Determinants of Inflation in EU Member States: A Dynamic Analysis of Cost-Push and Demand-Pull Factors

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Abstract

This study examines the determinants of inflation in EU member states from 2014 to 2024 using quarterly data for old EU, new EU, and full EU27 country groups. A dynamic panel ARDL model estimated with the Pooled Mean Group estimator is applied to capture short-run dynamics and long-run relationships. The results show strong inflation persistence across all groups, with lagged inflation as a key short-run driver. Inflation is mainly explained by external and supply-side factors rather than domestic demand. Energy prices, exchange rates, food prices, and supply chain pressures have significant effects, while unemployment and industrial production remain largely insignificant, indicating a weakened Phillips curve relationship. Interest rates show a negative long-run effect in the full EU sample. New EU member states are more sensitive to external shocks, while old EU members display more stable inflation dynamics.

Keywords: *inflation, ARDL, cost-push factors, European Union, PMG estimator*

JEL Classification: E31, E52, C23, F41, Q43

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Introduction

What were the key forces driving the surge in inflation across Europe during 2022 – 2023? Why did inflation rates vary significantly among European Union (EU) member states? And what should an optimal monetary policy look like for the euro area moving forward? While we do not claim to offer definitive answers to these complex questions, this study identifies important patterns and transmission mechanisms behind the elevated consumer prices observed in all 27 EU member states between 2021 and 2023.

Even by the first half of 2024, some EU countries (such as Croatia and Estonia) continued to struggle with anchoring inflation expectations. The inflationary trend began in late 2021, marking a sharp increase in consumer prices. A comparable inflationary episode occurred more than a decade earlier, during 2007 – 2008. At that time, inflation was driven largely by a global food crisis and soaring prices of energy and raw materials amid robust global economic growth.

Despite some surface-level similarities, the two inflationary periods differ in several ways. The 2007 – 2008 price surge was partly driven by China's accelerated industrialization and massive rural-to-urban migration, which significantly increased global demand for raw materials. Domestically, inflation was further fueled by rising demand and growing unit labor costs.

In contrast, the most recent inflation spike was heavily influenced by geopolitical disruptions (particularly Russia's invasion of Ukraine), which led to skyrocketing energy and commodity prices, especially for food and fuel. The EU was particularly vulnerable due to its dependence on Russian oil and gas. The energy crisis pushed inflation to levels not seen since the oil shocks of the 1970s and 1980s. Energy prices became the primary source of divergence in inflation rates across euro area countries, influenced by varying degrees of energy price regulation, national support measures, energy generation mixes, and the structure of household utility contracts. In countries with fixed energy pricing over longer periods, the transmission of rising wholesale prices to consumers was delayed, resulting in more gradual inflationary pressures.

The nature and causes of inflation have important implications for economic policymaking. The effectiveness of stabilization policies depends on understanding the interplay between institutional mechanisms, short-term supply and demand fluctuations, and both domestic (controllable) and external (uncontrollable) factors. Price stability is widely regarded as a foundation for sustainable economic development, encompassing not only monetary balance but also structural and broader macroeconomic stability (e.g., Burton and Fischer, 1997; Blanchard, 2005; Snowdon and Vane, 2005; Stojanov, 2008).

In this context, our study contributes to the empirical literature in three distinct ways. First, it provides a clear empirical separation between demand-side and supply-side inflation drivers, which is often missing in previous EU-focused studies. Second, it examines the transmission channels of inflation heterogeneity by comparing old and new EU member states, revealing how structural vulnerabilities (particularly in energy markets) shape inflation persistence. Third, it introduces a structural break associated with the war in Ukraine to quantify the magnitude of external shocks, thereby extending the literature beyond pre-pandemic models that do not capture recent geopolitical disruptions. These contributions together help clarify the "complex interactions" between determinants referenced earlier in the introduction by explicitly showing which channels dominate in which country group and under what conditions.

The remainder of this paper is structured as follows: Section 1 provides a critical review of the relevant academic literature. Section 2 outlines our methodological approach and describes the data and variables used in the analysis. Section 3 presents empirical findings along with robustness checks and detailed analyses. Last section concludes the study with a discussion of policy implications and future research avenues.

1. Literature Review

The topic of inflation dynamics in Europe has drawn considerable scholarly attention, but the existing empirical research is highly fragmented and varies substantially in scope and methodology. First, studies target different groups of countries: while some examine the entire EU, others concentrate on narrower subsets such as the euro area, euro area "peripheral" member states, or only the newer EU member states after the enlargement in May 2004. Second, there is wide methodological diversity. Many researchers apply unit-root tests (either in time series or panel formats), while others explore inflation convergence through distributional analysis or wavelet techniques that capture co-movements in the time-frequency domain. Third, definitions of the inflation benchmark differ, ranging from the Maastricht criterion, Germany's inflation rate, the European Central Bank's 2% target, to simple cross-sectional averages. Fourth, and most notably, findings across studies are far from uniform; there is no clear consensus on whether inflation convergence has occurred in Europe.

These differences in scope, methods, and conclusions point to a deeper issue: the inherently dynamic and context-specific nature of inflation, which is strongly influenced by each country's structural and institutional characteristics. This complexity is particularly salient within the EU, where member states exhibit diverse historical legacies, levels of institutional maturity, and policy frameworks. While certain EU member states (especially those with post-socialist or transition legacies) are often grouped under umbrella labels, such classifications obscure important distinctions in monetary regimes, market structures, fiscal governance, and political institutions. These differences, in turn, have significant implications for how inflation behaves and responds to various macroeconomic shocks.

The body of existing empirical research has identified a wide spectrum of inflation determinants, yet it remains somewhat fragmented and inconsistent, especially when applied to transition contexts. Early contributions, such as Coorey, Mecagni and Offerdal (1996) and Cottarelli, Griffiths and Moghadam (1998), highlighted the dominant role of monetary factors, finding that inflation in transition economies was largely driven by fluctuations in money supply. Mahabadi and Kiaee (2015) extended this analysis by including GDP growth and oil prices, confirming that these macroeconomic variables exert considerable influence on inflation across a wider panel of countries.

