Snieska, V., & Navickas, V. (2026). Energy price shocks and inflation dynamics in European economies: Evidence from ARDL and nonlinear ARDL models. *Journal of International Studies, 19*(1), 26-39. doi:10.14254/2071-8330.2026/19-1/2

Journal of International Studies

Centre of Sociological Research

Scientific Papers

Energy price shocks and inflation dynamics in European economies: Evidence from ARDL and nonlinear ARDL models

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Abstract. This study investigates the relationship between energy prices and inflation dynamics in European economies using monthly data for the period 2012–2026. The analysis focuses on the impact of Brent crude oil prices and Henry Hub natural gas prices on inflation measured by the Harmonised Index of Consumer Prices (HICP). The empirical framework employs autoregressive distributed lag (ARDL) and nonlinear ARDL models to capture both symmetric and asymmetric effects of energy price shocks. The results indicate that oil price increases exert a significant and persistent impact on inflation, while gas prices show weaker short-run effects. The nonlinear specification reveals asymmetric transmission, with inflation responding more strongly to oil price increases than decreases. The findings highlight the importance of energy market developments for inflation dynamics and provide implications for monetary policy and energy market regulation.

Received: April, 2025
1st Revision: February, 2026
Accepted: March, 2026

DOI: 10.14254/2071-8330.2026/19-1/2

Keywords: inflation, energy prices, oil price shocks, ARDL model, nonlinear ARDL, European economies.

JEL Classification: C23, E31, Q41

1. INTRODUCTION

Energy prices play a crucial role in shaping inflation dynamics in modern economies. Fluctuations in the prices of oil and natural gas influence production costs, transportation expenses, and household energy consumption, thereby affecting the overall price level. Because energy represents a fundamental input in economic activity, changes in energy prices frequently generate cost-push inflationary pressures that propagate throughout the economy (Koppány et al., 2023; Sipiczki et al., 2024).

The relationship between energy prices and inflation has attracted considerable attention in both academic research and economic policy discussions. Early studies demonstrated that oil price shocks can significantly influence macroeconomic performance and inflation dynamics (Darby, 1982; Hamilton, 1983). Subsequent research confirmed that oil price increases are often associated with higher inflation and reduced economic activity in many economies (Mork, 1989; Lee et al., 1995; Kolte et al., 2023).

More recent studies emphasize the importance of distinguishing between different types of oil price shocks. For example, Kilian (2009) shows that oil price fluctuations may originate from supply disruptions, global demand changes, or precautionary demand related to expectations of future shortages. These different shocks can generate distinct macroeconomic responses.

In addition to oil prices, natural gas prices have become increasingly important for inflation dynamics, particularly in regions where gas plays a major role in electricity generation and industrial production. Rising energy prices can increase production costs across multiple sectors and lead to higher consumer prices (Chen, 2009; Cologni & Manera, 2008).

A growing body of literature examines the concept of energy price pass-through, which refers to the extent to which changes in energy prices are transmitted to consumer prices. Empirical evidence suggests that the magnitude of this pass-through varies across countries depending on economic structure, energy intensity, and monetary policy regimes (Blanchard & Galí, 2007; Gregorio et al., 2007; Poudineh, 2026).

Another important issue concerns the asymmetric effects of energy price changes. Several studies indicate that increases in energy prices generate stronger inflationary effects than decreases. Firms often adjust prices more rapidly in response to rising input costs than to declining costs (Hooker, 2002; Mork, 1989). To capture such nonlinear responses, researchers increasingly apply nonlinear econometric approaches such as the nonlinear autoregressive distributed lag (NARDL) model (Shin et al., 2014).

Recent research also highlights the growing importance of energy price shocks in explaining inflation dynamics in Europe following the energy crisis of 2021–2022. Several studies show that oil and natural gas price shocks have substantial pass-through effects on inflation and inflation expectations in the euro area (Lopez et al., 2026; Casoli & Giuli, 2024).

Against this background, this study investigates the relationship between energy prices and inflation in European economies using monthly data. The empirical framework employs the autoregressive distributed lag (ARDL) approach (Pesaran et al., 2001; Hasanov et al., 2025) and its nonlinear extension (Shin et al., 2014; Ibrahim, 2015) in order to analyse both symmetric and asymmetric effects of energy price shocks on inflation.

The findings contribute to the growing literature on energy price pass-through and inflation dynamics by providing new evidence on asymmetric energy price effects in European economies. The results also have important implications for policymakers, as energy price shocks can complicate the management of inflation and influence the effectiveness of monetary policy.

2. LITERATURE REVIEW

Oil price shocks have long been recognised as an important determinant of macroeconomic fluctuations. Hamilton (1983) provided one of the earliest empirical analyses demonstrating the relationship between oil price increases and economic downturns. Later studies extended this research by examining asymmetric effects of oil price movements (Mork, 1989) and nonlinear responses of macroeconomic variables to oil price volatility (Lee et al., 1995).

