How does trade openness affect inflation in European Countries?

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Initials – JJ, RL, NV, KU.

Table of Contents

Introduction

Over the past decades, inflation has been one of the most closely monitored macroeconomic indicators in Europe. Given the continent's distinctive combination of markets and monetary policies, it's important to understand what factors drive inflation and this question remains important to this day. Among many different factors considered in various literature, trade openness has appeared as a possible influence on domestic price levels, both through direct competition and through its impact on aggregate demand. Some studies suggest that increased trade openness leads to lower inflation in developed economies. For instance, research by Binici, Cheung, and Lai (2012) found that greater trade openness enhances market competition, which in turn contributes to reduced inflation rates in OECD countries. This perspective posits that exposure to international markets disciplines domestic producers, leading to more efficient production and pricing strategies that help contain inflation. Conversely, other studies argue that trade openness can expose economies to external shocks that may elevate inflation. For example, the Balassa–Samuelson effect suggests that as countries open up to trade and experience productivity gains in tradable sectors, wages and prices in non-tradable sectors may rise, leading to overall inflationary pressures. Additionally, increased demand for imports can lead to trade deficits and currency depreciation, which may further contribute to inflation.

Thus, this paper investigates whether and how trade openness affects inflation in European countries. Specifically, we are examining the relationship between Trade (% of GDP) and Inflation (annual%) using a panel dataset of 20 European countries from the year 2000-2021. We think Europe offers interesting insights for this question, since some countries are in the Eurozone, sharing the same monetary policy, while other countries remain outside the Eurozone and maintain their own monetary policies set by their own central banks.

Theoretical Background and Conceptual Framework

This section provided essential economic meanings for examining the relationship between trade openness and inflation in European countries. Understanding this specific link between trade openness and inflation is crucial in understanding the context of economic integration, globalization and the goal of stable inflation across different economies.

1. Trade Openness

Trade Openness refers to the orientation of a country's economy in the context of international trade. The degree of openness is measured as the sum of exports and imports as a percentage of GDP, which is a very common macroeconomic research indicator. This demonstrates how exposed an economy is to different international markets.

Economic theory suggests a few different ways through which trade openness may actually influence inflation:

- Increased competition: Access to foreign goods and services may pressure domestic firms to reduce prices.
- Import of lower-cost goods: Greater openness enables countries to import cheaper intermediate and consumer goods, potentially lowering domestic price levels.
- External price transmission: Greater openness may also increase a country's sensitivity to international price shocks and global inflation trends.

2. Inflation

Inflation is defined as the rate of increase in the general price level over time, most commonly measured by the Consumer Price Index (CPI). CPI tracks the cost of a typical basket of goods and services consumed by households and is widely used by researchers and policymakers (IMF, 2021; Frisch, 1984; Oner, 2010).

3. Lagged Inflation

To account for inflation persistence, a lagged inflation term is included in the analysis. Past inflation values influence current inflation due to multiple factors as price-setting behaviour or wage contracts (Ball & Mankiw, 1994). Thus, including a lagged term helps isolate the effect of trade openness on inflation.

4. Additional macroeconomic Channels

In order to have a more accurate understanding and assessment of the trade-inflation link, several different macroeconomic variables are added that are suggested by prior literature. (Lane & Milesi-Ferretti, 2002)

- GDP growth: Economic expansion could lead to demand-pull inflation.
- Foreign Direct Investment (FDI). FDI could affect inflation by influencing production and technology

- Government Final Consumption Expenditure: Changes in public sector demand could have inflationary or deflationary effects.
- Exchange Rate: Depreciation of the domestic currency can raise import prices and lead to imported inflation relationship between trade openness and inflation exchange rate. The IMF (2004) categorises exchange rate regimes into multiple categories, those being: exchange arrangements with no separate legal tender, currency board arrangements, other conventional fixed peg arrangements, pegged exchange rates with horizontal bands, crawling pegs, exchange rates within crawling bands, managed floating with no predetermined path for the exchange rate, and independently floating. The ones most relevant to this investigation are independently floating, crawling pegs, managed floating with no predetermined path for the exchange rate, and other conventional fixed peg arrangements, as these are used by most of the countries of South America (IMF, 2004).

Theoretical Review

Theories explaining trade patterns

Understanding how countries engage in trade helps explain how trade openness might influence price levels. The Heckscher-Ohlin model suggests that countries specialize and export goods based on their most abundant factors of production, such as labour or capital (Jones, 2008). In the European context, this may influence production structures and costs in ways that affect inflation, particularly when economies open up to international markets.

A more modern approach is New Trade Theory (Krugman, 1980), which highlights economies of scale and product differentiation. It explains why even similar, developed countries trade with each other — a key feature of intra-European trade. This theory also suggests that openness increases market competition and consumer variety, which can pressure prices downward. While both models focus on trade patterns, they also set the stage for understanding how openness may affect inflation through specialization, competition, and input costs.

Theories explaining how Trade Openness Influences Inflation

To understand how trade affects inflation, it is useful to look at frameworks that incorporate expectations, external shocks, and price-setting behavior. The New Keynesian Phillips Curve provides a forward-looking model of inflation, emphasizing the role of expectations rather than past inflation (Mavroeidis et al., 2014). In its open economy extension, it also accounts for external factors like terms of trade and global price pressures (Mihailov et al., 2011). This makes it especially relevant for European economies, where inflation may be influenced by global conditions through trade.