However, the relationship between trade openness and inflation remains contested. While studies like Alfaro (2005), Mafi-Kreft and Kreft (2006), and Tasci et al. (2009) report a positive association, suggesting that openness may not necessarily constrain price growth, other empirical works – such as Romer (1993), Terra (1998), Catao and Terrones (2005), and Lin (2010) – observe a negative relationship, indicating that increased openness might help contain inflation through greater market discipline and import competition. This divergence underscores the context-specific nature of inflation dynamics and suggests that trade structure, import composition, and institutional quality could moderate this relationship.

Fiscal policy is another area where the literature offers mixed conclusions. While many studies (Cottarelli et al., 1998; Inoue, 2005; Staehr, 2010) acknowledge fiscal deficits as key inflationary pressures, especially in countries with weak institutional frameworks, others broaden the scope by including more comprehensive fiscal indicators. Studies like Catao and Terrones (2005) and Lin and Chu (2013) demonstrate that fiscal imbalances are particularly inflationary in high-inflation environments, implying a nonlinear impact of budgetary policy on price stability.

Institutional factors have gained increasing prominence in more recent studies. Authors such as Inoue (2005), Alfaro (2005), and De Grauwe and Schnabl (2008) emphasize the role of fixed or non-discretionary exchange rate regimes as external anchors for inflation expectations. Similarly, the importance of central bank independence in promoting nominal stability is well-documented (Bogoev et al., 2012; Posso and Tawadros, 2013; Garriga, 2016). Yet, these studies often fall short in disentangling the interaction between institutional quality and macroeconomic volatility, particularly in settings where central bank independence exists de jure but not de facto.

Some contributions go further by examining the broader process of economic liberalization. Hammermann and Flanagan (2007) argue that structural reforms, especially in the CIS countries, contributed significantly to inflation reduction. Zoli (2009) similarly identifies price liberalization as a central inflation determinant in emerging EU economies, with additional effects stemming from external commodity shocks (Furceri et al., 2016).

The role of external shocks, especially oil and commodity prices, is well established in the literature. Cunado and Perez de Gracia (2005) and Sek et al. (2015) report that oil price changes have short-run and asymmetric effects on inflation, suggesting that energy prices can disrupt inflation trajectories even in well-anchored economies. Aisen and Veiga (2006), Choi et al. (2018), and others also emphasize global factors, but often fail to account for domestic transmission channels, such as labor market rigidity or exchange rate pass-through.

The labor market and business cycle position have also been explored. Staehr (2010) and Kalimeris (2011) identify unemployment as a meaningful inflation determinant, while Agayev (2012) and Deniz et al. (2016) stress the wage-inflation nexus. Yet, the causality and lag structure of these effects remain underexplored. Blanchard and Gali (2007) and Blinder and Rudd (2008) further argue that increased wage flexibility reduces inflation persistence and diminishes the transmission of external shocks, an insight that has not been sufficiently tested in transition economies.

A novel contribution is provided by Broz and Kocenda (2017), who examine inflation convergence in the EU using a panel of 28 member states and three inflation benchmarks. By employing a Seemingly Unrelated Regression (SUR) framework augmented with dummy variables for major events such as the Global Financial Crisis and the implementation of the acquis communautaire (AC), they find robust evidence for convergence in inflation rates. However, their findings also question the effectiveness of EU institutional mechanisms, suggesting that the AC's impact on inflation convergence may have been overstated.

Čaklovica and Efendic (2020) delve into inflation determinants in 28 European transition economies using dynamic panel modeling for 2005 – 2015. They identify structural variables like unemployment and real wage growth as key inflation drivers in both the short and long run. Importantly, their results reveal persistent inflation inertia, attributed to supply-side shocks and market rigidities. One notable finding is the uniformity of inflation determinants across EU and non-EU countries, suggesting that structural features may override institutional affiliations.

Binici et al. (2022) explore inflation during the post-pandemic period, applying Generalized Dynamic Factor Models and Local Projections on monthly data from 30 European countries (2002 – 2022). They find that while global factors remain important, country-specific responses to the pandemic, particularly monetary and fiscal policies, have become increasingly influential. This shift underscores the evolving nature of inflation drivers in the wake of large-scale economic disruptions.

Moessner (2022) focuses on short-term inflation expectations in the euro area, finding that food and commodity prices, exchange rate depreciations, and the output gap significantly shape professional forecasts. These findings reinforce the role of expectations management in inflation dynamics but also highlight the persistent underestimation of non-core inflation components in policy design.

In summary, the existing literature on inflation determinants in transition and European economies offers a wealth of insights but suffers from fragmentation and limited theoretical integration. Many studies adopt empirical approaches without fully embedding them in structural macroeconomic models, which weakens the generalizability of their findings.

Moreover, while the importance of institutional quality is frequently emphasized, its interaction with macroeconomic policy and external shocks is often inadequately theorized or empirically tested. Our study aims to address these gaps by providing a more comprehensive and context-sensitive analysis of inflation determinants, with a particular focus on EU economies' unique structural and institutional features.

2. Methodological Approach

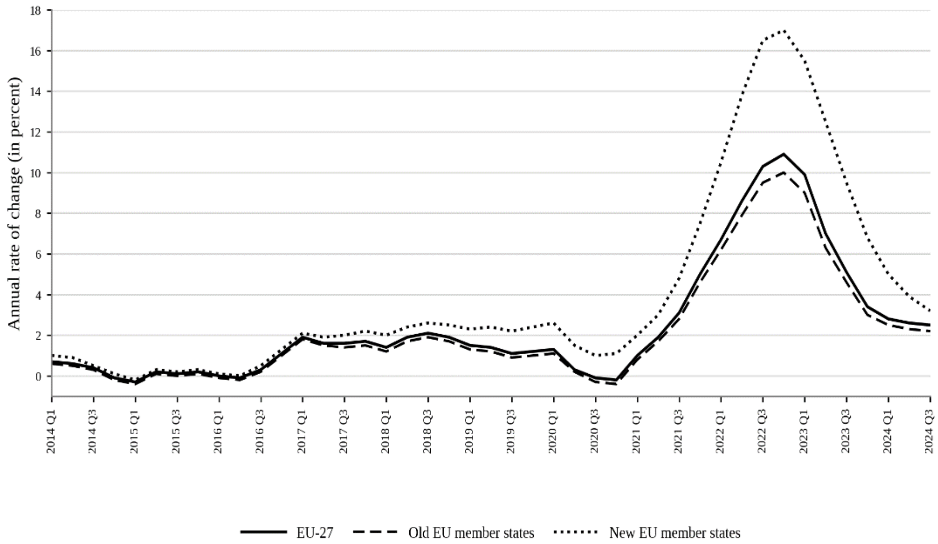
2.1. Data and Variables

In this study, we employ panel data analysis using quarterly frequency data to investigate the determinants of inflation across the 27 EU member states from 2014 to 2024.