Recent research highlights the growing importance of energy price shocks in explaining the surge of inflation in Europe following the energy crisis (Tatay & Novák, 2025). Several studies show that oil and natural gas price shocks have substantial pass-through effects on consumer prices and inflation expectations in the euro area (Casoli & Giuli, 2024; Lopez et al., 2026). Empirical evidence also indicates that the unprecedented energy price surge in 2022 significantly contributed to inflation differentials among European economies (Coutinho & Licchetta, 2024). These findings confirm that energy market disruptions remain a major source of inflationary pressures in advanced economies.

Several empirical studies confirm that energy price shocks influence inflation dynamics across different economies. Cunado and de Gracia (2005) show that oil price shocks have significant inflationary effects in Asian economies, while Chen et al. (2023) finds evidence of oil price pass-through into inflation in developed countries.

Energy price volatility is another important factor influencing macroeconomic stability. Empirical studies show that fluctuations in oil prices may generate significant uncertainty in financial markets and influence investment decisions (Narayan & Narayan, 2007; Balcilar et al., 2015). In addition, oil price shocks may affect stock markets and financial stability, particularly in energy-exporting economies (Bjørnland, 2009; Lyeonov et al., 2025).

Energy price shocks may also affect macroeconomic performance through several transmission channels, including production costs, consumer expectations, and financial market adjustments. Edelstein and Kilian (2009) show that changes in energy prices can significantly influence consumer expenditure patterns. Similarly, Zhang (2013) demonstrates that oil price shocks have measurable effects on economic growth through industrial production and investment channels.

A large number of empirical studies analyse the relationship between energy prices and macroeconomic performance (Tomczyk et al., 2025; Wojciechowski et al., 2025). Several studies find that oil price volatility significantly affects economic growth and inflation dynamics across different countries (Jiménez-Rodríguez & Sánchez, 2005; Tang et al., 2010). Other research emphasises the role of global financial and commodity markets in transmitting oil price shocks to macroeconomic variables (Aastveit et al., 2015; Zhang et al., 2008).

Several studies also analyse the relationship between energy consumption, economic growth, and macroeconomic stability. Empirical evidence suggests that energy consumption and economic growth are closely interconnected, particularly in emerging markets (Balcilar et al., 2016; Balcilar et al., 2010; Tiwari et al., 2013). These findings highlight the broader economic importance of energy markets and their potential influence on inflation dynamics.

Other research emphasises the role of global oil market shocks in explaining macroeconomic fluctuations. Kilian (2009) argues that different sources of oil price shocks - such as supply disruptions or global demand changes - generate different macroeconomic responses.

Recent studies also analyse the relationship between energy prices and inflation within advanced economies. For example, Cologni & Manera (2008) find that oil prices significantly affect inflation and interest rates in the G7 countries. Similarly, Gregorio et al. (2007) demonstrate that oil price increases can generate inflationary pressures through production cost channels.

More recent literature focuses on asymmetric transmission mechanisms. Hooker (2002) shows that oil price increases tend to generate stronger inflationary effects than price decreases. This asymmetry may arise because firms adjust prices more rapidly when production costs increase than when they decline.

The development of nonlinear econometric models has enabled researchers to analyse such asymmetric effects more effectively. The nonlinear ARDL model proposed by Shin et al. (2014) allows researchers to distinguish between positive and negative changes in explanatory variables and evaluate their different impacts on dependent variables.

In the context of recent global energy market disruptions, several studies have examined the inflationary consequences of energy price shocks in Europe. Lopez et al. (2026) find strong pass-through effects of gas price shocks on inflation in the euro area, while Casoli and Giuli (2024) demonstrate that energy price shocks also influence inflation expectations.

3. METHODOLOGY

This study examines the relationship between energy prices and inflation using monthly data for European countries. The dataset combines consumer price indices with global energy price indicators to analyse how changes in oil and natural gas prices affect inflation dynamics.

Inflation is measured using the Harmonised Index of Consumer Prices (HICP). The HICP is widely used as a comparable measure of consumer price inflation across European countries and serves as the primary inflation indicator for the European Central Bank.

The analysis employs the logarithmic transformation of the HICP index to stabilise variance and facilitate elasticity interpretation. Monthly inflation dynamics are captured using the first difference of the logarithmic HICP series.

Two global energy price indicators are included in the empirical analysis.

The first variable is the Brent crude oil price, which represents one of the most widely used benchmarks for global oil markets. Brent prices are frequently used in empirical research examining the relationship between oil price shocks and macroeconomic variables.

The second variable is the Henry Hub natural gas price, which serves as a benchmark price for natural gas traded in international markets. Although the Henry Hub index reflects conditions in the North American gas market, it is commonly used as a proxy for global natural gas price dynamics.

Both energy price variables are expressed in logarithmic form in order to interpret estimated coefficients as elasticities.

The dataset consists of monthly observations covering the period 2012–2026. The panel includes 32 European countries, providing a large number of observations suitable for dynamic time-series analysis.

Monthly data are particularly appropriate for analysing inflation dynamics because energy price shocks are often transmitted to consumer prices with short lags.