Another framework, the Monetary Approach to the Balance of Payments, links price levels to the money supply in open economies. It suggests that trade and capital flows can create monetary imbalances that affect inflation, particularly under fixed exchange rate regimes (Mihailov, 1977). While less applicable to countries with floating rates, this model still highlights how external flows can shape domestic monetary conditions.

Together, these theories support the idea that trade openness can influence inflation through channels such as expectations, external price shocks, and monetary dynamics.

Empirical literature review

Many The relationship between trade openness and inflation has been widely studied in developing and emerging economies, but there is less consensus when focusing on European countries. The empirical literature presents mixed findings, often depending on the methodological approach and macroeconomic context.

Ahmad and Mahmood (2013) examined the long- and short-term relationship between trade openness and inflation in Pakistan using ARDL bounds testing on data from 1975–2011. Their findings indicated a positive relationship, suggesting that greater openness could increase price levels in some developing contexts. Their use of time series modeling contributes to understanding how openness may interact with inflation through dynamic mechanisms. In contrast, Munir and Kani (2011) used Johansen cointegration and VECM methods to test the effect of various trade openness measures—exports, imports, and total trade—on inflation in Pakistan (1976–2010). Interestingly, they also found a positive effect of trade openness on inflation, contradicting earlier theoretical predictions such as those by Romer (1993), which suggest a negative link due to increased competition and lower import prices. Mansilla et al. (2020) applied a nonlinear Phillips Curve model to Brazil and found that inflation dynamics differ under high and low trade openness regimes. In more open settings, they observed weaker inflation-unemployment trade-offs, suggesting

that external integration changes the way domestic inflation behaves. This supports the relevance of using models that account for openness-related structural shifts—especially useful for European economies with varying trade intensities and monetary frameworks. Lastly, Rajagopal (2007) studied South American countries using OLS regression and found a positive relationship between trade openness and inflation. Though based on a different region, the study's use of trade-to-GDP and GDP deflator measures offers a methodological reference for the current paper. Overall, the empirical literature reflects divergent findings, and no consensus has emerged regarding the direction or strength of the trade–inflation relationship. This underlines the importance of context-specific analysis and supports the use of panel methods to better understand how trade openness may shape inflation in the diverse economies of Europe.

Based on the reviewed literature, theoretical insights, and European context, the paper tests the following hypotheses:

- H1: Increased trade openness is associated with lower inflation in European economies due to competitive and cost effects.

- H2: Exchange rate fluctuations moderate the impact of trade on inflation, especially in countries with floating regimes.

- H3: The trade–inflation relationship is stronger in countries with stable monetary policy frameworks.

Approach to Estimating the Trade–Inflation Relationship

This section outlines the empirical approach used to examine the relationship between trade openness and inflation in European countries. Building on existing theoretical and empirical research, the study applies a panel data framework to estimate this relationship while controlling for relevant macroeconomic factors. The methodology aims to identify whether trade openness has a significant effect on inflation and how this effect may vary across countries and over time.

Econometric Model Specification

To investigate the relationship between trade openness and inflation in European countries, this study employs a fixed effects panel regression model. The panel structure allows us to control for both country-specific characteristics (such as institutions, geography, and policy regimes) and time-specific shocks (such as global crises or EU-wide monetary policies) that could influence inflation.

The baseline regression model is specified as follows:

$$\text{Inflation}_{\{it\}} = \alpha_i + \lambda_t + \beta_1 \cdot \text{Trade}_{\{it\}} + \beta_2 \cdot \text{LaggedInflation}_{\{it\}} + \beta_3 \cdot \text{GDPGrowth}_{\{it\}} + \beta_4 \cdot \text{FDI}_{\{it\}} + \beta_5 \cdot \text{GovConsumption}_{\{it\}} + \beta_6 \cdot \text{ExchangeRate}_{\{it\}} + \varepsilon_{\{it\}}$$

Where:

- “i indexes countries”
- “t indexes years”
- “α_i captures country fixed effects”
- “λ_t captures year fixed effects”
- “$\varepsilon_{\{it\}}$ is the error term”

The dependent variable is Inflation, measured as the annual percentage change in consumer prices (CPI). The key explanatory variable is Trade, defined as the total exports and imports as a percentage of GDP. To account for inflation persistence, a lagged inflation term is included. Additional controls include GDP growth, foreign direct investment (FDI), government consumption growth, and the exchange rate (LCU per USD).

All models are estimated using the PanelOLS function from the linearmodels library in Python, with robust standard errors clustered at the country level. The model is estimated on an unbalanced panel of 20 European countries over the period 2000 to 2021.

Variables

To estimate the effect of trade openness on inflation, a set of variables was selected based on theoretical relevance, prior empirical studies, and data availability across European countries. The dependent variable is Inflation, measured as the annual percentage change in the Consumer Price Index (CPI). This is a standard measure of price level changes and is widely used in macroeconomic analysis. The key independent variable is Trade openness, measured as the sum of exports and imports as a percentage of GDP. This indicator captures the extent to which a country is integrated into the global market and is a commonly used measure in the trade–inflation literature .A lagged inflation variable is included to account for inflation persistence, as price changes tend to exhibit inertia over time.