The dependent variable is inflation, measured as the year-on-year percentage change in the quarterly Harmonised Index of Consumer Prices (HICP), based on the European Classification of Individual Consumption by Purpose (ECOICOP). The HICP is compiled by Eurostat and national statistical institutes using harmonized methods, making it internationally comparable. As illustrated in Figure 1, there are major differences among old and new EU member states in terms of inflation dynamics during the observed period.

F i g u r e 1

Quarterly Inflation Dynamics in EU27: Old vs. New Member States, 2014 – 2024



Note: [1] Harmonised Index of Consumer Prices – quarterly data (annual rate of change), data code: prc_hicp_manr. [2] Old EU member states: Germany, France, Italy, Spain, Portugal, Greece, Austria, Belgium, Netherlands, Luxembourg, Denmark, Sweden, Finland, Ireland, United Kingdom. [3] New EU member states: Poland; Czech Republic; Slovakia; Hungary; Slovenia; Estonia; Latvia; Lithuania; Cyprus; Malta; Bulgaria; Romania; Croatia.

Source: Authors' calculations based on Eurostat (2026) data.

Demand-Side Determinants

The first explanatory variable is the domestic output gap. We follow Binici et al. (2022) and use the natural logarithm of the seasonally adjusted Industrial Production Index (LIPI) as a proxy to calculate the domestic output gap. Studies have used various transformations of GDP to investigate inflation, including GDP per capita, real growth of GDP per capita, and output gap.

To account for labor market developments, we include the logarithm of the unemployment rate for the 27 EU countries. The relationship between unemployment and inflation was first identified by Phillips (1958), showing a negative association between unemployment and inflationary pressures. In line with the Phillips curve framework, lower unemployment typically signals tighter labor market conditions, which can increase demand-driven inflation through wage-price transmission. The Phillips curve provides a foundational framework linking inflation dynamics to real economic activity through labor market slack. In its original formulation (Phillips, 1958), lower unemployment leads to upward wage pressures, which subsequently translate into price increases. However, since the Global Financial Crisis, a growing body of empirical research finds that the slope of the Phillips curve in advanced and transitional European economies has become significantly flatter (Blanchard, Cerutti and Summers, 2015; IMF, 2021). This means that fluctuations in output or unemployment translate into relatively muted inflationary responses.

Guided by the Taylor Rule, interest rates represent a key channel through which monetary policy influences inflation (Taylor, 1993). Lower interest rates reduce the cost of borrowing and stimulate consumption and investment, which can increase inflationary pressures. In contrast, higher interest rates restrain demand and help stabilize prices. In this study, the interest rate variable is proxied by the European Central Bank deposit facility rate, which acts as an operational anchor and reflects the stance of monetary policy in the euro area. For the non-Euro EU member states, we use key policy interest rates of their respective central banks.

Supply-Side Determinants

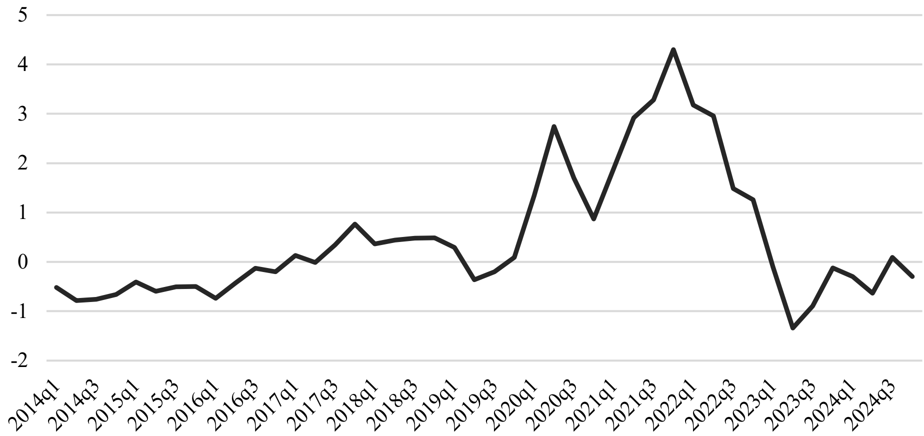
As one of the determinants, we will include the nominal exchange rate in our inflation models to capture the influence of monetary policy on price dynamics. Specifically, a depreciation of the euro tends to increase the cost of imported energy products, especially since many energy contracts are denominated in US dollars. The nominal effective exchange rate (EXR) of the euro represents a weighted average of the euro's bilateral nominal exchange rates against a basket of currencies from its main trading partners. The natural logarithm of this index reflects the external value of the euro relative to these foreign currencies. When LEXR rises, it implies that, on average, one euro can buy more foreign currency, making it more expensive for foreign buyers to convert their currency into euros. Conversely, a decline in LEXR indicates that one euro obtains less foreign currency on average, making it cheaper for foreign currencies to be exchanged into euros. This measure, published by the European Central Bank (ECB), is thus a key indicator of the euro's external purchasing power and is essential for understanding how exchange rate movements impact inflationary pressures.

Global food prices can also significantly impact inflation, particularly in less developed EU member states where food expenses constitute a large portion of consumer spending. We use the natural logarithm of the Global Food Price Index (2016 = 100).

