goods and government spending in its scope.

Trade openness and global exposure, representing Factor 3, show a similarly weak short-term impact on both inflation measures. In the CPI model, the coefficient is small and statistically insignificant, suggesting limited direct effects on consumer price levels. However, for the GDP deflator, Factor 3 demonstrates a larger coefficient (though still statistically insignificant), indicating a potentially stronger influence of trade dynamics on overall economic price changes. Over time, variance decomposition reveals that Factor 3 plays an increasingly important role, particularly for the GDP deflator, reflecting the greater sensitivity of economy-wide prices to trade and global conditions.

Inflation's feedback effects on its drivers are weak in both models. CPI inflation demonstrates weak relationships with with Factors 1 and 2, while the GDP deflator shows significant negative feedback on Factor 3. This suggests that inflation in the GDP deflator erodes trade competitiveness and exerts tight monetary policy, a dynamic that is less pronounced in the CPI. The broader economic inclusion of the GDP deflator likely amplifies these feedback effects, capturing export and trade-related adjustments.

Variance decomposition highlights similar patterns for both measures. Factor 1 consistently dominates the explained variance across all horizons, emphasizing the centrality of supply-side shocks. Factor 2 remains a minor contributor in both cases, reinforcing its limited short-term role. Factor 3′s contribution, however, grows significantly over time, especially for the GDP deflator, where trade and global exposure eventually become more significant than Factor1. This highlights the longer-run influence of globalization and trade dynamics on broader price measures.

5. Conclusions and policy implications

This study provides critical insights into the drivers of CPI inflation and GDP deflator inflation. The findings reveal that supply-side shocks, i.e. changes in food and oil prices and supply disruptions, are the dominant drivers of inflation for both measures. These findings highlight the significant vulnerability of economies to external pressures and fluctuations in global commodity prices, underscoring the dominant role of supply-side disruptions in driving inflation. They also emphasize the need for coordinated international policy efforts to mitigate the impact of external price shocks. The fiscal stance, REER, and GDP growth, the core fundamentals of Factor 2, while theoretically significant, exhibit a weak short-term impact on inflation, possibly reflecting the influence of systems and policies. Trade openness, gold price fluctuations, and global exposure, which dominate Factor 3, play an increasingly significant role in GDP deflator inflation over time, highlighting its sensitivity to global economic conditions, while having a slightly lesser impact on CPI inflation.

Additionally, CPI inflation is more susceptible to supply-side shocks than GDP deflator inflation, underscoring households' greater exposure to global economic fluctuations. This highlights the significant impact of external inflationary pressures on consumer welfare and overall household well-being. The limited feedback effects of inflation observed in both measures further reinforce the need to address these drivers directly for effective inflation management. These findings emphasize the interconnected nature of inflation dynamics across different measures and underscore the necessity of tailored policy approaches that account for the distinct drivers and characteristics of CPI and GDP deflator inflation. The weaker and insignificant effects of Factor 2 and Factor 3 suggest that macroeconomic stability and structural globalization play a secondary role in the short term. However, this may also indicate the effectiveness of contemporary monetary regimes in mitigating inflationary pressures.

Robust monetary frameworks and effective inflation-targeting policies may play a crucial role in mitigating the immediate inflationary effects of fiscal policies and trade openness, helping to stabilize price levels. While this study does not directly address seller's inflation, the persistence and magnitude of supply-side shocks observed support the idea of inflation driven by global cost pressures rather than demand-side factors.

To effectively address the challenges posed by supply-side shocks, policymakers should adopt tailored strategies that vary across different time horizons to mitigate their impact on inflation. This involves diversifying energy sources, strengthening food supply chains, and establishing strategic reserves of essential commodities to help stabilize prices during periods of heightened volatility. The COVID-19 pandemic and geopolitical events, such as the Russia-Ukraine war, have shown the critical need for resilient supply chains to mitigate inflationary pressures. Strengthening supply chain resilience requires strategic investments in global infrastructure, support for local production capabilities, and the promotion of regional trade agreements to reduce dependence on specific regions for essential goods.

Furthermore, the findings suggest that while supply-side inflationary pressures are strong, their effects may not be sustained in the long run. The evolving influence of macroeconomic factors, particularly trade openness, money supply, and gold prices, underscores the gradual but significant role of both domestic and global forces in shaping inflation trends, especially for GDP deflator inflation. This highlights the need for policy responses that address both short-term volatility and long-term structural shifts in inflationary trends. Thus, while fiscal and monetary variables have limited short-term effects, their role in shaping long-run inflation variance remains significant and should not be overlooked. Governments must ensure fiscal discipline to prevent inflationary pressures stemming from excessive deficits, while central banks should maintain their independence and credibility to effectively anchor inflation expectations.

Tailored policy responses are essential to address the distinct dynamics of CPI and GDP deflator inflation. For CPI inflation, tools should prioritize domestic price stability, such as targeted subsidies or assistance programs to protect consumers from the immediate effects of global supply shocks. In contrast, managing GDP deflator inflation requires broader policies that consider global trade and export dynamics. Policymakers should consider the trade-off between controlling domestic inflation and maintaining international competitiveness.

In conclusion, this study underscores the importance of understanding the relative contributions of supply-side shocks, fiscal and monetary indicators, economic growth, gold prices, exchange rate and trade openness in shaping inflation. Supply-side disruptions remain the dominant driver, while trade openness grows in importance over time, particularly for GDP deflator inflation. Policymakers must adopt a multifaceted approach that addresses immediate supply-side challenges, strengthens fiscal and monetary frameworks, and builds resilience against global economic disruptions. These efforts will not only stabilize inflation but also foster sustainable economic growth in an increasingly interconnected global economy.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author used ChatGPT by OpenAI to improve readability and grammar. After utilizing this tool, the author carefully reviewed and edited the content as necessary and take full responsibility for the final version of the publication.

CRediT authorship contribution statement

Noura Abu Asab: Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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