Several control variables are added to isolate the effect of trade openness:

- “GDP growth (annual %) – to control for overall economic activity.”
- “Foreign direct investment (FDI) (% of GDP) – to account for external capital flows which may affect price levels.”
- “Government final consumption expenditure (annual % growth) – included as a proxy for fiscal stance.”
- “Official exchange rate (LCU per USD) – to reflect the role of exchange rate movements in pass-through effects on inflation.”

All variables were sourced from reliable international databases (e.g., World Bank) and are available for a balanced set of European countries between 2000 and 2021.

Country selection

The analysis focuses on a panel of 20 European countries over the period 2000 to 2021. These countries were selected based on data availability and their relevance to the research question, as they represent a diverse mix of economies with varying degrees of trade openness, inflation histories, and monetary policy frameworks. European countries offer a particularly suitable context for this study due to their integration into the European Union, the Eurozone, and global markets. The dataset includes both Eurozone members and non-Eurozone economies, allowing for comparisons across different exchange rate

regimes and monetary systems. Countries with substantial missing data or inconsistently reported macroeconomic indicators were excluded to maintain the quality of the panel. The final sample covers both Western and Eastern European countries, enhancing the variation in trade exposure, institutional quality, and economic development. This cross-country variation provides a useful basis for identifying the average effect of trade openness on inflation while controlling for time-invariant country characteristics and common time trends through fixed effects.

The final sample consists of the following 20 European countries: Austria, Belgium, Croatia, Czechia, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovak Republic, Spain, and Sweden.

Model Development

While the initial selection of variables was guided by economic theory and past empirical literature, the final model was refined through iterative testing to ensure both statistical reliability and theoretical coherence. All model specifications used consumer price inflation (CPI, annual %) as the dependent variable. The baseline model included trade openness (% of GDP) as the main explanatory variable and lagged inflation to account for persistence in price dynamics. In its simplest form, the model also included GDP growth as a core macroeconomic control. However, this specification resulted in a relatively low explanatory power, with an adjusted R^2 of approximately 0.04, indicating the need for a broader set of control variables to capture inflation determinants in European economies. The model was subsequently extended to include foreign direct investment (FDI), government consumption expenditure, and the official exchange rate (LCU per USD). These additions significantly improved model performance and aligned better with the theoretical channels linking trade, capital flows, fiscal activity, and exchange rates to inflation. To test for heterogeneity in the trade–inflation relationship, an interaction term was introduced between trade openness and a Eurozone dummy, designed to capture differences in monetary policy autonomy. However, this interaction was not statistically significant and did not meaningfully improve model fit. Similarly, tests using lagged values of trade openness (at 1- and 2-year lags) and interactions with lagged inflation produced weak results and were excluded from the final specification due to low explanatory power and insignificant coefficients .The final preferred specification includes country and year fixed effects, and retains the key macroeconomic controls that showed stable and interpretable effects across different models. This model strikes a balance between theoretical justification, empirical robustness, and model parsimony.

Empirical Workflow and Data Implementation

Multiple This section outlines the main steps taken to prepare and explore the dataset before conducting the econometric analysis. Using Python in Google Colab, the workflow relied primarily on libraries such as pandas for data manipulation and matplotlib and seaborn for visualization. The data, collected from the World Bank and IMF, originally came in wide-format Excel files. These included annual indicators for 20 European countries, such as consumer price inflation, trade openness (measured as total trade as a % of GDP), GDP growth, foreign direct investment (FDI), and others for the period 1999–2022. The dataset was reshaped into a long format using pandas.melt(), then filtered to retain the years 1999–2022. After converting the year to numeric form, we pivoted the data so that each macroeconomic indicator became a separate column. Column names were cleaned and renamed for clarity (e.g., Inflation, Trade, GDPGrowth, etc.), and the dataset was sorted by country and year to ensure proper panel structure. A dummy variable EuroDummy was created to mark Eurozone membership, and a lagged inflation variable (Lagged_Inflation) was added to capture persistence in price changes. The year 1999 was retained solely to compute the lag for 2000, and all rows with missing values in essential columns were dropped. We also excluded 2022 to avoid incomplete data, resulting in a final balanced panel of 260 observations from 2000 to 2021. To preliminarily assess the inflation–trade relationship, we generated scatterplots by country using seaborn. These visualizations showed a diverse set of patterns across countries — some with negative relationships, others flat or unclear — highlighting the need for a more structured regression framework.

