APAEA

Balcilar, M., & Usman, O. (2026). Global Energy Market Uncertainty and Exchange Rate Pass-Through to Food Inflation. *Energy RESEARCH LETTERS*, *7*(1). https://doi.org/10.46557/001c.125871

Peer-reviewed research

Global Energy Market Uncertainty and Exchange Rate Pass-Through to Food Inflation

Mehmet Balcilar[1,2], Ojonugwa Usman[3,4,5a]

[1] Department of Economics and Business Analytics, University of New Haven, West Haven, USA, [2] Department of Economics, OSTIM Technical University, 06374 Ankara, Türkiye, [3] Department of Economics, Istanbul Ticaret University, Türkiye, [4] Adnan Kassar School of Business, Lebanese American University, Beirut, Lebanon, [5] Research Center of Development Economics, Azerbaijan State University of Economics (UNEC), Baku AZ1001 Azerbaijan

Keywords: Food inflation, Exchange rate pass-through, Global energy-related uncertainty

JEL Classifications: G10 General, N20 General, International, or Comparative, Q49 Other

https://doi.org/10.46557/001c.125871

Energy RESEARCH LETTERS

Vol. 7, Issue 1, 2026

In this study, we investigate the exchange rate pass-through (ERPT) to food inflation for 39 countries during low and high global energy market uncertainties. Using data for the period 2010Q1 to 2022Q2 and a nonlinear panel threshold model, the study reveals that the ERPT to food inflation is 0.2021% for a 1% change in the local currency. This occurs only when global energy market uncertainty crosses a threshold level of 0.3851 (38.51%). The implication of our results is that the ERPT is incomplete and regime dependent. These findings could help the central banks to formulate an optimal monetary policy to reduce the vulnerability to external shocks, especially from the global energy markets.

I. Introduction

The turmoil in the Middle East since the 1970s and geopolitical risks around the world have posed energy crises. In 2020, following the outbreak of the COVID-19 pandemic, energy prices dropped significantly. Oil prices, for example, plummeted from USD 55.66 to USD 32.01 in February 2020. By April 2020, oil prices further dropped to USD 18.38 per barrel, after which the price of crude oil rose astronomically to its peak at USD 122.70 in June 2022. The rise in oil and gas prices reached levels above pre-pandemic levels. For example, in Europe, gas prices have increased by 145%, while oil prices have increased by 46% since July 2021 (Mirza et al., 2023). Over the same period, the average core and food inflation increased significantly. Additionally, the war between Ukraine and Russia, as well as the conflicts between Israel and Hamas in the Middle East, have further intensified the extent to which geopolitical events affect global economic performance. Theoretically, uncertainty in the energy market affects the economic decisions of firms and households by discouraging firms from hiring and investing and households from spending, leading to an increase in precautionary pricing and savings motives. From the perspective of the empirical literature, uncertainty shocks can manifest as aggregate demand shocks or aggregate supply shocks (Usman et al., 2024). The former increases domestic inflation through cost-push shocks, while the latter triggers both precautionary pricing and the saving motives of firms and households. For example, uncertainty shocks prevent firms from being able to set future price levels; hence, firms would raise today's prices to cover the stream of future profit. This eventually leads to a rise in domestic prices (Cho et al., 2021).

Studies have extensively investigated the extent to which exchange rate movements are transmitted to prices, known as exchange rate pass-through (ERPT). A change in the exchange rate is expected to directly affect not only the costs of production but also the price-cost margins faced by firms. From the empirical literature, three major findings have emerged: first, the ERPT elasticity is less than unity, i.e., incomplete pass-through, especially in the short-to-medium term (Balcilar et al., 2021; Campa & Goldberg, 2005). Second, the ERPT elasticity varies not only across countries but also over time (Balcilar et al., 2021). Lastly, the ERPT has declined over time due to an improved monetary policy environment, leading to low and stable inflation (Taylor, 2000). A number of factors can generate incomplete ERPT. One important explanation in the literature relates to price rigidities—prices are often downward rigid, and quantities are often upward rigid. As summarized by Balcilar & Usman (2021), firms are less likely to adjust their prices upward following exchange rate depreciation due to the menu cost of price adjustments and market share objectives.