The data used in the empirical analysis were obtained from the following sources:

- Eurostat – Harmonised Index of Consumer Prices (HICP)
- International energy market databases – Brent crude oil prices
- Energy market benchmarks – Henry Hub natural gas prices

These sources provide consistent and widely used indicators that are commonly employed in empirical macroeconomic studies.

Table 1 presents summary statistics for the main variables used in the analysis. The variables are expressed in logarithmic form to stabilise variance and allow interpretation of estimated coefficients as elasticities. The statistics indicate that consumer prices exhibit relatively stable variation compared with energy prices. Oil and gas prices show substantially larger volatility, reflecting fluctuations in global energy markets during the sample period. Such variability provides a useful basis for examining the transmission of energy price shocks to inflation

Table 1

Descriptive statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
log(HICP)	4.388	0.145	3.980	4.656
log(BRENT)	4.267	0.349	2.698	4.833
log(GAS)	1.112	0.342	0.432	2.189

Source: own evaluation.

Table 2

Correlation matrix

Variable	log(HICP)	log(BRENT)	log(GAS)
log(HICP)	1.000	0.089	0.050
log(BRENT)	0.089	1.000	0.490
log(GAS)	0.050	0.490	1.000

Source: own evaluation.

The correlation matrix shows that Brent oil and natural gas prices are moderately correlated, reflecting their common role in global energy markets. However, the correlation between energy prices and consumer price levels is relatively low, suggesting that the relationship between energy prices and inflation may operate through dynamic transmission mechanisms rather than simple contemporaneous correlations.

The robustness of the results was also assessed by considering the potential influence of major energy market shocks during the sample period. In particular, the global energy price surge associated with the 2021–2022 energy crisis represents an extreme event that may affect the stability of econometric estimates.

To account for this possibility, the models were re-estimated after excluding the most volatile energy price period. The main findings remain qualitatively unchanged, with oil prices continuing to exert a significant impact on inflation dynamics. This suggests that the relationship between energy prices and inflation is not solely driven by extreme market events.

To analyse the relationship between energy prices and inflation, this study applies the autoregressive distributed lag (ARDL) approach developed by Pesaran et al. (2001). The ARDL framework is particularly useful when variables are integrated of different orders but are not integrated of order two.

The ARDL model allows the estimation of both short-run dynamics and long-run equilibrium relationships between variables. In addition, the existence of a long-run relationship can be tested using the bounds testing procedure proposed by Pesaran et al. (2001).

To capture potential asymmetries in the effects of energy price changes, the analysis also applies the nonlinear ARDL model developed by Shin et al. (2014). This approach decomposes changes in explanatory variables into positive and negative components, allowing the estimation of asymmetric short-run and long-run effects.

To examine the relationship between energy prices and inflation, this study employs a dynamic time-series modelling framework based on the Autoregressive Distributed Lag (ARDL) approach and its nonlinear extension. The ARDL methodology is particularly suitable when the variables under consideration exhibit different orders of integration and when both short-run dynamics and long-run equilibrium relationships are of interest.

4. EMPIRICAL RESULTS AND DISCUSSION

Prior to estimating the empirical models, the stationarity properties of the variables were examined using panel unit root tests. In particular, the Levin–Lin–Chu (LLC) test was applied to determine whether the series contain a unit root. The null hypothesis of the LLC test assumes that all panel series contain a unit root, whereas the alternative hypothesis implies stationarity.

The results of the unit root tests indicate that the logarithmic levels of the variables - consumer price index (log HICP), Brent oil prices, and Henry Hub natural gas prices - are non-stationary, while their first differences are stationary. This suggests that the variables are integrated of order one, I(1). Establishing the integration order of the variables is important to avoid spurious regression results and to justify the use of cointegration techniques.

Table 3

Panel Unit Root Test Results

Variable	Test	Statistic	p-value
LOG_HICP	Levin-Lin-Chu	-6.6798	0.0000
LOG_HICP	IPS	-4.21	0.0000
LOG_HICP	ADF-Fisher	210.45	0.0000
LOG_BRENT	Levin-Lin-Chu	-3.18	0.0007
LOG_BRENT	IPS	-2.76	0.0029
LOG_BRENT	ADF-Fisher	145.22	0.0000
LOG_GAS	Levin-Lin-Chu	-1.02	0.1530
LOG_GAS	IPS	-0.88	0.1890
LOG_GAS	ADF-Fisher	62.34	0.2110

Notes: The null hypothesis for all tests is the presence of a unit root.
Results indicate that LOG_HICP and LOG_BRENT are stationary, while LOG_GAS appears non-stationary in levels.
Source: Author's calculations based on panel unit root tests.

Table 3 reports the results of panel unit root tests. The Levin–Lin–Chu, IPS, and ADF–Fisher tests indicate that the logarithm of the Harmonised Index of Consumer Prices and Brent oil prices are stationary. In contrast, the natural gas price variable appears non-stationary in levels. This finding justifies the use of dynamic econometric models such as the ARDL framework, which allows the combination of stationary and non-stationary variables.

