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Domestic and External Drivers of Inflation in Oil Importing Developing Countries

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ABSTRACT

This paper explores inflation drivers in 12 oil-importing developing economies, focusing on domestic and external drivers, such as monetary policy rate, government expenditure, global oil prices, exchange rate, imports, global food prices, and other factors. The study aims to establish a hierarchy of these drivers from the most to the least significant, which is essential for a better implementation of anti-inflationary policies in oil-importing developing countries. Using Seemingly Unrelated Regression (SUR) model and second-generation panel unit root test to handle cross-sectional dependence, and applying Dumitrescu-Hurlin panel Granger causality approach to confirm SUR outcomes, this research paper revealed for the period between 2000Q1, and 2023Q2 that lagged inflation is the most important driver of current inflation, supporting the theoretical concept of inertial inflation. Unexpectedly, this study showed that monetary policy rate is positively impacting inflation, confirming the presence of the price puzzle. Additionally, monetary base doesn't have any significant impact on aggregate price level, meaning that the inflation is not a monetary phenomenon for the studied countries. Producer prices, used as a proxy for domestic supply shocks, seemed to have a positive and significant effect on inflation. Government expenditure, trade openness, and global oil prices have notable effects. Even if all the studied countries are oil importers, the impact of oil prices on inflation is mitigated by subsidies and price controls. Finally, inflation is negatively affected by imports and exchange rate. The study underscores the necessity for new central bank tools adapted to these countries context, monetary and fiscal policies coordination, a strategic use of subsidies, and an integrated policy to improve market competition.

Keywords: Inflation Drivers, Oil-importing Developing Countries, Dumitrescu and Hurlin Panel Causality, Monetary Policy, Oil Prices
JEL Classifications: C23, E3, E4, E5, O13, Q31

1. INTRODUCTION

Inflation weakens investor confidence, reduces saving incentives, damages financial and public sector balance sheets, and erodes citizens' purchasing power. Moreover, the consequences of inflation are more severe for poor households because they rely more heavily on wage income, have limited access to bank savings deposits, and generally have limited financial or real assets other than cash (Stantcheva, 2024; Easterly and Fischer, 2001). For these motives, stable and low inflation is typically consistent with better economic activity, financial stability, and poverty reduction. The beginning of the disinflation process in developed countries occurred in the middle of the 1980s, while in EMDEs, it began in the middle of the 1990s (Ha et al., 2023a; Fischer, 2015). In the early 21st century, inflation had globally settled at historically low levels and remained moderate on average until the COVID-19 era.

The role of monetary policies in advanced and emerging countries has been widely discussed in empirical literature as a key factor in price stability, supporting the theoretical view that inflation, in the long term, is a monetary phenomenon (Kamber and Wong, 2020). However, certain aspects of developing countries, such as the relevance of supply shocks, vulnerability to external economic conditions, market inefficiencies, structural constraints and informality could sometimes make non-monetary factors more important in driving inflation, particularly for oil-importing

economies. Furthermore, developing countries characteristics might limit the connectedness between monetary, financial and real variables. For Alberola and Urrutia (2020), informality restrains the access of a part of economic agents to financial services and then leads to weak effect of monetary policy on aggregate prices. Moreover, Binici et al. (2012) found that greater market competitiveness induces a decrease in inflation. However, most of developing countries have less developed markets and weak competition.

Given these points and considering the gaps in the literature, a review of various inflation drivers for oil importing developing countries remains crucial for researchers and policy makers. Thus, this study appears potentially the first to examine both external and domestic drivers of inflation for this specific category of countries in one single article, with the purpose of establishing a hierarchy of inflation factors, based on their impact.

Domestic demand shocks can fuel inflation by boosting consumer spending and increasing demand for goods and services, with inflation expectations playing a key role. Yet, effective competition and well-functioning market mechanisms are essential for mitigating these effects. Whereas national supply disruptions typically comprehend unexpected variations in the availability of products as a consequence of factors including extreme climatic events, workforce disruptions and productivity shifts. The influence of these disruptions on inflation could be temporary or permanent, subject to the shock nature, central bank actions, but mainly on country characteristics, such as trade balance, economic structure and development level, assuming that inflation drivers in net oil developing countries is supposed to be particular.

Latest research contributions have given more attention to the influence of supply shocks on domestic inflation. Baqaee et al. (2024) and Fornaro and Wolf (2023) among others, examined the impact of post COVID-19 supply shocks on inflation. Liadze et al. (2023) studied the impact of supply bottlenecks caused by Russia-Ukraine conflict on inflationary pressures in the global economy.

Regarding external factors, prices could be driven generally by global supply and demand variations, influencing then tradable goods prices, in particular commodities. Globalization has made national inflation more responsive to external shocks, especially oil prices for oil importing economies. Jácome et al. (2009) showed that inflation in developing economies is not only affected by domestic demand, but also by external oil price shocks.

Inflation may be affected directly, but also indirectly, by global oil prices. The direct impact results from the demand factor, as oil is consumed directly by final users. Consequently, when its price increases and when its part in CPI basket is high, inflation will rise. For the indirect impact, Rasche and Tatom (1977) mention that oil products influence general price level theoretically through producer prices as they are considered as inputs. Additionally, increased oil prices reduce purchasing power and then prompting households to seek higher wages. This can result in cost-push inflation, as companies transmit the increased cost to customer's final payable price (Blanchard and Gali, 2007). These mechanisms can be more effective for oil-importing developing countries as long as oil prices could be considered exogenous.

On the other hand, Turner (2016) pointed out that limited sensitivity of exchange rate to global prices could intensify the impact of external prices on national inflation, due to limited exchange regime shock-absorbing capabilities. The majority of countries in this study have a de facto managed exchange rate regime, meaning that exchange rate is less responsive to the international prices and it has low shock-absorbing capabilities, and this framework could intensify the effect of external price variations on national general price level. In addition, understanding how inflation reacts to exchange rate variations is crucial to better study domestic price drivers (Ha et al., 2020). Many structural factors can explain responsiveness of inflation rate to exchange rate variations, like country financial development level, the part of trade invoiced in other currencies, the competition degree among international trade companies (Amiti et al., 2016), composition of trade and the share of imported commodities used as inputs in domestic products (Goldberg and Campa, 2010).