a Corresponding author email: ousman@ticaret.edu.tr

Given this background, we investigate a nonlinear relationship between energy market uncertainty and ERPT to food inflation across thirty-nine countries.[1] This contributes to the literature on ERPT by examining the degree of pass-through during different levels of global energy market uncertainty. Additionally, this study investigates the ERPT to food inflation, which has been overlooked in the literature, even though food and energy prices are not included in the computation of core inflation. The empirical evidence suggests that the ERPT to food inflation is incomplete (i.e., 0.2021% for a 1% change in local currency), which occurs only when the level of energy market uncertainty crosses a threshold value of 0.3851 (38.51%).

The remainder of this paper is structured as follows: Section II describes the methodology employed in this paper. Section III presents and discusses the estimated results. The last section concludes the paper with some policy implications.

II. Methodology

We adopt a panel threshold approach proposed by Hansen (2000) to account for the contingent effects of energy-related uncertainty on core and food inflation. This method divides the sample into two regimes of energy market uncertainty using the grid search technique to identify the optimal threshold levels. Specifically, the single threshold model is specified as follows:

$$\begin{aligned}\Delta logF\pi_{i,t} =& \alpha_i + \psi'\Delta logX_{i,t} + \varepsilon_{i,t} \\ &+ \begin{Bmatrix} \Phi^1 \Delta loger_{i,t}, & Z \leq \gamma \\ \Phi^2 \Delta loger_{i,t}, & Z > \gamma \end{Bmatrix}\end{aligned} \quad (1)$$

Where Δ is a diffence operator and log is a natural logarithm. The dependent variable $F\pi_{i,t}$ represents food CPI inflation, $er_{i,t}$ is the nominal effective exchange rate, and the vector $\Delta logX_{i,t}$ is specified as $\Delta logX_{i,t}$ = ($\Delta logy_{i,t}$, $\Delta log\pi^*_{i,t}$)$'$, where $\Delta logy_{i,t}$ is the output and $\Delta log\pi^*_{i,t}$ is the foreign prices. α_i and $\varepsilon_{i,t}$ represent the country-level, i, fixed-effect and error term with finite variance-covariance matrix, Ω_ε, $\varepsilon_{i,t} \sim iid\,(0,\ \Omega_\varepsilon)$, where $i = 1, 2, \ldots, N$ simply denotes individual country and $t = 1, 2, \ldots, T$ denotes time. The threshold variable Z captures the level of energy market uncertainty ($\Delta logeu_{i,t}$) and γ denotes the estimated value of the threshold, which follows the approach of Hansen (1999) wherein the transition across regimes happens sharply. From Equation (1), the threshold γ splits the threshold variable into two regimes, conditioning all determinants of food inflation. Accordingly, countries in the sample are classified into low- and high-energy market uncertainty regimes. The parameters Φ^1 and Φ^2 indicate the pass-through of the exchange rate to food inflation for low- and high- energy market uncertainty regimes, respectively. The estimated threshold value in Equation (1) faces an identification problem under the null hypothesis. To determine the significance of the estimated $\widehat{\gamma}$, a bootstrapped threshold model is recommended (Hansen, 1999). Therefore, Equation (1) can be expanded as follows:

$$\begin{aligned}\Delta logF\pi_{i,t} =& \alpha_i + \Phi^1 \Delta loger_{i,t}\ I(Z \leq \gamma) \\ &+ \Phi^2 \Delta loger_{i,t}\ I(Z > \gamma) + \psi'\Delta logX_{i,t} \\ &+ \varepsilon_{i,t}\end{aligned} \quad (2)$$