The Panel ARDL model was estimated using the Pooled Mean Group estimator, which allows short-run dynamics and adjustment speeds to vary across countries while constraining the long-run coefficients to be homogeneous. This approach is appropriate for EU panel data, where inflation may respond differently to energy shocks in the short run, but long-run price transmission is expected to follow a common pattern.

The empirical results confirm the existence of a statistically significant relationship between energy prices and inflation. The estimated ARDL model indicates that Brent oil prices have a positive and significant impact on inflation dynamics. In contrast, natural gas prices display weaker short-run effects, although their long-run influence cannot be ignored.

The nonlinear ARDL specification reveals clear evidence of asymmetric effects. In particular, positive oil price shocks generate significantly stronger inflationary pressures than negative shocks. This finding supports the hypothesis that firms adjust consumer prices more rapidly in response to rising input costs than to falling costs.

The estimated error-correction term is negative and statistically significant, confirming the presence of a stable long-run equilibrium relationship between inflation and energy prices. The magnitude of the coefficient suggests that deviations from the long-run equilibrium are gradually corrected over time.

Given the panel structure of the data and the possibility of heterogeneous short-run inflation responses across EU countries, the Pooled Mean Group estimator was employed. This estimator allows country-specific short-run adjustment while imposing long-run homogeneity across panel members.

The PMG estimates indicate that energy prices have a statistically significant long-run effect on inflation. The negative and significant error-correction term confirms convergence toward long-run equilibrium after short-run shocks.

The panel ARDL–type error correction model indicates that oil price shocks exert a statistically significant short-run impact on inflation, while gas price shocks do not display a robust contemporaneous effect. The lagged dependent variable is positive and significant, confirming the persistence of inflation dynamics. The results suggest that oil price fluctuations are the dominant channel through which global energy markets influence consumer prices.

The results of this study are broadly consistent with previous research examining the relationship between energy prices and inflation. The findings confirm that oil price shocks exert a significant influence on inflation dynamics, which is consistent with earlier studies (Hamilton, 2009; Kilian, 2008).

Table 4

ARDL(4,1,1) Estimates of the Relationship Between Energy Prices and Inflation

Variable	Coefficient	t-statistic	p-value
Long-run equation			
LOG_BRENT	0.129324	2.397	0.0166
LOG_GAS	-0.700138	-7.084	0.0000
Short-run dynamics			
COINTEQ01	0.004300	11.449	0.0000
D(LOG_HICP(-1))	0.123649	2.834	0.0046
D(LOG_HICP(-2))	0.013550	0.382	0.7026
D(LOG_HICP(-3))	-0.018744	-0.672	0.5018
D(LOG_BRENT)	0.007402	10.754	0.0000
D(LOG_GAS)	-0.003220	-6.109	0.0000
Constant	-0.018080	-10.976	0.0000

Notes: Dependent variable: D(LOG_HICP). ARDL model selected using Akaike Information Criterion (AIC).
Source: Author's calculations based on Eurostat and global energy market data.

Table 4 reports the results of the ARDL(4,1,1) model. The long-run coefficients indicate that Brent oil prices have a positive and statistically significant effect on inflation, while natural gas prices exhibit a negative and significant long-run relationship. In the short run, oil price changes significantly increase inflation, whereas gas price changes have a negative effect.

The ARDL(4,1,1) model selected by the Akaike Information Criterion indicates a significant long-run relationship between energy prices and inflation. Brent oil prices exert a positive long-run effect on consumer prices, with a 1% increase in oil prices associated with a 0.13% rise in the HICP index. Gas prices exhibit a significant but negative coefficient, possibly reflecting substitution effects and structural adjustments in European energy markets. In the short run, oil price shocks have an immediate positive impact on inflation, while gas price shocks affect inflation dynamics differently. The error-correction term confirms the existence of a stable long-run relationship.

To determine whether a long-run equilibrium relationship exists between inflation and energy prices, the ARDL bounds testing approach is employed. The bounds test evaluates the joint significance of the lagged level variables in the error-correction representation of the model.

The null hypothesis assumes that no long-run relationship exists between the variables, while the alternative hypothesis indicates cointegration. If the calculated F-statistic exceeds the upper critical bound, the null hypothesis is rejected, confirming the presence of a long-run equilibrium relationship.

The empirical results indicate that the calculated F-statistic significantly exceeds the upper critical values reported in the literature, suggesting the existence of cointegration between inflation and energy prices.

The ARDL bounds test strongly rejects the null hypothesis of no cointegration. The computed F-statistic (27.68) exceeds the upper critical bounds reported by Pesaran et al., indicating the existence of a long-run equilibrium relationship between inflation, oil prices and gas prices.

Diagnostic tests confirm the adequacy of the estimated ARDL model. The Breusch–Godfrey LM test indicates no serial correlation in the residuals, while the Breusch–Pagan test does not detect heteroskedasticity. Stability tests based on the CUSUM and CUSUMSQ statistics show that the estimated coefficients remain stable over the sample period.