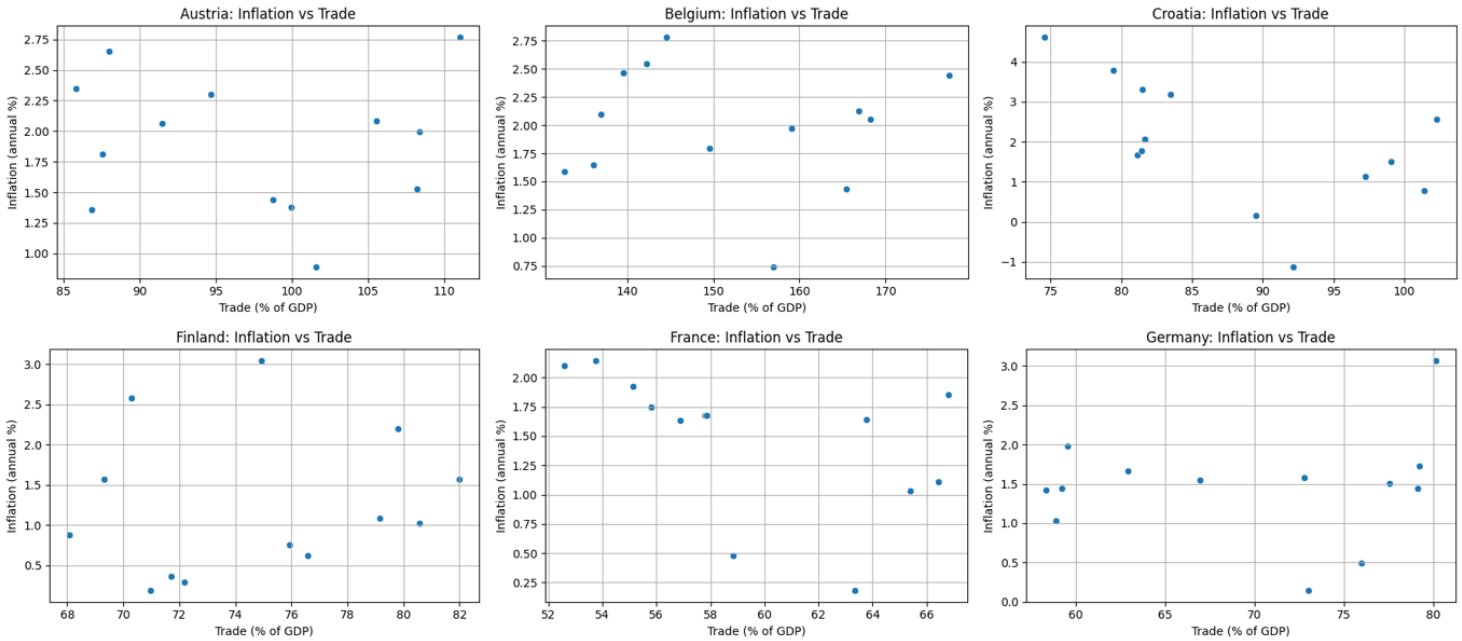


Figure 1. Scatterplots of Inflation vs. Trade Openness (2000–2021) in Selected European Countries

Model Estimation and Specification Refinement

To empirically assess the relationship between trade openness and inflation, several panel regression models were estimated using fixed effects (country and year) and clustered standard errors. The baseline model included inflation as the dependent variable and key explanatory variables: trade openness, lagged inflation, GDP growth, FDI, government consumption, and exchange rate. This initial specification yielded a strong overall fit (R^2 = 0.8371), with lagged inflation being highly statistically significant, while trade openness showed a positive but statistically insignificant relationship.

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.8371
Estimator:	PanelOLS	R-squared (Between):	0.9855
No. Observations:	260	R-squared (Within):	0.7554
Date:	Mon, May 12 2025	R-squared (Overall):	0.8314
Time:	18:59:41	Log-likelihood	-420.58
Cov. Estimator:	Clustered		
		F-statistic:	190.18
Entities:	20	P-value	0.0000
Avg Obs:	13.000	Distribution:	F(6,222)
Min Obs:	13.000		
Max Obs:	13.000	F-statistic (robust):	438.07
		P-value	0.0000
Time periods:	13	Distribution:	F(6,222)
Avg Obs:	20.000		
Min Obs:	20.000		
Max Obs:	20.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	-0.7124	0.9452	-0.7537	0.4518	-2.5750	1.1502
Trade	0.0101	0.0095	1.0641	0.2885	-0.0086	0.0289
Lagged_Inflation	0.7952	0.0410	19.395	0.0000	0.7144	0.8760
GDP growth (annual %)	0.0050	0.0613	0.0813	0.9353	-0.1159	0.1259
Foreign direct investment, net inflows (% of GDP)	0.0022	0.0034	0.6434	0.5206	-0.0045	0.0090
General government final consumption expenditure (annual % growth)	0.0892	0.0615	1.4489	0.1488	-0.0321	0.2105
Official exchange rate (LCU per US$, period average)	-0.0021	0.0020	-1.0434	0.2979	-0.0061	0.0019

"Figure 2. Baseline fixed effects regression results (2000-2021)"

To explore the effect of monetary frameworks, an additional specification introduced a Eurozone dummy and an interaction term between trade and Euro membership. However, the interaction did not yield significant results.

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.8372
Estimator:	PanelOLS	R-squared (Between):	0.9835
No. Observations:	260	R-squared (Within):	0.7550
Date:	Mon, May 12 2025	R-squared (Overall):	0.8305
Time:	19:07:18	Log-likelihood	-420.56
Cov. Estimator:	Clustered		
		F-statistic:	162.31
Entities:	20	P-value	0.0000
Avg Obs:	13.000	Distribution:	F(7,221)
Min Obs:	13.000		
Max Obs:	13.000	F-statistic (robust):	786.33
		P-value	0.0000
Time periods:	13	Distribution:	F(7,221)
Avg Obs:	20.000		
Min Obs:	20.000		
Max Obs:	20.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	-0.6568	0.9479	-0.6929	0.4891	-2.5249	1.2113
Trade	0.0110	0.0116	0.9486	0.3439	-0.0119	0.0339
Lagged_Inflation	0.7967	0.0462	17.242	0.0000	0.7056	0.8877
GDP growth (annual %)	0.0041	0.0611	0.0668	0.9468	-0.1164	0.1246
Foreign direct investment, net inflows (% of GDP)	0.0020	0.0033	0.6061	0.5451	-0.0046	0.0086
General government final consumption expenditure (annual % growth)	0.0891	0.0615	1.4488	0.1488	-0.0321	0.2104
Official exchange rate (LCU per US$, period average)	-0.0021	0.0020	-1.0616	0.2896	-0.0060	0.0018
Trade_Euro	-0.0023	0.0135	-0.1719	0.8637	-0.0290	0.0244