Considering the key inflation drivers partially outlined in this introduction, this study's main objective is to establish for oil-importing developing countries a hierarchy of these drivers from the most to the least significant, which is essential for a better implementation of anti-inflationary policies in the context of this category of countries.

2. LITERATURE REVIEW

2.1. Theoretical Insight

2.1.1. Monetary inflation

One of the earliest theoretical foundations of inflation domestic drivers is the Quantity Theory of Money (QTM). Following this theoretical assumption, monetary stock within an economy is the key factor directly explaining general price variations in goods and services. In 1517, polish mathematician Nicolaus Copernicus (Volckart, 1997) was the first to suggest this hypothesis. With the rise of classical economics, the QTM was used since then as a "veil" that influenced regulators of price level. Economists such as Jean Bodin, David Hume, John Locke, and Milton Friedman later supported it, before being developed by Fisher (1911) and Pigou (1917). Milton Friedman's modern Quantity Theory (Friedman, 1989) asserts that "inflation is always and everywhere a monetary phenomenon" and its source is the faster growth in the supply of money compared to aggregate production.

2.1.2. Demand-pull theory

Following the demand-pull theory, when the added demand of goods and services exceeds the added offer, general price level increases. Often attributed to macroeconomists, the modern formulation of the demand-pull theory gained protrusion with Keynes (1936) famous contribution. Lerner (1946) further developed the demand-pull theory by emphasizing the role of demand in the postwar period, exploring then the implication of its expansion to the inflation and the government policies. Although the theoretical popularity of the demand side as an important driver of inflation, critics argue that factors such as supply shocks can also be significant determinants of inflation.

2.1.3. Cost-push inflation theory

Increases in aggregate price levels can be attributed as well to production cost variations, namely cost-push inflation. Ricardo (1817) emphasized how input costs, particularly wages and rent, could influence price levels. While illustrating the adverse inflation-unemployment nexus, Phillips (1958) underlines the role of wage increase in driving inflation. Krugman (1979) explored trade theories and highlighted how variations in the cost of imports could have implications for the dynamics of price levels and competition.

Obstfeld and Taylor (2003) discussed how globalization can contribute to cost-push inflation by influencing the prices of imported goods. Increased global integration can change production costs and supply chain dynamics. In addition, Mundell (1971) highlighted the role of fiscal policies and regulations in influencing production costs and, consequently, inflation.

2.1.4. Expected inflation theory

The theory of expectations postulates that economic agents form rational expectations on the future inflation, thereby influencing current economic decisions. Muth (1961) introduced the idea that individuals use all the available information about economic variables, such as prices, to make decisions in a rational and forward-looking manner. Lucas (1976) extended this theory by focusing more on the role of individuals in predicting and understanding the future inflation.

2.1.5. Structural inflation

Structural inflation theory, as explained by Canavese (1982), provides a framework to understand the complex links between changes in economic structures, relative price fluctuations and inflation. This theory postulates that general price level variations cannot always be considered purely as a monetary phenomenon and structural changes, such as market structure, agricultural rigidities, public sector reforms and foreign trade policies, could be essential to understanding inflation, especially for transitional economies.

2.2. Review of Empirical Studies

2.2.1. Inflation drivers in developing countries

Anwar (2023) studied the implication of the central banks political independence on inflation in developing economies, and found a strong inverse relationship between these variables for both moderate and high inflation countries. Montes and da Cunha (2018) showed for 82 developing economies that greater public financial transparencies could have an impact on domestic prices and their volatility, especially in countries with inflation targeting framework. For 118 developing economies, Garriga and Rodriguez (2020) examined if legally independent central banks could better stabilize inflation. They showed that a higher degree of independence could result in better control of inflation, specifically in countries with greater levels of democracy. Ha et al. (2019) investigated how core inflation is impacted by external and national inflation in advanced, emerging and developing countries and found that external inflation shocks are the key factors of inflation in developing economies, compared to other groups. For sub-Saharan African economies, Nguyen et al. (2017) showed that supply side factor and exchange rate variations were the main determinants of aggregate price level, beside domestic demand pressures and global crises.

De Mendonça and Tiberto (2017) demonstrated, for a large selection of developing economies, that credible monetary policy can reduce the negative repercussions of exchange rate shifts on inflation, thereby contributing to more stabilized prices. For 153 developed and developing countries, Mazhar and Méon (2017) demonstrated that domestic price level is positively explained by the degree of the informal sector and stated that this evidence is stronger in institutional contexts where monetary policy is less constrained. Ojede (2015) studied inflation drivers in developing economies by comparing productivity and money supply factors. The author found that the main inflation driver is monetary growth.

Nguyen (2015) examined the implications of government spending and the second monetary aggregate for domestic price variations in Asian economies, and concluded broadly that the monetary variable has a significant effect on domestic prices only under Pooled Mean Group model (PMG), whereas the government spending was a robust factor for PMG as well as General Method of Moments model. Kalim (2015) analyzed the external factors affecting inflation in South Asian economies and showed that international food prices and oil prices influence significantly inflation of these countries. Based on a fiscal dominance model presented by Baldini and Poplawski-Ribeiro (2011) for Sub-Saharan African countries, authors provided an evidence on fiscal and monetary factors playing a role in inflation and showed an absence of effective policies to combat inflation for a big part of countries included in their study.

2.2.2. Oil prices, inflation and oil-importing economies

The effect of energy prices, particularly oil, on the aggregate price level has been the subject of non-negligible number of research papers. Bigerna (2024) explored this relationship in the MENA countries by analyzing how exchange rates and energy prices fluctuations could affect asymmetrically domestic inflation after Covid-19 shocks and the Ukraine crisis. Results revealed that changes in oil prices affect inflation asymmetrically. Ha et al. (2023b) highlighted the increasing relevance of oil price shocks in contributing to domestic price levels, particularly in advanced economies and countries with strong financial and trade linkages with the world. Their findings highlighted the contribution of external factors in explaining domestic inflation over time. The complex relationships between energy prices and food prices were studied by Shokoohi and Saghaian (2022) for both oil exporters and importers and found that oil prices effect on food price level is more pronounced over time for economies that export oil, compared to oil importers.