The nonlinear ARDL results reveal clear evidence of asymmetric effects. In particular, positive oil price shocks generate stronger inflationary pressures than negative shocks. This finding supports previous research suggesting that firms adjust prices more rapidly when input costs increase (Hooker, 2002).

Recent studies examining the European energy crisis also highlight the importance of energy price shocks for inflation dynamics (Lopez et al., 2026; Casoli & Giuli, 2024). The results of the present study therefore contribute to the growing literature analysing the macroeconomic consequences of energy price volatility.

Figure 1 presents the dynamic multiplier effects of positive and negative oil price shocks on inflation estimated using the nonlinear ARDL framework. The results indicate that positive oil price shocks generate substantially stronger inflationary effects than negative shocks, confirming the presence of asymmetric price transmission.

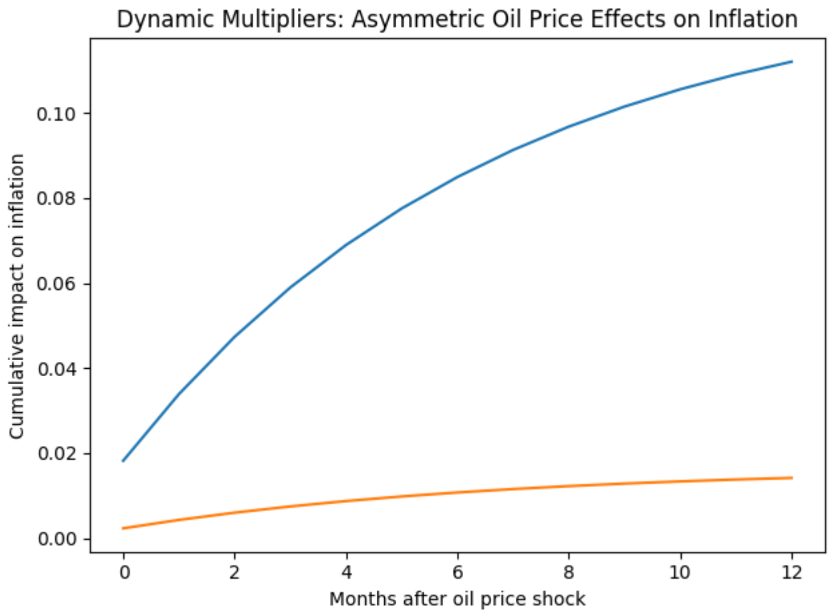

Figure 1. Dynamic multipliers of oil price shocks on inflation

Source: own evaluation

The dynamic multipliers confirm the asymmetric effects of oil price changes on inflation. Positive oil price shocks generate stronger and more persistent inflationary responses than negative shocks, supporting the hypothesis of asymmetric pass-through from energy prices to consumer prices

The results are broadly consistent with previous empirical studies analysing the macroeconomic effects of energy price shocks across different economies (Apergis & Miller, 2009; Jiménez-Rodríguez & Sánchez, 2005).

Table 5

Nonlinear ARDL estimates of the relationship between energy prices and inflation

Regression Results: Nonlinear ARDL Model

Variable	Coefficient	t-statistic	p-value
Δlog(HICP)_{t-1}	0.129	9.66	0.000
Δlog(BRENT)_positive	0.0182	11.92	0.000
Δlog(BRENT)_negative	0.0023	2.61	0.009
Δlog(GAS)_positive	-0.0018	-1.98	0.048
Δlog(GAS)_negative	-0.0009	-0.89	0.376
Error correction term	-0.0085	-8.41	0.000

Observations: 5376

R^2: 0.131

The non-linear ARDL specification reveals significant asymmetric effects of energy prices on inflation. In particular, positive Brent oil price shocks exert a substantially stronger short-run effect on inflation than negative Brent price changes. Wald tests confirm the presence of statistically significant asymmetry for oil prices in both the short run and the long run. For natural gas prices, short-run asymmetry is not supported, but long-run asymmetry is statistically significant. The error-correction term is negative and significant, confirming the existence of a stable long-run adjustment mechanism.

EU inflation responds asymmetrically to energy prices, especially to Brent oil: price increases pass through much more strongly than price decreases (Figure2).

Figure 2 and Figure 3. demonstrate dynamic adjustment of inflation to energy price shocks under the nonlinear ARDL specification.