F-test for Poolability: 5.2952
P-value: 0.0000
Distribution: F(31,221)

Included effects: Entity, Time

"Figure 3. Dummy "

To test whether the effect of trade appears with delay, we re-estimated the model using one-period lagged trade, which showed some improvement in trade significance, though the model's R^2 decreased slightly.

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.7958
Estimator:	PanelOLS	R-squared (Between):	0.8432
No. Observations:	240	R-squared (Within):	0.7087
Date:	Mon, May 12 2025	R-squared (Overall):	0.7525
Time:	19:17:32	Log-likelihood	-345.91
Cov. Estimator:	Clustered		
		F-statistic:	131.88
Entities:	20	P-value	0.0000
Avg Obs:	12.000	Distribution:	F(6,203)
Min Obs:	12.000		
Max Obs:	12.000	F-statistic (robust):	133.16
		P-value	0.0000
Time periods:	12	Distribution:	F(6,203)
Avg Obs:	20.000		
Min Obs:	20.000		
Max Obs:	20.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	-1.7244	0.9156	-1.8834	0.0611	-3.5297	0.0808
Trade_Lag1	0.0219	0.0086	2.5417	0.0118	0.0049	0.0389
Lagged_Inflation	0.6608	0.0453	14.577	0.0000	0.5714	0.7502
GDP growth (annual %)	0.0834	0.0539	1.5472	0.1234	-0.0229	0.1897
Foreign direct investment, net inflows (% of GDP)	0.0024	0.0038	0.6390	0.5235	-0.0051	0.0100
General government final consumption expenditure (annual % growth)	0.0112	0.0308	0.3627	0.7172	-0.0495	0.0718
Official exchange rate (LCU per US$, period average)	0.0020	0.0054	0.3777	0.7060	-0.0086	0.0127

F-test for Poolability: 5.4272
P-value: 0.0000
Distribution: F(30,203)

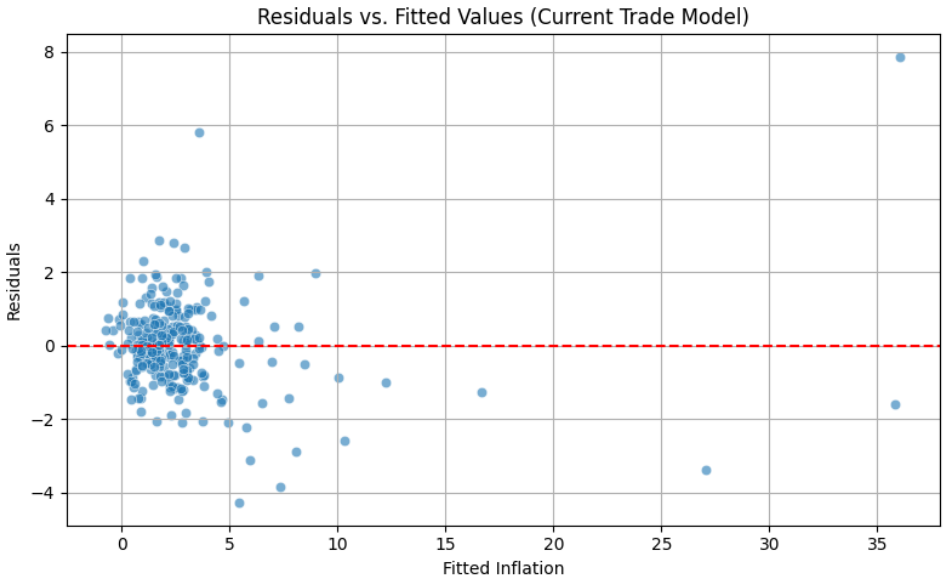
Included effects: Entity, Time

"Figure 4. Model using lagged trade openness"