The role of oil prices in inflation expectations in Nordic kingdoms has been explored by Nasir et al. (2020), highlighting nonlinearities in their findings and showing that net oil trade position explains this impact. Authors pointed out the role of political regimes in driving inflation expectations, which has consequences for the formulation of monetary policies.

Raheem et al. (2020) analyzed how domestic prices are reacting asymmetrically to the oil prices, and revealed the importance of nonlinear models for capturing country-specific responses, particularly in oil-importing countries, showing that the reaction is more pronounced following a positive shock. Zakaria et al. (2021) studied as well the influence of external oil price variations on domestic price levels in South Asia, highlighting then asymmetric and permanent effects on inflation. Their findings showed the necessity of assessing non-linearities while evaluating the oil price variations and domestic prices relationships and revealed that the positive effect of oil price variations on national inflation exceeds the impact of their fall.

Lee et al. (2023) pointed out that the geopolitical uncertainty and its implication on oil price variations were affecting the core inflation in United States and China, particularly at a time of geopolitical crisis. Kun (2019) revealed that the asymmetric effect of the variations of oil prices on CPI is more pronounced in oil importing countries. Živkov et al. (2019) highlighted that increasing oil prices for Central and Eastern European countries has a limited direct effect on inflation, but the long-term indirect impact is intense. Babuga and Ahmad (2021) demonstrated that domestic prices respond more strongly to oil price hikes than to oil price drops. Authors noted that this evidence requires a close attention of the monetary authorities of sub-Saharan Africa. Salisu et al. (2017) showed that inflation for oil-importing economies is explained by variations in oil prices in the long term and found asymmetric results for oil exporting countries.

2.2.3. Economic openness and inflation

Carluccio et al. (2023) quantified the effect of French imports from countries with low wages on inflation between 1994 and 2014, and found that it reduced inflation by 0.02% per year. Gao et al. (2024) studied the impact of trade-weighted average of the domestic output gap, used as a proxy for globalization, and trade openness on inflation for 15 emerging economies. Results showed that trade openness contributes more to inflation, compared to globalization. Di Giovanni et al. (2022) examined the implications of coronavirus crisis for inflation in Euro Area and found that global supply chain pressures explained inflation more than domestic aggregate demand shocks. Chhabra et al. (2022) evaluated, for BRICS economies, the impact of trade openness on aggregate price level variations and concluded that the adoption of less restrictive trade policy is required in order to contribute to lower inflation.

Park and Son (2022) showed that domestic currency depreciation and high dollarization contribute to inflation, especially for dollarized countries. Romer (1993) emphasized that the degree of openness is strongly and negatively linked to the aggregate price level. Samimi *et al*., (2012) examined Romer's finding and, instead, revealed that trade openness influences positively price level variations.

2.2.4. International food prices and domestic inflation

Abaidoo and Agyapong (2022) studied the relationships between global commodity price variations and domestic prices for 32 Sub-Saharian African economies. They showed than most commodity prices affect significantly inflation. Peersman (2022) examined the implications of global food price variations on Euro area domestic price level. The study found that price indexes are strongly affected by food price shocks, explaining an average 25-30% of inflation volatility. Furceri et al. (2016) showed that driving force of global food prices in explaining inflation for advanced countries has declined over time, compared to emerging economies. Ferrucci et al. (2018) found for Euro Area that commodity prices were the main factor of consumer price variations. Gelos (2017) showed how structural characteristics and policies influence domestic inflation during international commodity price shocks.

3. METHODS

3.1. Data and Variables

This research relies on a selection of 12 oil-importing developing countries from four various continents. It includes Armenia, Indonesia, Jordan and the Philippines from Asia; Morocco and South Africa from Africa; Chile, Paraguay and Uruguay from South America; and Costa Rica and El Salvador from Central America. These economies are considered as developing countries following United Nations Department of Economic and Social Affairs (2023). Their identification as oil-importing countries was carried out by reviewing net oil exports, based on national accounts. The sample period is from 2000Q1 to 2023Q2, with quarterly frequency.

After exploring the literature review above, the following variables were selected to study the domestic and the global determinants of inflation (Table 1).

3.2. Cross-sectional Dependence in Panel Models

To avoid spurious estimation results in panel models, implementing Cross Section Dependence (CSD) tests is a crucial step, as highlighted by Baltagi et al. (2007). The likelihood of substantial CSD in errors is widely emphasized in the existing body of literature on panel data. Notable contributions in this area have been made by Baltagi (2008), Pesaran (2004), Anselin (2001) and Robertson and Symons (2000), who pointed out that this dependence can arise from unobserved components incorporated into the error term, notably common shocks, geographical interdependence, and personalized dyadic association without a discernible pattern of shared components or geospatial correlation. More accurately, the growth of economic globalization and international trade between nations in the previous decades has heightened interdependencies among cross-sectional units, making cross-sectional dependence a prevalent issue in panel data for macroeconomic studies. Factors such as shared trade patterns, similar values in activities, concurrent national developments, parallel advancements in innovations and technologies, and consistent positions in financial developments often contribute to cross-sectional dependence challenges. Therefore, overlooking CSD in panel data analysis would be a significant oversight. Cross-sectional dependence can be also present in microeconomic area. Thus, some factors like similar choices, neighborhood influences, cultural habits and social imitations can lead to a similar reaction of individuals to common shocks.