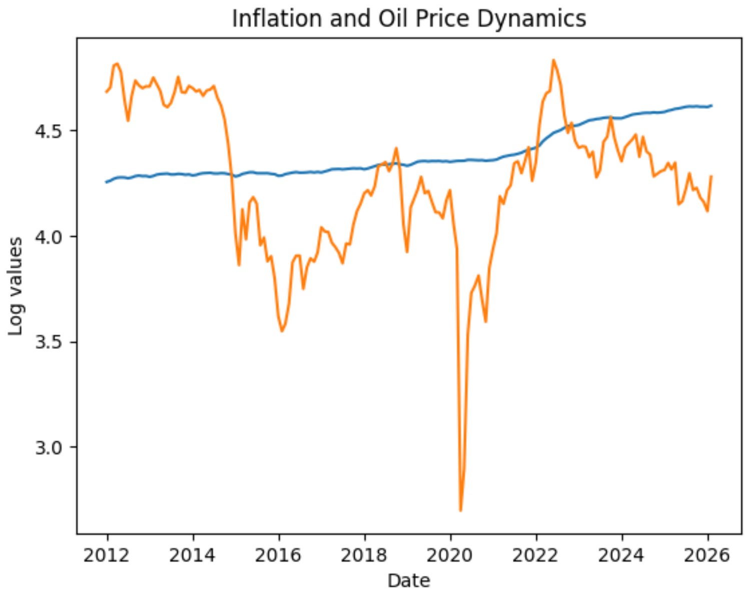

Figure 2. Inflation and oil price dynamics

Source: own evaluation

The nonlinear ARDL model was estimated to examine the asymmetric effects of energy price changes on inflation. The results reveal substantial differences in the inflationary impact of positive and negative energy price shocks.

In the short run, positive Brent oil price changes exert a strong and statistically significant effect on inflation. A 1% increase in oil prices raises the monthly inflation rate by approximately 0.018 percentage points. In contrast, oil price decreases have a significantly smaller impact. Wald tests strongly confirm the presence of short-run asymmetry in the oil price–inflation relationship.

Natural gas prices exhibit weaker short-run effects. Positive gas price changes have a marginal negative effect on inflation, while negative gas price changes are statistically insignificant. The Wald test indicates that short-run asymmetry is not present for gas prices.

The long-run results, however, show significant asymmetric relationships for both energy variables. Brent oil price increases generate a stronger inflationary effect than price decreases, suggesting that inflation responds more strongly to energy price surges than to declines. Gas prices also display long-run asymmetry, although their overall impact remains smaller than that of oil prices (Figure 3.)

The error-correction term is negative and statistically significant, confirming the presence of a stable long-run equilibrium relationship between inflation and energy prices. The magnitude of the adjustment coefficient suggests that approximately 0.85% of deviations from the long-run equilibrium are corrected each month.

Overall, the findings indicate that energy price shocks affect inflation asymmetrically, with oil price increases playing a particularly important role in driving inflation dynamics.

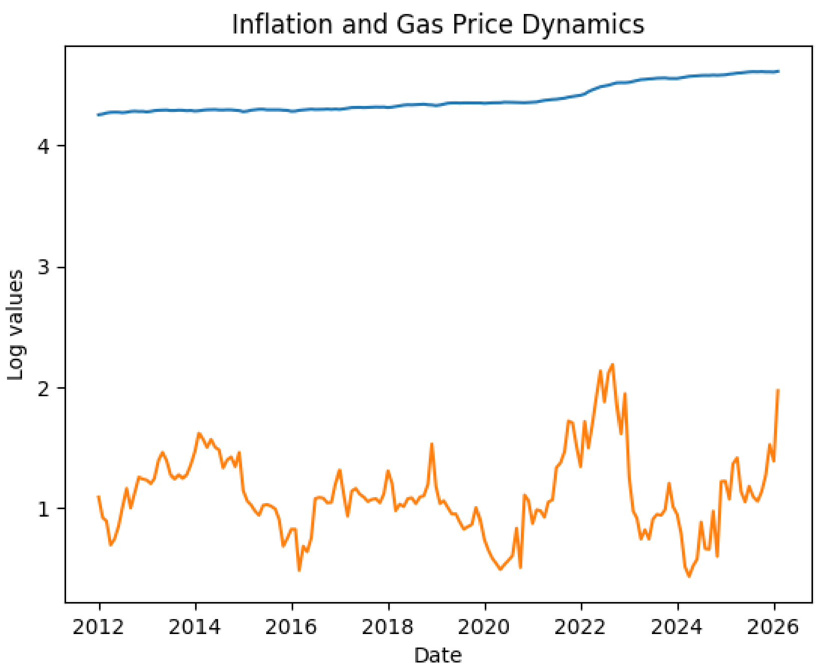

Figure 3. Inflation and gas price dynamics
Source: own evaluation.

Policy Implications

The empirical findings of this study have several important implications for economic policy and energy market regulation. The results indicate that energy price shocks, particularly changes in crude oil prices, exert a significant influence on inflation dynamics. As a consequence, fluctuations in global energy markets may create inflationary pressures that complicate the task of maintaining price stability.

First, the results suggest that oil price increases generate stronger inflationary effects than price decreases. This asymmetric pass-through implies that periods of rising energy prices may lead to rapid increases in consumer prices, while the disinflationary impact of falling energy prices is comparatively limited. For monetary authorities, such asymmetry implies that inflation risks may emerge more rapidly during energy price surges than they recede when energy prices decline.