Global Price of Energy Index (with base year 2016 = 100) is another determinant of inflation in the 27 EU member states. Energy prices have a direct and significant impact on production costs, transportation, and household utility expenses, all of which are key drivers of consumer price inflation. Given the EU's high dependence on energy imports and the sensitivity of its economies to global energy market fluctuations, changes in the GPEN can quickly transmit into domestic price levels, affecting both headline and core inflation. Incorporating this index allows for a more accurate assessment of external inflationary pressures and enhances the explanatory power of inflation models in an increasingly interconnected global energy market.

The GSCPI measures the intensity of pressure on global supply chains. It reflects transportation capacity, logistics infrastructure, and the regulatory environment. Developed by the Federal Reserve Bank of New York, it includes 11 yearly variables related to supply chain disruptions and transportation costs. Positive GSCPI values indicate supply chain pressure, which is associated with goods and producer price inflation (Figure 2). The index is standardized with a mean of zero and a standard deviation of one.

F i g u r e 2
The Global Supply Chain Pressure Index (Q1 2014 – Q4 2024)



Source: Federal Reserve Bank of New York (March 2026).

The recent acceleration of consumer inflation is influenced by the war in Ukraine, increasing the prices of energy, raw materials, and food. We introduce a dummy variable with a value of one for the period from 2022 to 2024 and zero for the rest of the period.

The data for the selected variables were obtained from the Eurostat, the Federal Reserve Bank of St. Louis, and the Federal Reserve Bank of New York. Table 1 presents the variables in the model, their symbols, short definitions and data sources.

We also present descriptive statistics for all countries, and we additionally discuss the main trends in the evolution of the selected variables over time.

T a b l e 1

Definition of Variables

Variables	Symbol	Measurement Units / Range	Source
Inflation	INFL	Logarithmic difference of the Harmonized Index of Consumer Prices ($\Delta \ln HICP \approx \ln(HICP_t) - \ln(HICP_{t-1})$)	Eurostat
Unemployment rate, in percent	UNP	Share of unemployed individuals in the total labor force, expressed as a percentage.	
Industrial Production Index	LIPI	Natural logarithm of the Industrial Production Index, base year 2015 = 100.	
Nominal Effective Exchange Rate	LEXR	Natural logarithm of the weighted average of the euro's bilateral nominal exchange rates against a basket of currencies from main partners	
Interest Rate	IR	Percentage points	
Global Price of Energy	LGPEN	Natural logarithm of the Global Energy Price Index, base year 2016 = 100.	FRED, Federal Reserve Bank of St. Louis
Global Price Food Index	LGPFI	Natural logarithm of the Global Food Price Index, Index 2016 = 100	
Global Supply Chain Pressure Index	GSCPI	Global Supply Chain Pressure Index (non-log)	Federal Reserve Bank of New York

Source: Authors' calculations based on Eurostat, ECB, and FRED data.

T a b l e 2

Descriptive Statistics

	LHICP	UNP	LIPI	LEXR	IR	LGPENER	LGPFI	GSCPI
Mean	0.008	4.791	4.547	4.664	0.880	4.949	4.737	0.476
Median	0.006	4.300	4.572	4.678	0	4.864	4.666	0.038
Maximum	0.2628	16.600	4.919	4.704	4.5	5.858	5.084	4.301
Minimum	–0.229	1.300	4.003	4.595	0	4.231	4.543	–1.340
Std. Dev.	0.059	2.440	0.122	0.033	1.531	0.373	0.150	1.313
Observations	1,159	1,188	1,180	1,188	1,188	1,188	1,188	1,188

Source: Authors' calculations.

The descriptive statistics show moderate variability across most variables, with inflation (LHICP) and the supply chain index (GSCPI) exhibiting the highest volatility, reflecting strong short-term fluctuations and shocks. In contrast, variables such as the exchange rate (LEXR) and industrial production (LIPI) display relatively low dispersion, indicating more stable behavior across EU countries over the sample period.

Table 3 presents the correlation matrix used to test for multicollinearity among explanatory variables. Multicollinearity becomes problematic when correlation coefficients exceed 0.80 (Kennedy, 2008). All correlation coefficients in the model remain below this threshold, indicating that multicollinearity does not represent a significant issue.

The empirical analysis begins with panel unit root tests presented in Table 4. These tests include the Im-Pesaran-Shin test and Fisher-type tests based on the

ADF and Phillips-Perron procedures following Maddala and Wu (1999). The tests are conducted at both levels and first differences to determine the order of integration of each variable.

Table 3

Correlation Matrix

	LHICP	UNP	LIPI	LEXR	IR	LGPENER	LGPFI	GSCPI
LHICP	1.00	–0.06	0.14	0.17	–0.12	0.21	0.16	0.32
UNP	–0.06	1.00	–0.14	–0.37	–0.15	–0.20	–0.20	–0.16
LIPI	0.14	–0.14	1.00	0.40	0.24	0.40	0.39	0.18
LEXR	0.17	–0.37	0.40	1.00	0.25	0.43	0.47	0.56
IR	–0.12	–0.15	0.24	0.25	1.00	0.39	0.56	–0.37
LGPENER	0.21	–0.20	0.40	0.43	0.39	1.00	0.90	0.32
LGPFI	0.16	–0.20	0.39	0.47	0.56	0.90	1.00	0.31
GSCPI	0.32	–0.16	0.18	0.56	–0.37	0.32	0.31	1.00

Source: Authors' calculations.

Table 4

Panel Unit Root Tests

Variables	Im, Pesaran and Shin W-stat (Level)	Im, Pesaran and Shin W-stat (First diff.)	ADF-Fisher Chi-square (Level)	ADF-Fisher Chi-square (First diff.)	PP-Fisher Chi-square (Level)	PP-Fisher Chi-square (First diff.)	Conclusion
LHICP	–23.841***	–	561.042***	–	570.877***	–	I(0)
UNP	–3.033***	–	88.2645***	–	124.750***	–	I(0)
LIPI	–4.8550***	–	129.631***	–	213.085***	–	I(0)
LEXR	–1.636*	–3.550***	53.042	284.917***	16.119	125.795***	I(1)
IR	2.423	–5.123***	18.839	103.441***	10.361	284.957***	I(1)
LGPENER	–2.855***	–	68.583*	–	51.911	–	I(0)
LGPFI	1.169	–20.580***	26.547	474.097***	18.470	477.980***	I(1)
GSCPI	–3.439***	–	76.835**	–	45.472	–	I(0)

Notes: [1] Significance: *** p < 0.01; ** p < 0.05; p < 0.10. [2] I(0): Stationary at level; I(1): Non-stationary at level, stationary after first difference.