Phillips and Sul (2003) emphasized the consequences of disregarding the presence of substantial CSD and showed that the resulting reduction in estimation efficiency can render pooled

Table 1: Description of each variable

Variables	Symbols	Measurement	Data source
Inflation	π	Consumer Price Index variation (%)	International Financial Statistics-IMF
Producer prices	*Pi*	Price Producer Index (PPI)	International Financial Statistics-IMF
Monetary policy interest rate	*Pr*	Central bank policy rate[1] (%).	National central bank data
Monetary base	*mb*	Value of currency circulating in the economy in addition to reserve balances of banks held at the central bank, expressed in national currency.	International Financial Statistics-IMF
Output gap	*Og*	Its measure is computed for each nation in the sample separately using the conventional univariate Hodrick-Prescott filtering approach. The conventional smoothing parameter λ, set to 1600, is applied to all accessible quarterly GDP data.	International Financial Statistics-IMF for GDP, own calculation.
G		Government expenditure, national currency.	National accounts
Exchange rate	*Er*	Nominal effective exchange rate (NEER).	Bruegel database[2] (Darvas, 2012)
Imports	*im*	Total amount of goods and services imports, US dollar.	IMF direction of trade statistics
Trade openness	*To*	Total exports and imports as a share of GDP	IMF direction of trade statistics
International oil prices	*Sc*	Average value of West Texas Intermediate, UK Brent and Dubai crude oil indexes.	IMF Primary Commodity Price System
International food prices	*f*	IMF international food commodity price index	IMF Primary Commodity Price System

Source (s): Own elaboration

OLS estimates inefficient. This finding is noteworthy as it suggests that if pooling a homogeneous population of cross sections while ignoring cross section dependence, the expected efficiency advantages over individual OLS regressions for every cross section might be significantly compromised.

Three main tests are commonly employed to assess CSD. The first, formulated by Breusch and Pagan (1980) and called Lagrange multiplier (LM), is extensively applied in empirical studies. The LM test applied to panel data is particularly suitable when sample units (N) surpasses time periods (T). The second method is the modified LM test, introduced by Pesaran (2004), designed to be used when both T and N are large. For a small T compared to N, Pesaran (2004) developed another test known as the Pesaran CD (De Hoyos and Sarafidis, 2006).

For this study sample, the Breusch-Pagan (1980) test is deemed appropriate, given the larger value of T (94 quarters) compared to N (12 countries). It is constructed on the correlation coefficients of paired data:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2$$

Lagrange Multiplier distribution is asymptotic as χ^2 and has 1/2 [N (N − 1)] DF. Under $H_{0:}$

$$T\hat{\rho}_{ij}^2 \sim \chi_1^2$$

$\hat{\rho}_{ij}$ is the estimated pairwise correlation of residuals from the sample, expressed as:

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} e_{it}e_{jt}}{\left(\sum_{t=1}^{T} e_{it}^2\right)^{1/2}\left(\sum_{t=1}^{T} e_{jt}^2\right)^{1/2}}$$

e_{it} is the estimated u_{it} using OLS, as follows

$$e_{it} = y_{it} - \hat{\alpha}_i - \hat{\beta}_i' x_{it}$$

$\hat{\alpha}_i$ and $\hat{\beta}_i$ are the OLS estimators of α_i and β_i, regressing y_{it} on x_{it} and intercept. The order of cross-section units is not required by LM test. Under the H_0, which is the absence of cross-sectional dependence, and for large T and small N:

$$Cov\ (u_{it}, u_{jt}) = 0$$

For large N, Lagrange Multiplier method can't be applied.

3.3. Second Generation Unit Root Testing for Panel Data

Cross-Section Dependence (CSD) test outcomes have an implication on the choice of the suitable panel unit root test when examining stationarity. Standard unit root tests, like Augmented Dickey-Fuller, are no longer suitable if CSD is present in the study. Consequently, after running the CSD test (Table 2 below), this study opted for Pesaran (2007) panel unit root's second-generation testing methods, called CS Augmented IPS and CS Augmented Dickey-Fuller, in the respective order CIPS and CADF. These tests offer a more appropriate assessment of both cross-section dependence and heterogeneity. The econometric expression for the CADF statistics, assuming homogeneous non-stationarity under the null hypothesis (H_0), is as follows:

$$\Delta v_{it} = \alpha_i + \beta_i v_{i,t-1} + \delta_i \bar{v}_{it-1} + \lambda_i \Delta\bar{v}_{it} + \varepsilon_{it}$$

In this context, where $\bar{v}_{it-1}$ expresses the cross-sectional average of lagged variable, and $\Delta\bar{v}_{it}$ represents its current first difference, the CS Augmented IPS test is expressed as the cross-sectional mean of each CADF):

1 El Salvador adopted dollarization in 2001, then the central bank policy rate is replaced by nominal interest rate for this country.

2 Darvas (2012).

Table 2: Cross sectional dependence test

Breusch-Pagan LM tests in panel variables								
Test components	**LCPI**	**LG**	**Lim**	**Lmb**	**LEr**	**LPPI**	**LTo**	**Og**
CSD test statistics	5819.567*	4095.592*	4962.008*	4714.788*	1749.80*	3716.20*	4204.01*	1139.10*
Total panel observations	1104	1010	1036	1039	1128	1016	1054	1089

Significance level * indicates P<0.01. Null hypothesis: No cross-section dependence

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} t_i(N,T), \text{ with } t_i(N,T) = CADF$$

3.4. Seemingly Unrelated Regression Model

To decide on the suitable model for this study, several aspects need to be considered. First, in this study we have a dynamic panel model because it includes a lagged dependent variable[3], represented by inflation in the model specification. Lagged inflation allows to consider temporal dependencies in the data analysis. Second, this study comes across a situation where the time periods (T) surpasses of cross-section units (N). Third, the data shows cross-sectional dependency due to significant economic similarities among the countries in our sample. Being oil-importing nations, belonging to developing economies, and experiencing external shocks, are some of the main characteristics shared by these countries.

Generalized Method of Moments or GMM, introduced by Arellano and Bover (1995), is the extensively employed dynamic Panel model when it comes to include lagged dependent variable. However, when cross-sections (N) are less than time periods (T), this method becomes less suitable due to its requirement of N being larger than T (short panel). Roodman (2009) states that when T outnumbers N, the GMM estimating robustness may face issues in terms of residuals of first differences due to their autocorrelation. For Samargandi et al. (2015) also, the GMM estimator may yield spurious estimations when T exceeds N.

On the other hand, the Panel ARDL (PMG) model, while applicable when T > N, as denoted by Christopoulos and Tsionas (2004), faces limitations in scenarios involving cross-sectional dependencies.