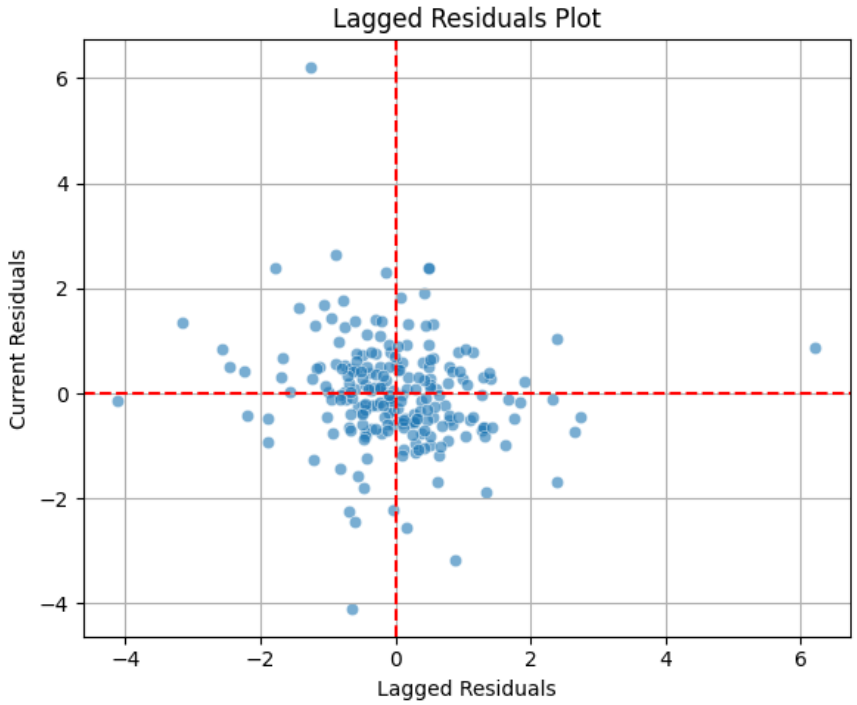
Across all specifications, lagged inflation remained the most consistent and significant driver of current inflation. The results support the importance of expectations and macroeconomic inertia, while the direct impact of trade openness appears weaker than initially expected.

To ensure that the final panel regression model meets standard econometric assumptions, we conducted residual diagnostics using two key plots. First, the Residuals vs. Fitted Values plot was generated to visually check for heteroscedasticity and model fit quality. Ideally, residuals should appear randomly scattered around zero with no clear pattern—this suggests that the variance of the errors is stable across predicted values and that the model is well-specified. In our case, the spread of residuals appears fairly homoscedastic, supporting this assumption. Second, a Lagged Residuals Plot was created to test for autocorrelation in the residuals. In panel data, especially with time-series elements, residuals may be correlated over time within countries, which can violate independence assumptions and bias standard errors. By plotting current residuals against their one-period lag, we can visually assess whether past errors predict future ones. The lack of a discernible linear trend

in our plot indicates that the residuals are mostly uncorrelated over time, further strengthening the reliability of our model results.



“Figure 5. Residuals vs. Fitted Values for the Final Model”



“Figure 6. Lagged Residuals Plot for Residual Independence Check”

Robustness Checks and Sensitivity Analysis

To verify the reliability of our results, we conducted several robustness checks and sensitivity analyses. These tests aimed to assess whether the main findings held under alternative specifications and minor structural changes to the data. First, we tested the

robustness of standard errors by clustering them by year instead of by country. This check helps address the possibility of time-specific shocks that may affect all countries simultaneously, such as global inflationary trends or financial crises. The results remained stable, indicating that our estimates are not driven by year-level clustering assumptions.

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.8372
Estimator:	PanelOLS	R-squared (Between):	0.9835
No. Observations:	260	R-squared (Within):	0.7550
Date:	Mon, May 12 2025	R-squared (Overall):	0.8305
Time:	21:58:11	Log-likelihood	-420.56
Cov. Estimator:	Clustered		
		F-statistic:	162.31
Entities:	20	P-value	0.0000
Avg Obs:	13.000	Distribution:	F(7,221)
Min Obs:	13.000		
Max Obs:	13.000	F-statistic (robust):	51.764
		P-value	0.0000
Time periods:	13	Distribution:	F(7,221)
Avg Obs:	20.000		
Min Obs:	20.000		
Max Obs:	20.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	-0.6568	0.9569	-0.6864	0.4932	-2.5426	1.2290
Trade	0.0110	0.0190	0.5783	0.5637	-0.0265	0.0485
Trade_Euro	-0.0023	0.0157	-0.1485	0.8821	-0.0332	0.0286
Lagged_Inflation	0.7967	0.0951	8.3732	0.0000	0.6092	0.9842
GDP growth (annual %)	0.0041	0.0781	0.0523	0.9584	-0.1499	0.1581
Foreign direct investment, net inflows (% of GDP)	0.0020	0.0050	0.4034	0.6871	-0.0079	0.0119
General government final consumption expenditure (annual % growth)	0.0891	0.0563	1.5842	0.1146	-0.0218	0.2001
Official exchange rate (LCU per US$, period average)	-0.0021	0.0015	-1.3909	0.1657	-0.0051	0.0009

F-test for Poolability: 5.2952
P-value: 0.0000
Distribution: F(31,221)

Included effects: Entity, Time

“Figure 7. Model using clustered errors by year.”

Second, we performed exclusion tests by removing countries that may disproportionately influence the model due to economic irregularities. Specifically, we excluded Hungary and the Slovak Republic, both of which exhibited inflation dynamics or policy regimes that deviated from the general trend observed in the rest of the sample. Interestingly, the exclusion of these countries led to an improvement in the R-squared values, suggesting a stronger model fit and greater explanatory power without these outliers. This implies that the overall relationship between trade openness and inflation is more consistently captured once these influential cases are removed. These robustness checks strengthen the validity of our conclusions by showing that the main findings are not sensitive to the inclusion of potentially distortive observations or to different clustering strategies.