Source: Authors' calculations.

Overall, the results show a mixed order of integration across variables. Inflation, unemployment, industrial production, energy prices, and supply chain pressures are I(0), while exchange rates, interest rates, and food prices are I(1). This structure justifies the use of econometric techniques that accommodate mixed integration orders, such as dynamic panel models or ARDL-type specifications.

2.2. Methodology

The presence of variables integrated at different orders, I(0) and I(1), has important methodological implications for econometric modeling. Traditional cointegration techniques such as the Engle-Granger two-step method (Engle and

Granger, 1987) and the Johansen cointegration approach (Johansen, 1988; Johansen and Juselius, 1990) require that all variables be integrated at the same order. When variables exhibit mixed integration orders, these approaches may produce unreliable results.

In such cases, the Autoregressive Distributed Lag (ARDL) model provides a more appropriate econometric framework. The ARDL approach, developed by Pesaran and Shin (1995) and later extended by Pesaran, Shin, and Smith (1999), allows the estimation of long-run relationships between variables regardless of whether they are integrated at level I(0) or first difference I(1), provided that none of the variables is integrated of order two, I(2). This flexibility makes ARDL particularly suitable for empirical studies with mixed integration properties.

Another advantage of the ARDL framework is the ability to estimate both long-run equilibrium relationships and short-run dynamics within a single model. Through the error correction representation of the ARDL model, it is possible to analyze how deviations from the long-run equilibrium are corrected over time. The error correction term captures the speed at which the dependent variable returns to equilibrium after short-term shocks.

The ARDL approach is also appropriate for datasets with relatively small or moderate sample sizes. Previous studies show that ARDL estimation provides reliable results even when the time dimension of the dataset is limited (Pesaran and Shin, 1997; Pattichis, 1999; Mah, 2000). This characteristic is particularly useful for panel datasets where the number of observations across time may be constrained.

Furthermore, the ARDL model allows different lag structures for each variable. This flexibility helps capture the dynamic adjustment process more accurately and reflects the underlying data-generating process through a general-to-specific modeling framework (Laurenceson and Chai, 2003). Appropriate lag selection allows the model to capture both short-term fluctuations and long-term equilibrium relationships.

Another important feature of the ARDL approach is that the Error Correction Model (ECM) can be derived directly from the ARDL specification through a linear transformation (Banerjee et al., 1993). The ECM representation provides information about the speed of adjustment toward the long-run equilibrium following short-term disturbances.

The unit root tests presented earlier indicate that none of the variables in the model is integrated of order two, I(2). This condition is necessary for applying the ARDL methodology because the bounds testing procedure used in ARDL estimation remains valid only when variables are integrated of order I(0) or I(1) (Ouattara, 2004).

Given the mixed orders of integration and the absence of I(2) variables, the ARDL framework represents an appropriate econometric approach for examining the determinants of inflation in EU member states. This methodology allows simultaneous analysis of long-run equilibrium relationships and short-run dynamics between inflation and its macroeconomic and external determinants.

To illustrate the ARDL model, we will start from the basic equation (1) and present the ARDL model through the equation:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{p} \beta_j \Delta x_{t-j} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \varepsilon_t \tag{1}$$

where y_{it} denotes the dependent variable, inflation, for country i in year t. The term x_{it} denotes the vector of explanatory variables included in the model, namely industrial production, unemployment, the nominal effective exchange rate, interest rates, global energy prices, global food prices, supply chain pressures, and the geopolitical dummy. The coefficients β_i and β_j capture the short-run effects of changes in the lagged dependent variable and the explanatory variables. The coefficients λ_1 and λ_2 capture the long-run adjustment terms associated with the lagged level of the dependent variable and the lagged level of the explanatory variables. The error term is denoted by ε_t. Accordingly, the differenced terms in equation (1) represent the short-run dynamics of the ARDL model, while the lagged level terms represent the long-run relationship between inflation and its determinants.

In this specification, determining the appropriate lag structure is essential in order to identify a sufficient number of lags while avoiding autocorrelation in the model. The first step involves deciding the maximum number of lags to be included in the ARDL model. The lag length should be sufficiently large to ensure statistical validity of the results, but not excessively large given the relatively short time series available in the dataset.

The selection of the optimal lag length is based on regression specification tests and information criteria. In particular, statistical validity is evaluated through diagnostic tests, while the explanatory power of the regression models is assessed using information criteria such as the Schwarz Bayesian Criterion (SBC) and the Akaike Information Criterion (AIC).

The second procedure in the first stage involves testing the null hypothesis that there is no statistically significant cointegration or long-run relationship between the dependent variable and the explanatory determinants. This hypothesis is tested against the alternative hypothesis that at least one long-run coefficient is different from zero, which would imply the existence of at least one long-run equilibrium relationship between the dependent variable and one or more independent variable (H_1: $\lambda 1 \neq \lambda 2 \neq \ldots \neq \lambda_n \neq 0$). The presence of a cointegration relationship among the determinants is examined using the so-called bounds testing approach developed by Pesaran and Pesaran (1997) and Pesaran et al. (2001). Pesaran and Pesaran (1997, p. 478) proposed two sets of critical values for this test. The first set assumes that all determinants are integrated of order one, I(1), and represents the upper bound critical values. The second set assumes that the determinants are integrated of order zero, I(0), and represents the lower bound critical values.

According to this procedure, if the calculated test statistic exceeds the upper bound critical value, the null hypothesis of no cointegration is rejected, indicating the existence of a long-run relationship among the variables. If the calculated test statistic falls below the lower bound critical value, the null hypothesis cannot be rejected, implying that no cointegration relationship exists. However, if the calculated statistic lies between the lower and upper critical bounds, the result is considered inconclusive, and no definitive conclusion regarding cointegration can be made.