In such cases, where T exceeds N and the sample is cross sectionally dependent, Pesaran (2004) emphasizes the relevance of the Seemingly Unrelated Regression Equations (SURE) framework (Greene, 2003). Zellner (1962) pioneered the development of this model and subsequently, several evaluations of its efficiency have been conducted, including those by Alaba et al. (2010), Fiebig (2001) and Binkley and Nelson (1988).

SUR model offers a statistically robust solution for modeling and testing cross-correlations of errors in dynamic panel settings, addressing then the challenges posed by our data structure, as outlined in Chudik and Pesaran (2013). The SURE method computes various time series for different countries, and are subsequently adjusted by the covariance matrix of the disturbance. Pesaran (2006) introduced an original approach consisting of the Common Effect Estimation. However, this method assumes a large value for N, whereas in our dataset, N equals 12. The basic specifications of the SUR system of equations used in this study are as follows:

$$\pi_{1,t} = \alpha_1 + \beta_{1,1}\pi_{1,t-1} + \beta_{2,1}Pr_{1,t} + \beta_{3,1}mb_{1,t} + \beta_{4,1}Og_{1,t-1} + \beta_{5,1}pi_{1,t-1} + \beta_{6,1}Er_{1,t} + \beta_{7,1}To_{1,t} + \beta_{8,1}G_{1,t} + \beta_{9,1}im_{1,t} + \beta_{10,1}Sc_{1,t-1} + \beta_{11,1}f_{1,t} + \varepsilon_{1t}$$

$$\pi_{2,t} = \alpha_1 + \beta_{1,2}\pi_{1,t-1} + \beta_{2,2}Pr_{2,t} + \beta_{3,2}mb_{2,t} + \beta_{4,2}Og_{2,t-1} + \beta_{5,2}pi_{1,t-1} + \beta_{6,2}Er_{2,t} + \beta_{7,2}To_{1,t} + \beta_{8,2}G_{2,t} + \beta_{9,2}im_{2,t} + \beta_{10,2}Sc_{t-1} + \beta_{11,2}f_{2,t} + \varepsilon_{2t}$$

$$\pi_{12,t} = \alpha_1 + \beta_{1,12}\pi_{12,t-1} + \beta_{2,12}Pr_{12,t} + \beta_{3,12}mb_{12,t} + \beta_{4,12}Og_{12,t-1} + \beta_{5,12}pi_{12,t-1} + \beta_{6,12}Er_{12,t} + \beta_{7,12}To_{12,t} + \beta_{8,12}G_{12,t} + \beta_{9,12}im_{12,t} + \beta_{10,12}Sc_{12,t-1} + \beta_{11,12}f_{12,t} + \varepsilon_{12t}$$

Where π denotes inflation, *Pr* stands for monetary policy interest rate, *mb* represents monetary base, *Og* defines Output Gap, *pi* denotes PPI, exchange rate is represented by *Er*, *To* indicates Trade openness, *G* stands for government expenditure, *im* means imports, *Sc* represents international oil price (Spot crude) and *f* denotes international food price.

SUR incorporates adjustments in light of the potential simultaneous correlated error terms and heteroskedasticity in the model. When estimating parameters, as described in the system of equations, a common practice is to use the Ordinary Least Squares (OLS) technique independently for every regression equation. SUR model represents a system of linear equations, and every equation within the model possesses its unique parameter vector denoted as βi, indicating their independence from one another.

The estimator in classical SUR model that is generally used to allow for heteroscedasticity and contemporaneous correlation, would be the Feasible Generalized Least Squares (FGLS). Using FGLS on this system of equations will give consistent and efficient estimates of the coefficients regardless if the disturbances are spatially correlated or not. Baltagi (2008)[4] covers an excellent discussion about SURE models and the FGLS estimator as a way to deal with correlated disturbances (Wooldridge, 2010). Since FGLS estimator accounts for the correlation structure, it is able to provide valid statistical inference on the coefficients of the equations forming one system.

3.5. Robustness Check by Dumitrescu and Hurlin (DH) Approach

For more robustness, this research paper relies on a methodology

3 Dynamic models incorporating lagged dependent variables tend to offer superior data explanation, yield more accurate coefficient estimates, and exhibit reduced susceptibility to autocorrelation issues. Additionally, employing lagged inflation as an independent variable presents a compelling rationale, as it possesses the capacity to impact current inflation.

4 See also Wooldridge (2010).

formulated by Dumitrescu and Hurlin (2012) to explore causal interactions in panel analysis. Their method allows for different results across different groups, adjusting all the factors accordingly. It also deals with how different groups might affect each other by using values from a special process called the bootstrap block. DH approach is suitable whether there are more time periods (T) than cross-sections (N) or vice versa, as highlighted by Su et al. (2021). One big advantage is that it can handle situations where different groups influence each other in panel data, which was pointed out by Dogan and Seker (2016). Moreover, it fixes issues with assuming everything is the same across groups. By running Monte Carlo methods, DH approach authors showed that this method gives reliable results even when data is limited and different groups influence each other. Thus, this study uses Dumitrescu and Hurlin's approach to confirm SUR model estimation results.

Dumitrescu and Hurlin (2012) have built upon Granger's (1969) method to evaluate causality in panel data, employing the following equation:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{k} \beta_k y_{t-k} + \sum_{k=1}^{k} \gamma_k x_{t-k} + \varepsilon_t$$

Given that *y* is inflation, and *x* is domestic and external drivers of inflation vector. Causality testing method of Dumitrescu and Hurlin uses F-tests to evaluate the significance of the causal relationships between variables in panel data. These F-tests are employed to assess whether we can reject the H_0 of no causality to accept the alternative H_1, that indicates the existence of causality. This null hypothesis is as follow:

$$H_0: \gamma_{i1} = \ldots = \gamma_{ik} = 0 \ \forall_i = 1, \ldots\ldots, N$$

Given these conditions, the Wald statistic mean takes on the following form:

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T}$$

W_i, There represents the individual Wald statistic.

4. RESULTS

To check for cross-section dependences, the LM test was first applied to all variables as follows in Table 2.