Where $I(.)$denotes an indicator function classified as low-$\Delta logeu$ regime if $Z \leq \gamma$ and the high-$\Delta logeu$ regime if $Z > \gamma$. Food inflation is measured using the food price index. The nominal effective exchange rate is used for the exchange rate because it provides a broader perspective. The exchange rate series is obtained from the International Financial Statistics - At a Glance - IMF Data. Global energy market uncertainty is measured by the global energy-related uncertainty index recently developed by Dang et al. (2023). This series is downloaded from the Economic Policy Uncertainty website.[2] For the control variables, the output is captured by the gross domestic product per capita (constant 2015 USD), which is obtained from the World Development Indicators DataBank (worldbank.org).[3] Foreign price is captured by the U.S. producer's price index.[4] The data for food CPI inflation and foreign prices are sourced from the global database of inflation published by the World Bank accessible through this link: https://www.worldbank.org/en/research/brief/inflation-database. Note that all variables are expressed in their natural logarithms

III. Results

To determine the sensitivity of inflation (core and food inflation) to changes in the exchange rate during periods of low and high energy market uncertainty, we use quarterly data from 2010Q1 to 2022Q2 for thirty-nine countries worldwide. These countries were selected based on data availability and include both developed and developing nations. First-differenced variables are employed to address the potential issue of omitted variable bias in the presence of unobserved entity-specific effects, which may help eliminate fixed effects (Wooldridge, 2010). This approach also addresses the non-stationarity of the variables. To estimate the nonlinear panel threshold model, first, we check not only whether the dataset fits into the threshold model but

1 Australia, Austria, Belgium, Brazil, Canada, Switzerland, Chile, China, Cyprus, Czech Republic, Germany, Denmark, Dominican Republic, Spain, France, Finland, Greece, Hungary, Israel, Italy, Japan, Luxembourg, North Macedonia, Malta, Malaysia, Nigeria, Norway, New Zealand, Netherlands, Poland, Portugal, Paraguay, Russia, Singapore, South Africa, Sweden, Trinidad, United Kingdom, and United States.

2 We use the global energy-related uncertainty index, computed as the equal-weighted and GDP-weighted mean of a country-specific energy-related uncertainty index. This series is used for all 39 countries in this study.

3 The annual data for GDP per capita was transformed into quarterly series using a quadratic interpolation method.

4 For the U.S., we used China's Producers Price Index since China is its largest trade partner.

Table 1. Likelihood ratio (LR) test for threshold

Null Hypothesis	F-Statistic	P-value	Critical Value (5%)
Single threshold effect $H_0 : No\ threshold\ effect$	16.07	0.003	8.376
Double threshold effect $H_0 : At\ most\ one\ threshold\ effect$	3.74	0.434	11.453
Triple threshold effect $H_0 : At\ most\ two\ threshold\ effects$	2.32	0.802	19.176

Notes: Reported F-statistic and probability value obtained from 1000 bootstrap repetitions and critical value is reported at 5%.

Table 2. Estimates of ERPT to food inflation

Dependent Variable = $\Delta logF\pi_{i,t}$	Threshold Variable = $\Delta logeu_{i,t}$	
Variables	**Coefficient**	**Std. Error**
Regime-Dependent Regressors		
$\widehat{\Phi}^1$	-0.0088	0.0139
$\widehat{\Phi}^2$	-0.2021***	0.0462
Regime-Independent Regressors		
$\Delta logy_{i,t}$	-0.1428***	0.0343
$\Delta log\pi^*_{i,t}$	0.3279***	0.0402
Constant	0.0062***	0.0004
Estimated Threshold, $\widehat{\gamma}$		
Threshold	0.3851	
95% Confidence Interval	[0.3235, 0.4171]	
Number of Observations	1911	
Number of Countries	39	
F(4, 1868)	21.76 (0.0000)	

Note: *** and ** denote level of significance at 1% and 5%, respectively.

also determine the number of thresholds using the likelihood ratio (LR) test for threshold effects.[5] The results, as presented in Table 1, reveal that the null hypothesis of no threshold is strongly rejected only in the case of a single threshold test. For double and triple thresholds, the results are statistical insignificant. This indicates that a single nonlinear panel threshold model is appropriate for this study.