It is also important to consider the order of integration of the determinants when interpreting the results. If all variables are integrated of order zero, I(0), the decision should be based on the lower bound critical value. Conversely, if all variables are integrated of order one, I(1), the decision should be based on the upper bound critical value. When the null hypothesis is rejected, it indicates the existence of a long-run relationship between the selected determinants, allowing the analysis to proceed to the next stage of the ARDL methodology.

The second stage involves determining the appropriate ARDL model specification, particularly the optimal number of lags, and estimating the coefficients of the long-run relationship. In this phase, the optimal order of the ARDL model, denoted as ARDL(p, q), is selected using model selection criteria such as the Schwarz Bayesian Criterion (SBC), the Akaike Information Criterion (AIC), or the Hannan-Quinn Information Criterion (HQ).

The following step consists of estimating the long-run coefficients based on the selected ARDL specification. The final stage involves estimating the Error Correction Model (ECM), which integrates the short-run dynamics with the long-run equilibrium relationship among the variables. The coefficient associated with the ECM term represents the speed of adjustment toward equilibrium, indicating how quickly the system returns to its long-run equilibrium following a short-term shock affecting one of the determinants.

3. Results

This section presents the results of the econometric analysis examining the determinants of inflation in EU member states.

T a b l e 5

Kao Residual Cointegration Test Results (EU Panels)

Indicator	All EU	New EU	Old EU
ADF t-statistic	–29.857	–21.836	–18.807
Probability	0.0000	0.000	0.000
Residual Variance	0.0058	0.007	0.004
HAC Variance	0.003	0.004	0.002
RESID(-1)	–1.400***	–1.409***	–1.392***
t-statistic (RESID(-1))	–35.885	–25.017	–25.415
D(RESID(-1))	0.388***	0.388***	0.381***
R-squared	0.583	0.586	0.577
Adjusted R-squared	0.583	0.586	0.576
S.E. of regression	0.050	0.055	0.044
Log-Likelihood	1735.505	786.653	966.967
Durbin-Watson stat	2.025	1.953	2.114
Observations (adjusted)	1,097	530	567

Source: Authors' calculations.

Since the unit root tests indicated the presence of non-stationary series, panel cointegration tests were conducted as the next step in the empirical analysis. The results of the Kao (1999) cointegration test presented in Table 5 confirm the existence of a long-run relationship among the variables included in the model. The rejection of the null hypothesis of no cointegration confirms a stable long-run relationship between inflation and its determinants across all EU, New EU, and Old EU groups.

To further verify the long-run relationship, the ARDL bounds test for cointegration was applied. Tables 6 and 7 present the results of the bounds testing procedure used to determine whether a stable equilibrium relationship exists between inflation and the explanatory variables. The null hypothesis of the test states that no long-run relationship exists among the variables. Rejection of this hypothesis indicates the presence of cointegration.

T a b l e 6

ARDL Bounds Test Critical Values

Significance Level	I(0) Lower Bound	I(1) Upper Bound
10%	1.850	2.850
5%	2.110	3.150
1%	2.620	3.770

Note: Finite sample critical values are not available due to model size. Asymptotic values are used.

Source: Authors' calculations.

The bounds test critical values indicate the thresholds used to assess the existence of a long-run relationship in the ARDL framework. Since finite sample values are not available due to the number of regressors, asymptotic critical values are applied for all three models.

T a b l e 7
ARDL-PMG Results and Model Specifications (EU, New EU, Old EU)

Explanatory variables	**[1] EU27**	**[2] New EU**	**[3] Old EU**
Long-run coefficients			
Unemployment rate	–0.0005 [0.00]	–0.0004 [0.00]	0.0001 [0.00]
Industrial production (log)	0.004 [0.01]	0.032* [0.02]	–0.007 [0.01]
Exchange rate (log)	–0.206*** [0.04]	–0.292*** [0.07]	–0.284*** [0.06]
Interest rate	–0.004*** [0.00]	–0.004 [0.00]	–0.003 [0.00]
Energy prices (log)	0.052*** [0.01]	0.072*** [0.01]	0.065*** [0.01]
Food prices (log)	0.041** [0.02]	0.098*** [0.04]	0.117*** [0.04]
Global supply chain index	0.006*** [0.00]	0.009*** [0.00]	0.008*** [0.00]
War dummy	0.0010** [0.00]	0.012 [0.01]	0.024*** [0.01]
Constant	0.890*** [0.21]	1.337*** [0.39]	1.598*** [0.38]
Short-run coefficients			
Error correction term	–1.431*** [0.06]	–1.432*** [0.10]	–1.392*** [0.09]
Lagged inflation	0.395*** [0.03]	0.403*** [0.04]	0.339*** [0.06]
Δ Interest rate	–0.003 [0.00]	–0.013** [0.01]	0.001 [0.01]
Δ Interest rate (-1)	–0.021*** [0.01]	–0.028*** [0.01]	– –
Δ Food prices	0.169*** [0.03]	0.204*** [0.06]	0.211*** [0.05]
Δ Food prices (-1)	– –	– –	0.119*** [0.05]
Δ War dummy	– –	– –	0.021 [0.02]
Model specifications			
Dependent Variable	D(LHICP)	D(LHICP)	D(LHICP)
Method	ARDL–PMG	ARDL–PMG	ARDL–PMG
Sample Period	2014Q4–2024Q4	2014Q4–2024Q4	2014Q4–2024Q4
Observations	1099	530	569
Number of Countries	27	13	14
Dependent Variable Lags	2	2	2
Regressors	UNP, LIPI, LEXR, IR, LGPENER, LGPFI, GSCPI, DUM	Same	Same
Maximum Lags (Regressors)	2	2	2
Deterministics	Restricted constant, no trend	Same	Same
Model Selection Criterion	AIC	AIC	AIC
Number of Models Evaluated	13,122	13,122	13,122
Selected Model	PMG(2,0,0,0,2,0,1,0,0)	PMG(2,0,0,0,2,0,1,0,0)	PMG(2,0,0,0,1,0,2,0,1)
Log-Likelihood	2080.629	944.623	1155.813

Note: [1] Standard errors are in square brackets. [2] *, **, and *** show that the null hypothesis can be rejected at 10%, 5%, and 1% significance levels respectively.

Source: Authors' calculations.