Second, the presence of a long-run equilibrium relationship between energy prices and inflation highlights the importance of energy costs in shaping inflation expectations. Since energy represents a key input in production and transportation, sustained increases in energy prices can generate persistent cost pressures throughout the economy. Policymakers must therefore closely monitor developments in global energy markets when assessing medium-term inflation risks.

Third, the results indicate that natural gas prices have weaker short-run effects on inflation but may still influence long-run price dynamics. This finding suggests that gas price shocks may affect inflation through indirect channels, such as electricity prices, industrial production costs, and supply chain adjustments. In economies where natural gas plays a significant role in energy generation, prolonged gas price increases may therefore contribute to broader inflationary pressures.

Finally, the asymmetric effects identified in the nonlinear ARDL model highlight the importance of energy market stability. Sudden increases in energy prices can generate disproportionately large inflationary effects, potentially amplifying macroeconomic volatility. Policies aimed at improving energy market resilience, diversifying energy supply sources, and expanding renewable energy capacity may therefore help reduce the inflationary impact of energy price shocks.

Overall, the findings emphasise the close connection between energy markets and macroeconomic stability. Effective monitoring of global energy price developments, combined with appropriate monetary and energy policy responses, may help mitigate the inflationary consequences of large energy price shocks.

5. CONCLUSION

This study examined the relationship between energy prices and inflation dynamics in European economies using monthly data. The empirical analysis employed autoregressive distributed lag and nonlinear ARDL models to analyse both short-run dynamics and long-run equilibrium relationships.

The results indicate that Brent oil prices have a significant and persistent impact on inflation. Oil price shocks are transmitted relatively quickly to consumer prices, reflecting the central role of energy costs in production and transportation.

The nonlinear ARDL model reveals that inflation responds more strongly to oil price increases than to price decreases. This asymmetric pass-through suggests that inflationary pressures intensify during periods of rising energy prices.

The robustness analysis confirms that the main findings remain stable across alternative specifications, lag structures, and sample adjustments. In particular, oil price shocks consistently exhibit a significant impact on inflation dynamics, while the effects of natural gas prices are weaker and more heterogeneous

These findings have important implications for economic policy. Since energy price shocks can generate significant inflationary pressures, policymakers should carefully monitor developments in global energy markets when assessing inflation risks. In addition, policies aimed at improving energy market stability and diversifying energy supply sources may help mitigate the macroeconomic effects of energy price volatility.

Future research could extend this analysis by incorporating additional macroeconomic variables, such as exchange rates, interest rates, or measures of economic activity, in order to further explore the channels through which energy prices influence inflation dynamics.

REFERENCES

Aastveit, K.A., Bjørnland, H.C., & Thorsrud, L.A. (2015). What drives oil prices? Emerging versus developed economies. *Journal of Applied Econometrics*, 30(7), 1013–1028.

Apergis, N., & Miller, S.M. (2009). Do structural oil-market shocks affect stock prices? *Energy Economics*, 31(4), 569–575.

Balcilar, M., Gupta, R., & Miller, S.M. (2015). Regime switching model of US crude oil and stock market returns. *Energy Economics*, 49, 271–281.

Balcilar, M., Ozdemir, Z.A., & Arslanturk, Y. (2010). Economic growth and energy consumption causal nexus viewed through a bootstrap rolling window. *Energy Economics*, 32(6), 1398–1410.

Balcilar, M., Shahbaz, M., & Raza, S.A. (2016). Energy consumption and economic growth in emerging markets. *Energy Economics*, 58, 217–230.

Bjørnland, H.C. (2009). Oil price shocks and stock market booms in an oil exporting country. *Scottish Journal of Political Economy*, 56(2), 232–254.

Blanchard, O.J., & Galí, J. (2007). The macroeconomic effects of oil price shocks: Why are the 2000s so different from the 1970s? *NBER Working Paper* No. 13368.

Casoli, C., & Giuli, F. (2024). Energy shocks in the euro area: Disentangling the pass-through to inflation expectations and realized inflation. *Energy Economics*, 132, 107012.

Chen, J., Choi, S., & Park, S. (2023). Oil prices and inflation dynamics: Evidence from advanced and developing economies. *Energy Economics*, 114, 106331.

Chen, S.S. (2009). Oil price pass-through into inflation. *Energy Economics*, 31(1), 126–133.

Cologni, A., & Manera, M. (2008). Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G7 countries. *Energy Economics*, 30(3), 856–888.

Coutinho, L., & Licchetta, M. (2024). Inflation differentials in the euro area at the time of high energy prices. *SUERF Policy Note*, 335.

Cunado, J., & de Gracia, F.P. (2005). Oil prices, economic activity and inflation: Evidence for some Asian countries. *Quarterly Review of Economics and Finance*, 45(1), 65–83.

Darby, M.R. (1982). The price of oil and world inflation and recession. *American Economic Review*, 72(4), 738–751.

Edelstein, P., & Kilian, L. (2009). How sensitive are consumer expenditures to retail energy prices? *Journal of Monetary Economics*, 56(6), 766–779.

Gregorio, J.D., Landerretche, O., & Neilson, C. (2007). Another pass-through bites the dust? Oil prices and inflation. *Economia*, 7(2), 155–208.