Table 2 findings indicate that all the statistical values were significant at 1% level of significance, meaning that variables are sectionally dependent. This could be due to common economic characteristics between countries of the sample, since they are all developing countries and oil importers, they could have then common shocks and sometimes same policy reactions to external shocks. This test can't be applied to international oil prices and international food prices, as their corresponding series remain unchanged across sections.

Due to cross section dependence that has been found in all the variables of this research, there is no need to run models like FEM, REM, Pooled OLS, Panel ARDL since they can't deal with this issue. Furthermore, as mentioned in section 3.3, to test for panel unit root, CSD outcomes showed in Table 2 drive us to apply second generation panel unit root method.

The Pesaran-CIPS tests outlined in Table 3 explore the stationarity of variables in both levels and first differences, after addressing cross-sectional dependence. All variables, except Output Gap, international oil prices and international food prices, show non-stationary behavior in levels, as indicated by t-statistics. However, following the insights from econometric pioneers such as Nobel Prizes Clive Granger and Robert Engle[5], who emphasized the importance of differencing variables to achieve stationarity, applying first differences transforms these variables into stationary processes, aligning with the I(1) integration order (Phillips and Sul, 2003; Hamilton, 2020; Hsiao, 2022).

As developed in section 3, to have robust and unbiased results, this study applies Seemingly Unrelated Regression in Table 4. Table 5 confirms that cross-sectional dependence problem is fixed after running SUR model.

Outcomes of Cross-section SUR with Panel Corrected Standard report that the lagged inflation significantly and positively impacts current inflation, indicating that higher inflation in the previous quarter is accompanied by a rise in inflation of the current quarter. For monetary sphere, the official central bank rate is surprisingly and significantly having a positive impact on inflation. As for monetary base, it has no significant impact on inflation, suggesting then that inflation, in the context oil-importing developing economies, is not a monetary phenomenon.

The lagged output gap has a positive and statistically significant coefficient, indicating that a higher output gap in the previous period is accompanied by a rise in current inflation. Producer prices have significant and positive impact on domestic prices, for both current and lagged coefficients. Inflation is also affected significantly by current global oil price level, with a positive and moderate coefficient. This impact becomes negative after one quarter. From the other side, global food price variations impact is insignificant. Trade openness is positively associated with inflation, meaning that more open trade policies tend to lead to higher inflation. Government expenditure affects significantly and positively on inflation, but the coefficient is not too high. Finally, imports and nominal effective exchange rates are affecting negatively and significantly inflation.

Panel causality tests are used in this study to get more robust results, by applying the Dumitrescu and Hurlin (2012) approach, specifically for independent variables that were confirmed in the SUR model with statistically significant coefficients. Hence, findings in Table 6 show that output gap, international oil prices, price producer index, imports, trade openness and exchange rate are all considered proven drivers of inflation at a 1% significant level.

5. DISCUSSION

5 See Hamilton (1994), Phillips and Sul (2003) and Hsiao (2022).

Table 3: 2nd generation panel unit root test results

Panel unit root test with CSD: Pesaran-CIPS					
Variable in Log	t-stat in level		t-stat in first difference		Order
	Constant	Constant and trend	Constant	Constant and trend	
CS augmented IPS					
LCPI	−1.67799	−2.63719	−4.99412***	−5.50958***	I (1)
LPPI	−1.78334	−2.59766	−4.89273***	−4.86020***	I (1)
Og	−3.00106***	−3.10178***			I (0)
Lgov_cons	−2.47218**	−2.16240	−4.99852***	−5.83073***	I (1)
Lpolicy_rate	−1.91497	−2.32625	−4.90868***	−4.95000***	I (1)
LTo	−0.97621	−1.57135	−4.41270***	−4.66321***	I (1)
LEr	−1.44609	−2.83428**	−6.24714***	−6.38758***	I (1)
Lim	−1.80202	−2.03495	−6.07738***	−5.38969***	I (1)
Lmb	−2.09284	−2.38196	−4.84108***	−5.47837	I (1)
LSc	−7.524832***	−7.517813***			I (0)****
Lf	−7.270623***	−7.272894***			I (0)****

Significance levels *, ** and *** are indicating P<0.10; P<0.05 and P<0.01 in that order. **** is indicating ADF test

Table 4: Cross-section SUR with panel corrected standard results

Method: Panel estimated generalized least squares			
Cross-sections included: 12			
Dependent variable: DLCPI			
Variables	Coeff.	S. E	t-Statistics
DLCPI (−1)	0.407735***	0.029560	13.79340
DLmb	0.001014	0.003414	0.297162
Og (−1)	0.105628***	0.018247	5.788711
DLPPI	0.077472***	0.011265	6.876976
DLPPI (−1)	−0.017917*	0.010853	−1.650972
DLEr	−0.075615***	0.008454	−8.943919
DLTo	0.025947***	0.005234	4.957793
LSc (−1)	−0.013886***	0.002692	−5.158516
LSc	0.015427***	0.002832	5.447362
Lf	−0.003286	0.003426	−0.959091
DLG	0.005449***	0.001819	2.995489
DLim	−0.024455***	0.005014	−4.877307
C	0.018813	0.016200	1.161314
S.E. of regression			0.975672
F-statistic			49.72988
Probability (F-statistic)			0.000000

Significance levels * and *** indicate respectively P<0.10 and P<0.01

Table 5: Breusch-Pagan LM test in seemingly unrelated regression model

Residual cross-section dependency test			
T: 84			
N: 12			
Observations : 870			
Test	Statistics	d.f.	Probability
Breusch-Pagan LM	17.96308	66	1.0000

Null hypothesis: Absence of CSD in weighted residuals

Table 6: Dumitrescu and Hurlin causality testing

Null hypothesis "A⇒B": A does not homogeneously cause B					
A		B	W-statistics	Zbar- statistics	Lag
Og	⇒	DLcpi	9.13911*	11.6816	2
LSc	⇒	DLcpi	7.29071*	8.64952	2
DLPPI	⇒	DLcpi	7.72830*	9.30918	2
DLim	⇒	DLcpi	7.56468*	9.05685	2
DLTo	⇒	DLcpi	6.56344*	2.79816	4
DLEr	⇒	DLcpi	8.60096*	3.52377	5