The results consistently indicate that inflation and its determinants move together in the long run across all country groups. The magnitude and significance of the adjustment term further suggest that deviations from equilibrium are corrected rapidly, confirming robust long-run dynamics in all three specifications. Overall, the bounds test framework, combined with the significant error correction term, supports the presence of cointegration and validates the use of the ARDL–PMG approach for all EU, new EU, and old EU models.

3.1. Results for All EU Countries

The estimation results are presented in columns [1] to [3] of Table 4.

Long-run results

The long-run estimates reveal a clear structure of inflation dynamics in the EU and strongly confirm the findings of Čaković and Efendić (2020), while extending them with more recent evidence.

Unemployment and industrial production are not statistically significant. This supports the flattened Phillips curve hypothesis and confirms that domestic demand and labor market conditions do not drive inflation in the EU. This finding is consistent with Blanchard et al. (2015) and Ball and Mazumder (2011) and reinforces the view that structural changes have weakened traditional inflation channels.

External and policy-related variables dominate the long run. The exchange rate has a strong negative and highly significant effect, confirming exchange rate pass-through and the importance of imported inflation. This result is fully in line with both the reference paper and the ECB evidence.

Interest rates show a negative and significant long-run effect. This confirms that monetary policy remains effective in controlling inflation through the interest rate channel. Unlike earlier emphasis on monetary aggregates, these results show that policy transmission operates primarily through interest rates, with effects that build over time.

A key extension relative to Čaković and Efendić (2020) is the role of energy prices. The results show a strong and highly significant positive effect, confirming that energy is a major structural driver of inflation in the EU. This aligns with ECB (2022) and IMF (2022), especially in the context of the recent energy crisis.

Food prices are statistically significant, although weaker. Their effect reflects global food shocks and their transmission into inflation, particularly during crisis periods. This supports recent European Commission evidence on food-driven inflation.

Supply chain pressures are positive and highly significant. This confirms that global production and logistics disruptions have a lasting impact on inflation. This factor extends earlier literature and reflects post-pandemic inflation dynamics.

The geopolitical dummy is positive and significant, indicating a direct effect of the Ukraine war on inflation. This goes beyond earlier findings and shows that geopolitical shocks now act as independent inflation drivers.

Overall, the long run is dominated by external, supply-side, and policy variables. Domestic demand factors do not explain inflation in EU countries, confirming a structural shift in inflation dynamics.

Short-run results

The short-run results capture immediate adjustments and confirm dynamic features of inflation in the EU, while remaining consistent with the broader literature.

The error correction term is negative and highly significant, confirming a stable long-run relationship and fast adjustment toward equilibrium. Deviations from the long-run path are corrected quickly.

Lagged inflation is positive and highly significant, confirming strong short-run persistence. Inflation dynamics remain backward-looking, which is consistent with Čaković and Efendić (2020) and other EU studies. The extended period of low inflation prior to 2022 may have influenced the estimated persistence. In other words, a low and stable inflation environment may mechanically reduce measured persistence due to limited variation in the data. This is an important caveat when interpreting our results, especially in comparison with periods of higher and more volatile inflation.

Interest rates do not show an immediate effect but become significant with a lag. This confirms that monetary policy operates with delays. The transmission of interest rate changes into inflation takes time, which is consistent with standard monetary theory and ECB empirical findings.

Food prices are positive and highly significant in the short run. This shows that food price shocks transmit quickly into inflation and are immediately reflected in price dynamics.

Not all determinants appear in the short run because short-run dynamics capture only variables with immediate transmission effects. Variables such as unemployment, industrial production, exchange rates, energy prices, and supply chain pressures influence inflation more gradually. Their effects are reflected in the long-run relationship rather than in short-term fluctuations.

The results confirm and extend the findings of Čaković and Efendić (2020). Inflation in the EU is no longer driven by domestic demand conditions. It is primarily shaped by external forces, including energy prices, exchange rates, global supply chains, and geopolitical shocks. At the same time, monetary policy remains effective through the interest rate channel, but with delayed effects, while inflation persistence continues to play a central role in both the short run and the long run.

3.2. Results for Old EU Countries

Long-run results

The long-run results show a stable and externally driven inflation structure, broadly consistent with EU-wide evidence but with stronger institutional anchoring.

Unemployment and industrial production remain statistically insignificant, confirming that domestic demand and labor market conditions do not drive inflation. This supports the flattened Phillips curve hypothesis and aligns with previous EU studies.

The exchange rate has a strong negative and highly significant effect, confirming the importance of imported inflation. The magnitude is large, indicating that exchange rate movements remain a key channel even in more advanced EU economies.

Interest rates are negative but not statistically significant in the long run. This suggests that while monetary policy remains important, its long-run impact on inflation is less direct, likely due to the strong credibility of the ECB and well-anchored inflation expectations.

Energy prices have a strong and highly significant positive effect, confirming that energy is a major driver of inflation even in advanced EU economies. This reflects structural dependence on global energy markets.

Food prices are positive and highly significant, with a larger coefficient than in new member states. This indicates that food price transmission remains important, even in higher-income economies, especially during periods of global shocks.

Supply chain pressures are positive and significant, confirming that global disruptions affect inflation across all EU countries, including more developed economies.

The geopolitical dummy is positive and highly significant, showing a strong direct impact of the Ukraine war on inflation. This suggests that geopolitical shocks have a more visible and structural effect in older EU member states.

Short-run results

The short-run dynamics reflect gradual adjustment and strong persistence, with fewer immediate transmission channels compared to new EU member states.

The error correction term is negative and highly significant, confirming a stable long-run relationship and fast adjustment toward equilibrium.

Lagged inflation is positive and significant, confirming short-run persistence, although the magnitude is slightly lower compared to new EU countries, suggesting somewhat stronger anchoring of expectations.

Interest rates are not significant in the short run, indicating weaker immediate monetary transmission. This reflects more stable financial systems and stronger policy credibility.

Food prices are positive and highly significant both contemporaneously and with a lag. This shows that food price shocks have a persistent short-run impact on inflation.

The geopolitical dummy is not significant in the short run, suggesting that its effects operate more through long-term structural channels rather than immediate shocks.