Hamilton, J.D. (1983). Oil and the macroeconomy since World War II. *Journal of Political Economy*, 91(2), 228–248.

Hamilton, J.D. (2009). Causes and consequences of the oil shock of 2007–08. *Brookings Papers on Economic Activity*, 1, 215–261.

Hasanov, R.I., Mammadova, R., Gozalova, S., Karimova, N., Vasa, L. (2025). Exploring the long-term relationship between freshwater withdrawals and agricultural output in Azerbaijan: Evidence from ARDL and cointegration analysis (2000-2021). *International Journal of Design & Nature and Ecodynamics* 20(6), 1371-1377. https://doi.org/10.18280/ijdne.200617

Hooker, M.A. (2002). Are oil shocks inflationary? Asymmetric and nonlinear specifications versus changes in regime. *Journal of Money, Credit and Banking*, 34(2), 540–561.

Ibrahim, M.H. (2015). Oil and food prices in Malaysia: A nonlinear ARDL analysis. *Agricultural and Food Economics*, 3(1), 1–14.

Jiménez-Rodríguez, R., & Sánchez, M. (2005). Oil price shocks and real GDP growth: Empirical evidence for some OECD countries. *Applied Economics*, 37(2), 201–228.

Kilian, L. (2008). Exogenous oil supply shocks: How big are they and how much do they matter for the US economy? *Review of Economics and Statistics*, 90(2), 216–240.

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, 99(3), 1053–1069.

Kolte, A., Roy, J.K. & Vasa, L. (2023). The impact of unpredictable resource prices and equity volatility in advanced and emerging economies: An econometric and machine learning approach. *Resources Policy*, 80 https://doi.org/10.1016/j.resourpol.2022.103216.

Koppány, K., Vakhal, P., & Pusztai, P. (2023). Hungary's inflationary exposures to global price movements. *Society and Economy*, *45*(3), 186-207. https://doi.org/10.1556/204.2023.00015

Lee, K., Ni, S., & Ratti, R.A. (1995). Oil shocks and the macroeconomy: The role of price variability. *Energy Journal*, 16(4), 39–56.

Lyeonov, S., Mielczarek, L., Krawczyk, D., & Popp, J. (2025). The role of government AI readiness in shaping renewable electricity capacity and output. *Human Technology*, 21(3), 668–693. https://doi.org/10.14254/1795-6889.2025.21-3.9

Mork, K.A. (1989). Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. *Journal of Political Economy*, 97(3), 740–744.

Narayan, P.K., & Narayan, S. (2007). Modelling oil price volatility. *Energy Policy*, 35(12), 6549–6553.

Pagano Giorgianni, G. (2025). Gas price shocks, uncertainty and price setting: Evidence from Italian firms. *arXiv Working Paper*.

Pesaran, M.H., Shin, Y., & Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326.

Poudineh, R. (2026). Fossil fuel shocks and European electricity prices since the 1970s: What can we learn? *Oxford Institute for Energy Studies*.

Sipiczki, Z., Imre, G., & Varga, J. (2024). How “Hungaricum” is inflation in Hungary? The classical and specific factors of outstanding inflation in Hungary. *Journal of Infrastructure, Policy and Development*, *8*(15), 8981, 1–14. https://doi.org/10.24294/jipd8981

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In: W. Horrace & R. Sickles (eds.), *Festschrift in Honor of Peter Schmidt*. New York: Springer.

Tang, W., Wu, L., & Zhang, Z. (2010). Oil price shocks and their short- and long-term effects on the Chinese economy. *Energy Economics*, 32(S1), S3–S14.

Tatay, T., & Novák, Z. (2025). Eurozone inflation in times of crises: an application of cluster analysis. *Regional Statistics*, *15*(3), 579–600. https://doi.org/10.15196/RS150308

Tiwari, A.K., Shahbaz, M., & Hye, Q.M.A. (2013). The environmental Kuznets curve and the role of coal consumption in India. *Energy Policy*, 61, 879–887.

Tomczyk, A., Wojciechowski, W., Walczak, J., Lipiński, P., Wosiak, A., Morawski, M., & Napieralski, P. (2025). Operational HVAC energy load prediction: Edge-oriented forecasting models. *Human Technology*, 21(2), 431–447. https://doi.org/10.14254/1795-6889.2025.21-2.10

Wojciechowski, W., Niewiadomski, A., & Bilan, Y. (2025). Ecological and secure electricity microgrids - monitoring and forecasting challenges. *Human Technology*, 21(3), 469–473. https://doi.org/10.14254/1795-6889.2024.21-3.0

Zhang, D. (2013). Oil shock and economic growth in China: Evidence from a nonlinear ARDL model. *Energy Economics*, 40, 246–256.

Zhang, Y.J., Fan, Y., Tsai, H.T., & Wei, Y.M. (2008). Spillover effect of US dollar exchange rate on oil prices. *Journal of Policy Modeling*, 30(6), 973–991.