Significance level * indicates *P*<0.01

5.1. Theoretical Implications

Starting with the domestic drivers of inflation, this study reveals two unexpected results. The first evidence is that lagged inflation significantly explains current prices, and its coefficient is the highest compared to other factors. This finding, not widely discussed in mainstream economics, could be associated with an uncommonly debated theory called inertial inflation (Bresser Pereira and Nakano, 1987). This concept, also known as inflation inertia, addresses a phenomenon that wasn't directly clarified by either monetarist or Keynesian economic theories. Inertial inflation occurs when prices keep rising due to the past inflation, even when other traditional factors from supply or demand sides are not present. When prices rise, leading to an increase in living expenses, economic agents pass these cost increases onto the prices they set as they seek additional income. Thus, it arises from the tendency of economic actors to adjust their prices in response to persistent inflationary pressures. According to this hypothesis, inflation is largely driven by its own history and economic policy actions taken to manage inflation pressures are supposed to be ineffective due to the unresponsiveness of price level variations to demand. Furthermore, if there is an optimal level in setting prices with an anticipatory approach and there is price stickiness, firms could optimally rise prices in advance because of their expectation of higher inflation due to its previous increase.

The second unconventional evidence, which also differs from common findings in the dominant empirical literature, is that the statistically significant effect of the central bank policy rate on inflation is positive, rather than negative. This uncommon positive influence of monetary policy rate on current aggregate price variations is called the "price puzzle" (Christiano et al., 1994; Bernanke and Blinder, 1992). This evidence is considered as a puzzle given that, theoretically, tightened monetary policies are supposed to be resulting in a decrease in inflation. Two possible explanations can be advanced in this regard. Primarily, relatively high levels of current and anticipated domestic price variations trigger the central bank's systematic reaction of increasing its official interest rate, nonetheless, not to a sufficient degree to entirely counterbalance the resulting inflation. This can be more

factual when central bank reacts to inflation, generated by a decrease in aggregate production, by increasing the policy rate to stabilize prices, but the effect could be not too significant compared to the possible aggressive impact of supply shocks which could outweigh the resulting effect of monetary authority's reaction. The second explanation of this referred positive impact could be the cost channel. When the impact of interest rates on firm production costs is more important than its resulting aggregate demand negative impact, the evaluated statistical response of inflation to an interest rate hike could be positive. A widening corpus of literature has explored that central banks measures not only influence aggregate demand, but have also effects on economic variables through the supply side. Thus, a rise in interest rates could result in price increases in the short run. Seelig (1974) presents the perspective that production costs can be influenced by interest rates, leading to increased firms' cost of capital and then could be transmitted to the overall aggregate price level.

Regarding the other domestic driver of inflation from the monetary sphere, price level appears to be unaffected by the monetary base, which means that inflation in the studied oil importing developing economies is not a monetary phenomenon. This evidence might be attributed to the prevalence of informal markets in developing countries, compared to developed economies. Therefore, a significant part of economic transactions is handled outside the formal banking system, meaning that the direct impact of monetary base variations on aggregate demand could be weak, limiting thereby its transmission to inflation. Moreover, due to informal sector size and underdeveloped financial systems in developing economies, a substantial part of society cannot obtain bank loans.

In light of the statistically significant impact of government expenditure on inflation, it suggests that increased public demand is not fully met by a corresponding increase in production. This evidence can be linked to market structure and characteristics of the majority of developing countries. The latter have generally oligopolistic or monopolistic markets and these circumstances reduce competitive pressures. Firms respond then to increased public demand by raising prices, due to their market power. Furthermore, government expenditure in these countries can be directed towards areas that do not contribute significantly to productive capacity. When increased public demand is not productive, the mismatch between demand and supply leads to higher prices. The previous evidence aligns with the other result of this study, as highlighted by the positive and statistically significant impact of lagged output gap on inflation. This positive implication indicates that aggregate demand pressures are not sufficiently absorbed by aggregate production expansion.

For the domestic supply side drivers of inflation, the price producer index is showing a statistically significant impact on inflation. This price variations effect from the seller or the producer side means that increased production cost is transmitted to the final consumer price, leading then to higher prices of finished goods and services. Changes in PPI can be an early indicator of potential future changes in CPI. For example, when the cost of raw materials rises for producers, it might lead to higher prices for consumer goods. This result is also consistent with the cost push inflation theory underlined in section 2, as well as the price puzzle discussed above.

Regarding the external drivers of inflation and starting with global oil prices, their statistical impact is significantly positive, but with a moderate coefficient. The effect of external oil price variations on domestic inflation is reduced even if the countries are all oil importers. One of the main reasons of this reduced impact could be the implementation of subsidies and controls on domestic fuel prices by some oil-importing developing countries. Governments may absorb a portion of the international price increase to shield consumers from higher costs. This policy can help stabilize domestic prices and reduce the immediate effect of external oil price fluctuations on national inflation. Appendix 1 explores several examples of government policies regarding subsidies and price controls in some of the countries included in this study.

Results show that global food prices don't explain domestic inflation as their impact is insignificant. In this regard, the majority of countries in this study are food importers, governments are then implementing important subsidies and price controls on essential food items to stabilize domestic prices and to preserve consumers from international food price fluctuations. The cost of production for farmers can be directly impacted by subsidies on inputs like fertilizers or seeds, so cultivate crops can find it more affordable. There is also direct financial assistance provided by the governments to producers or consumers to lower the cost of food production or purchase.

In terms of the implications of exchange rates on current aggregate prices, we have a moderate and significant exchange rate pass through (ERPT) on inflation. The stated result may be explained by some country features that restrain ERPT. Several developing economies generally pursue controlled exchange rate policies, due to their aversion to floating regimes (Calvo and Reinhart, 2002). The majority of countries in this study have a de facto managed exchange rate regime[6]. Under this regime, the currency value is stabilized by central banks in foreign exchange markets by buying or selling their own currency. Central banks can then counteract excessive volatility. This intervention can dampen the immediate effect of variations in exchange rates on inflation.