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.8372
Estimator:	PanelOLS	R-squared (Between):	0.9835
No. Observations:	260	R-squared (Within):	0.7550
Date:	Mon, May 12 2025	R-squared (Overall):	0.8305
Time:	21:58:11	Log-likelihood	-420.56
Cov. Estimator:	Clustered		
		F-statistic:	162.31
Entities:	20	P-value	0.0000
Avg Obs:	13.000	Distribution:	F(7,221)
Min Obs:	13.000		
Max Obs:	13.000	F-statistic (robust):	51.764
		P-value	0.0000
Time periods:	13	Distribution:	F(7,221)
Avg Obs:	20.000		
Min Obs:	20.000		
Max Obs:	20.000		

Parameter Estimates

	Parameter	S
const	-0.6568	
Trade	0.0110	
Trade_Euro	-0.0023	
Lagged_Inflation	0.7967	
GDP growth (annual %)	0.0041	
Foreign direct investment, net inflows (% of GDP)	0.0020	
General government final consumption expenditure (annual % growth)	0.0891	
Official exchange rate (LCU per US$, period average)	-0.0021	

"Figure 8. Excluding Hungary"

PanelOLS Estimation Summary

Dep. Variable:	Inflation	R-squared:	0.8651
Estimator:	PanelOLS	R-squared (Between):	0.9049
No. Observations:	247	R-squared (Within):	0.7762
Date:	Mon, May 12 2025	R-squared (Overall):	0.8195
Time:	22:11:27	Log-likelihood	-378.98
Cov. Estimator:	Clustered		
		F-statistic:	191.51
Entities:	19	P-value	0.0000
Avg Obs:	13.000	Distribution:	F(7,209)
Min Obs:	13.000		
Max Obs:	13.000	F-statistic (robust):	1845.3
		P-value	0.0000
Time periods:	13	Distribution:	F(7,209)
Avg Obs:	19.000		
Min Obs:	19.000		
Max Obs:	19.000		

Parameter Estimates

	Parameter	St
const	-1.2501	
Trade	0.0254	
Trade_Euro	-0.0140	
Lagged_Inflation	0.8138	
GDP growth (annual %)	-0.0004	
Foreign direct investment, net inflows (% of GDP)	0.0016	
General government final consumption expenditure (annual % growth)	0.0841	
Official exchange rate (LCU per US$, period average)	-0.0027	

"Figure 9. Excluding Hungary"

Conclusions

1. Across every specification, the coefficient on lagged inflation is large (≈ 0.80–0.92), highly significant ($p < 0.01$), and explains most of the within-country R^2. This confirms strong price inertia: past inflation is the primary driver of current inflation in Europe.

2. The contemporaneous trade openness coefficient is small and statistically insignificant in the baseline model ($\beta \approx 0.01$, $p > 0.2$), and remains so when interacting with a Eurozone dummy or using a 1-year lag of trade. This suggests that, contrary to some theoretical expectations, higher trade volumes do not mechanically translate into lower (or higher) inflation once inertia and other macro controls are accounted for.

3. GDP growth generally has a positive but weak effect on inflation ($p > 0.1$). FDI inflows and government consumption show the correct signs but are usually insignificant. Exchange rate pass through is negligible in our sample.

4. Model fit is very good-and improves with outlier removal. The baseline model achieves an overall R^2 around 0.83, rising to 0.86 after excluding Hungary and the Slovak Republic. This robustness check indicates that a small number of countries with atypical inflation dynamics can slightly distort the panel fit—but the core results remain unchanged.

5. Diagnostics confirm validity. Residuals vs. fitted and lagged-residuals plots show no clear heteroscedasticity or autocorrelation patterns, and clustering by year or country yields consistent standard errors. Pearson and Spearman correlation matrices (see Appendix A) reveal no extreme multicollinearity among regressors.

"While trade openness can affect inflation indirectly—by changing import prices or increasing competition—its direct impact is small. This means policymakers shouldn't rely on trade alone to control inflation but should use it alongside other tools like sound monetary and fiscal policies."

Appendix A.1 Pearson Correlation Matrix

Pearson Correlation:

	Inflation	Trade	Lagged_Inflation	GDP growth (annual %)	Foreign direct investment, net inflows (% of GDP)	General government final consumption expenditure (annual % growth)	Net barter terms of trade index (2015 = 100)	Unemployment, total (% of total labor force) (modeled ILO estimate)	Official exchange rate (LCU per US$, period average)
Inflation	1.00	-0.08	0.91	0.21	0.02	-0.14	-0.21	-0.02	0.11
Trade	-0.08	1.00	-0.11	0.15	0.20	0.08	-0.00	-0.33	0.28
Lagged_Inflation	0.91	-0.11	1.00	0.09	0.01	-0.21	-0.21	0.02	0.10
GDP growth (annual %)	0.21	0.15	0.09	1.00	0.04	0.22	-0.04	0.09	0.07
Foreign direct investment, net inflows (% of GDP)	0.02	0.20	0.01	0.04	1.00	0.05	0.12	-0.09	0.31
General government final consumption expenditure (annual % growth)	-0.14	0.08	-0.21	0.22	0.05	1.00	0.10	-0.05	0.08
Net barter terms of trade index (2015 = 100)	-0.21	-0.00	-0.21	-0.04	0.12	0.10	1.00	0.04	-0.00
Unemployment, total (% of total labor force) (modeled ILO estimate)	-0.02	-0.33	0.02	0.09	-0.09	-0.05	0.04	1.00	-0.13
Official exchange rate (LCU per US$, period average)	0.11	0.28	0.10	0.07	0.31	0.08	-0.00	-0.13	1.00
(modeled ILO estimate)									
Official exchange rate (LCU per US$, period average)	0.22	0.21	0.28	0.20	0.30	0.08	0.07	-0.06	1.00