Inflation in old EU member states is strongly influenced by external and global factors, similar to new member states, but with more stable and anchored dynamics. Energy prices, food prices, exchange rates, and supply chain pressures remain the main drivers, while domestic demand factors are insignificant. Monetary policy effects are weaker in the short run and less pronounced in the long run, reflecting stronger institutional credibility and more stable inflation expectations.

3.3. Results for New EU Countries

Long-run results

The long-run results show that inflation in new EU member states is strongly driven by external and supply-side factors, with a more pronounced sensitivity compared to the full EU sample.

Unemployment remains insignificant, confirming that labor market conditions do not play a meaningful role in shaping inflation. This supports the absence of a Phillips curve relationship in these economies.

Industrial production shows weak significance at the 10% level, suggesting that domestic economic activity has a slightly stronger role compared to the overall EU sample, but it remains limited. This indicates that demand-side pressures are not the main drivers of inflation even in newer member states.

The exchange rate has a strong negative and highly significant effect, with a larger magnitude than in the full EU model. This indicates a stronger exchange rate pass-through and higher exposure to imported inflation. New EU economies appear more vulnerable to currency fluctuations due to higher trade openness and reliance on imports.

Interest rates are not statistically significant in the long run, suggesting that monetary policy transmission is weaker or less direct in these economies. This may reflect structural differences, euro adoption status, or less developed financial markets.

Energy prices have a strong and highly significant positive effect, even larger than in the full EU sample. This confirms that new member states are more exposed to energy shocks, likely due to higher energy intensity and dependence on imports.

Food prices are positive and highly significant, with a stronger coefficient compared to the full EU results. This reflects the higher weight of food in consumption baskets in these countries, making inflation more sensitive to global food price movements.

Supply chain pressures are also positive and significant, confirming that global disruptions play an important role in driving inflation in these economies.

The geopolitical dummy is not statistically significant, suggesting that the impact of the Ukraine war is mostly transmitted indirectly through energy and food prices rather than directly.

Short-run results

The short-run dynamics show stronger and faster adjustment mechanisms compared to the full EU sample.

The error correction term is negative and highly significant, confirming a stable long-run relationship and rapid adjustment toward equilibrium.

Lagged inflation is positive and significant, confirming strong inflation persistence in the short run.

Interest rates are significant both contemporaneously and with a lag, unlike in the full EU sample. This indicates that monetary policy has a more immediate and stronger short-run effect on inflation in new EU member states.

Food prices are positive and highly significant, showing that food price shocks pass quickly into inflation and have a strong short-term impact.

Inflation in new EU member states is more sensitive to external shocks than in the overall EU. Energy, food prices, and exchange rates play a stronger role, while monetary policy effects are weaker in the long run but more visible in the short run. Domestic demand factors remain limited, confirming that inflation in these economies is largely driven by external and structural forces rather than internal economic conditions.

Conclusions

This study provides clear evidence on the structure and drivers of inflation dynamics across EU member states over the period 2014 – 2024 using quarterly data. The results consistently show that inflation is highly persistent across all country groups, confirming strong inflation inertia and backward-looking dynamics. This persistence is particularly pronounced in new EU member states, where inflation reacts more strongly to shocks and adjusts more slowly, indicating weaker anchoring of inflation expectations compared to older EU economies.

The analysis shows that inflation in the EU is primarily driven by external and supply-side factors rather than domestic demand conditions. Unemployment and industrial production are not statistically significant in any of the models, confirming the absence of a traditional Phillips curve relationship. This indicates that domestic economic activity and labor market conditions no longer play a central role in explaining inflation dynamics across EU countries.

External variables dominate the long-run inflation process. Energy prices emerge as one of the strongest and most consistent drivers of inflation across all groups, confirming the EU's structural exposure to global energy markets. The exchange rate also has a strong and significant effect, highlighting the importance of imported inflation. Supply chain pressures further reinforce this pattern, showing that global disruptions in production and logistics have a direct and lasting impact on inflation.

Food prices also play an important role, particularly in new and old EU member states. The results show both long-run and short-run effects, with stronger transmission in new member states due to higher consumption shares. This confirms that food price shocks are an important channel of inflation, especially during periods of global instability.

The role of monetary policy is confirmed but differs across time horizons. Interest rates have a negative and significant effect in the long run for the full EU sample, indicating that monetary policy is effective in controlling inflation over time. However, in country group estimations, interest rates are not significant in the long run, suggesting weaker or more indirect transmission. In the short run, interest rates show delayed effects, particularly in new EU member states, confirming that monetary policy operates with lags and does not affect inflation immediately.

Geopolitical factors also play a role, although their impact varies across groups. The Ukraine war dummy is significant in the full EU and old EU models, indicating a direct structural impact on inflation. In new EU member states, its effect is not significant, suggesting that geopolitical shocks are transmitted mainly through energy and food prices rather than directly.

Short-run dynamics confirm strong inflation persistence and rapid adjustment toward the long-run equilibrium. The error correction term is negative and highly significant across all models, indicating that deviations from equilibrium are corrected quickly. However, only a limited number of variables appear in the short-run specification, mainly lagged inflation, interest rates, and food prices. This reflects the fact that short-run inflation is driven by immediate shocks and adjustment mechanisms, while most determinants operate through long-term channels.

The results reveal clear differences between old and new EU member states. New member states are more sensitive to external shocks, particularly energy and food prices, and exhibit stronger short-run monetary transmission. Old EU member states show more stable dynamics, stronger geopolitical effects, and more anchored inflation expectations.

In sum, the findings show that inflation in the EU is no longer driven by domestic demand conditions but by global cost pressures, external shocks, and structural factors. Energy prices, exchange rates, food prices, and supply chain disruptions represent the main transmission channels. Inflation persistence reflects prolonged external shocks rather than internal overheating.

These results have important policy implications. A uniform monetary policy response is not sufficient in an environment where inflation is largely imported. While interest rates remain an important tool, their effects are gradual and limited in the short run. Policies aimed at energy diversification, supply chain resilience, and targeted fiscal support are necessary to address the root causes of inflation. The evidence supports a coordinated policy framework that combines monetary, fiscal, and structural measures, particularly in the presence of asymmetric effects across EU member states.

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