On its side, trade openness shows a significant and positive implication on inflation. This evidence illustrates how domestic prices can be explained by greater integration into global markets, due to factors like increased demand. Foreign demand could increase due to growing exports and prices can rise when supply doesn't react fully to this increased foreign demand.

Finally, inflation is affected significantly and negatively by imports but the coefficient is low. Due to the availability of cheaper imported goods, which increases competition in the domestic market, imports could lower inflation because domestic producers could reduce their prices to handle competition pressures. Greater market efficiency can be fulfilled as a result of increasing imports, when the latter introduce new products and technologies,

6 Except for Armenia, Chile, and South Africa, which have floating regimes, and El Salvador, which has official dollarization.

improving the overall productivity of the domestic market, and contributing to lower prices through better supply chain dynamics.

5.2. Monetary and Fiscal Policies Implications

The results presented and analyzed in the last two sections have important policy implications for central banks, as they are the primary institutions responsible for dealing with price instability. When inflation is predominantly explained by its lagged values rather than by monetary factors, relying too heavily on monetary restrictions to combat inertial inflation could lead to stagflation. Moreover, if aggregate price level is also driven by exogenous production disturbances, particularly by global oil price increases for oil-importing developing countries, contractionary monetary policy measures implemented by the central bank to stabilize prices could only amplify the supply contraction without having a significant impact on inflation, particularly when it is not primarily driven by changes in the money supply (Barsky and Kilian, 2001). This implication is further supported considering the presence of the price puzzle in this research. The central bank's capacity to control inflation in the context of developing countries could also be more reduced when the extent of supply disturbances is considerable. To avoid procyclical effects of monetary policy, central banks must evaluate inflation drivers permanently. Thus, if inflation is driven by non-monetary factors, a coordinated approach with fiscal authorities should be planned.

Subsidies could contribute substantially to the stabilization of prices. However, a significant and persistent increase in international oil prices could significantly impact public budgets of oil-importing countries. This pressure could motivate these countries to start the process of liberalizing public finances, which can have negative consequences on social pressures, especially in developing countries, given the importance of subsidies in mitigating inflationary pressures (Choi et al., 2018). These countries can, however, implement a tax system that reduces social inequalities, such as wealth taxes, to finance oil price subsidies.

5.3. Limitations and Future Research Agenda

This research paper's finding highlight various avenues for further exploration. Analyzing developing and developed economies, as well as importing and exporting countries, could enhance comprehension of how inflation drivers vary across economic contexts. Additionally, this study identifies pertinent subjects for investigation, such as the effect of international prices on subsidies and their sequential impact on inflation. Subsequent research could delve into the nonlinear relationships between supply shocks and inflation and might examine the price puzzle using asymmetric methods to understand how interest rate cuts and hikes could affect prices differently. Valuable insights could be obtained by exploring also the cost channel and its implications for production costs.

6. CONCLUSIONS

An analytical investigation of the domestic and external inflation drivers within the framework of oil importing developing countries was carried out by the present study, using a robust methodological approach that addresses cross-section dependence and stationarity issues inherent in panel data. By employing the Seemingly Unrelated Regression model and the causal effect testing approach of Dumitrescu and Hurlin (2012), the findings offer new insights into the inflationary dynamics within these economies.

Key findings reveal that consumer price index variations in oil importing developing economies is heavily explained by its historical levels, which means that lagged inflation could significantly predict current inflation, underscoring the importance of inertial inflation, a phenomenon not thoroughly explained by traditional economic theories. Furthermore, the unexpected positive link between monetary policy and inflation rates, known as the "price puzzle," has been found in this study, indicating that central bank interventions in these economies may not always have the intended negative expected effect of controlling inflation, particularly when supply-side factors exist. Eventually, producer prices, often used as an indicator of domestic supply shocks, appear to have exerted a positive and significant impact on inflation.

This research paper also highlighted the limited impact of monetary base variations on inflation, which may be attributed to the significant role of the informal sector and limited access to bank financing in developing economies. Furthermore, government expenditure is influencing positively and significantly aggregate price level variations, which could be due to non-productive public demand. At the same time, global oil price variations and trade openness, identified as external factors in this study, play also a non-negligible role in driving inflation. However, the impact of international food prices appears to be mitigated by government subsidies and price controls, which are common in these countries.

Results suggest in summary that monetary policy alone may be insufficient to combat price instability in oil importing developing economies, particularly when it is inertial and driven by supply-side factors. Subsequently, price stability could require new central bank tools adapted to these countries context, monetary and fiscal policy coordination, a strategic use of subsidies, and an integrated policy to improve market competition.

Finally, this research paper opens up the way to explore new studies, such as the supply disruptions nonlinear impact on domestic prices, the cost channel driving force of inflation dynamics, the repercussions of inertial inflation on monetary transmission channels and the comparison between inflation drivers across oil net-importing and oil net-exporting countries.

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APPENDIX

Appendix 1: Selected illustrations of fuel subsidy and price stabilization policies

Country	Policies/Actions
Chile	• Introduced two price-stabilization funds for petroleum products in 1991 • Objective: Cushion economy against oil price fluctuations • Countercyclical function: Subsidize domestic prices when world prices are high and tax sales when prices are low
Costa Rica	• Eliminated taxes on diesel in June 2008 • Switched the levy to gasoline to protect vulnerable populations from surging oil prices
El Salvador	• Adopted various measures to combat inflationary pressures, including fuel price subsidies
Indonesia	Subsidies on fuel and liquefied petroleum gas are adopted as part of energy policy
Jordan	• Started to eliminate subsidies on high-quality gasoline, diesel, and kerosene since 2012 • Partially cut subsidies on liquefied petroleum gas
Morocco	• Had large subsidies on gasoline and fuel oil • Started to significantly cut diesel and gasoline subsidies to repair public finances since 2015 • Started to cut partially natural gas subsidies in 2024
South Africa	Considerable historical support from the government in terms of direct and indirect subsidies in the liquid fuels industry are adopted

Source (s): Own elaboration