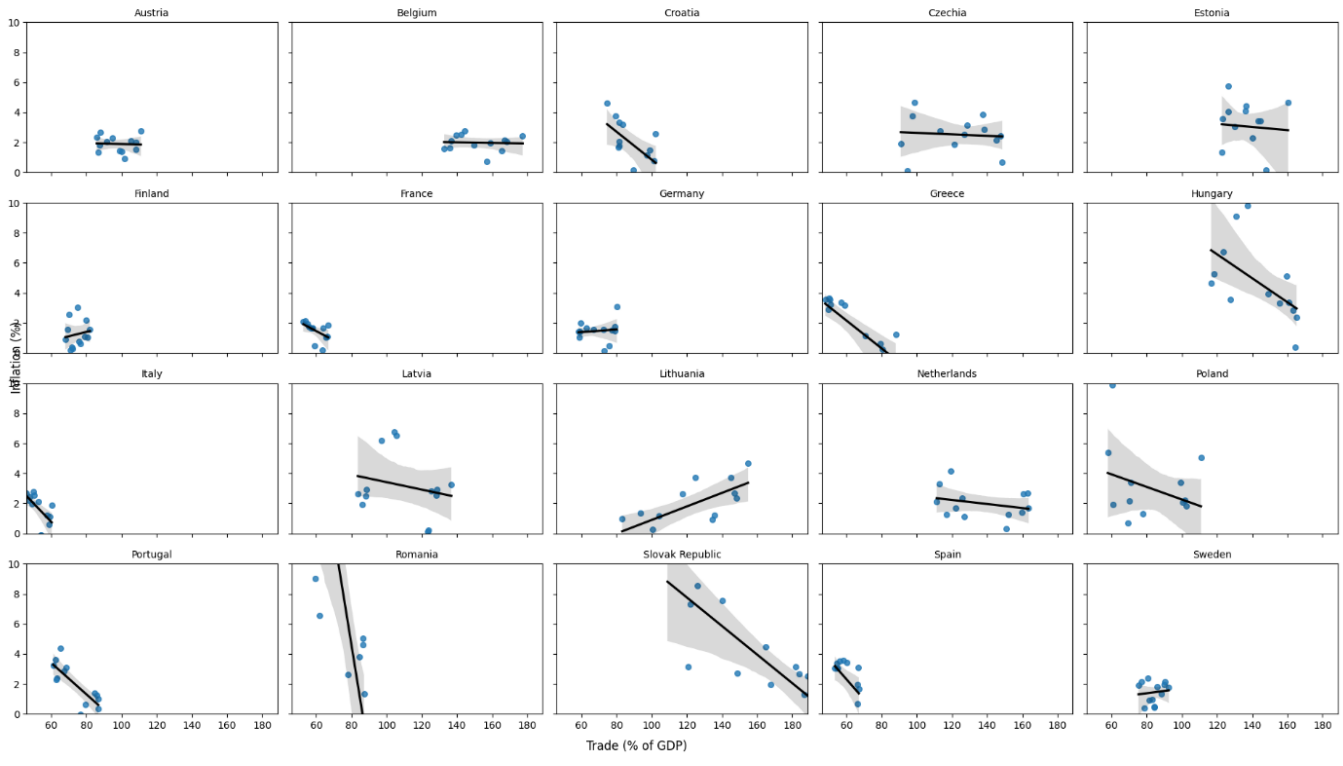
Appendix A.2 Spearman Correlation Matrix

Spearman Correlation:

	Inflation	Trade	Lagged_Inflation	GDP growth (annual %)	Foreign direct investment, net inflows (% of GDP)	General government final consumption expenditure (annual % growth)	Net barter terms of trade index (2015 = 100)	Unemployment, total (% of total labor force) (modeled ILO estimate)	Official exchange rate (LCU per US$, period average)
Inflation	1.00	0.08	0.50	0.42	0.25	0.26	0.03	-0.09	0.22
Trade	0.08	1.00	0.01	0.22	0.34	0.08	0.02	-0.41	0.21
Lagged_Inflation	0.50	0.01	1.00	0.05	0.14	0.16	0.14	0.02	0.28
GDP growth (annual %)	0.42	0.22	0.05	1.00	0.31	0.32	-0.10	0.14	0.20
Foreign direct investment, net inflows (% of GDP)	0.25	0.34	0.14	0.31	1.00	0.11	0.14	-0.07	0.30
General government final consumption expenditure (annual % growth)	0.26	0.08	0.16	0.32	0.11	1.00	0.07	-0.03	0.08
Net barter terms of trade index (2015 = 100)	0.03	0.02	0.14	-0.10	0.14	0.07	1.00	0.04	0.07
Unemployment, total (% of total labor force) (modeled ILO estimate)	-0.09	-0.41	0.02	0.14	-0.07	-0.03	0.04	1.00	-0.06
Official exchange rate (LCU per US$, period average)	0.22	0.21	0.28	0.20	0.30	0.08	0.07	-0.06	1.00

Appendix B

Inflation vs. Trade Openness by country



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Trade effects of the euro: Evidence from sectoral data

Baldwin et al. estimate gravity and synthetic-control models for euro-area countries, finding that the single currency—and the deeper trade integration it enabled—had spillover effects on sectoral price levels and inflation dynamics.

Link