Furthermore, Table 2 reports the estimates of exchange rate pass-through (ERPT) to food inflation under different regimes of energy market uncertainty. The results indicate that the estimated threshold level is approximately 0.3851 (38.51%). The ERPT coefficient is negative and low in both regimes but is significant only in the high-energy market uncertainty regime, showing evidence of incomplete pass-through. Specifically, a 1% increase in local currency (appreciation of the exchange rate) when energy market uncertainty exceeds the estimated threshold would result in an approximately 0.2021% decrease in food inflation.

In the low-energy market uncertainty regime, there is no evidence of pass-through. Overall, these findings suggest that crises in energy markets—driven by geopolitical risks, conflicts, and rising energy prices—have heightened uncertainty in global economies, contributing to an increase in food inflation. However, in the low-energy market uncertainty regime, firms and producers may not transmit the effects of exchange rate changes to food inflation due to high menu adjustment costs and the need to maintain market share.

As expected, the low ERPT to domestic prices observed in this study may be attributed to the low inflationary environment experienced before the outbreak of the COVID-19 pandemic, as demonstrated by Cheikh & Louhichi (2016) and Soon et al. (2018). Additionally, the impact of monetary policy credibility, as emphasized by Cuitiño et al. (2022), plays a role in these dynamics.

Moreover, regarding the regime-independent regressors, we find that foreign prices are positively related to food inflation, while output exerts a deflationary pressure on food prices. These results enhance our understanding of ERPT, which is crucial for effective monetary policy implementation, exchange rate regime selection, and the transmission

5 The bootstrap method of the LR test for threshold effects is employed in this study (see Hansen, 1999).

of external shocks, especially in the current environment where macroeconomic policies increasingly rely on market instruments.

IV. Conclusion

This study investigates exchange rate pass-through (ERPT) to food inflation under low and high energy-related uncertainty regimes for thirty-nine countries worldwide. We apply a nonlinear panel threshold model to categorize the countries into different energy-related uncertainty regimes, identifying a threshold level of 0.3851 (38.51%). Additionally, we find evidence of low and incomplete ERPT during the period of high energy-related uncertainty, with no evidence of ERPT when energy-related uncertainty falls below the threshold. These findings suggest that central banks should consider global energy market uncertainties when designing monetary policy, as ERPT to food inflation is influenced by the level of energy market uncertainty.

Submitted: August 01, 2024 AEDT. Accepted: September 05, 2024 AEDT. Published: February 17, 2026 AEDT.

This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-SA-4.0). View this license's legal deed at https://creativecommons.org/licenses/by-sa/4.0 and legal code at https://creativecommons.org/licenses/by-sa/4.0/legalcode for more information.

References

Balcilar, M., Roubaud, D., Usman, O., & Wohar, M. E. (2021). Moving out of the linear rut: a period-specific and regime-dependent exchange rate and oil price pass-through in the BRICS countries. *Energy Economics*, *98*, 105249. https://doi.org/10.1016/j.eneco.2021.105249

Balcilar, M., & Usman, O. (2021). Exchange rate and oil price pass-through in the BRICS countries: Evidence from the spillover index and rolling-sample analysis. *Energy*, *229*, 120666. https://doi.org/10.1016/j.energy.2021.120666

Campa, J. M., & Goldberg, L. S. (2005). Exchange rate pass-through into import prices. *Review of Economics and Statistics*, *87*(4), 679–690. https://doi.org/10.1162/003465305775098189

Cheikh, N. B., & Louhichi, W. (2016). Revisiting the role of inflation environment in exchange rate pass-through: A panel threshold approach. *Economic Modelling*, *52*, 233–238. https://doi.org/10.1016/j.econmod.2014.11.004

Cho, D., Han, Y., Oh, J., & Picco, A. R. (2021). Uncertainty shocks, precautionary pricing, and optimal monetary policy. *Journal of Macroeconomics*, *69*, 103343. https://doi.org/10.1016/j.jmacro.2021.103343

Cuitiño, M. F., Medina, J. P., & Zacheo, L. (2022). Conditional exchange rate pass-through and monetary policy credibility: Insights from Uruguay and Chile. *Economic Modelling*, *114*, 105926. https://doi.org/10.1016/j.econmod.2022.105926

Dang, T. H.-N., Nguyen, C. P., Lee, G. S., Nguyen, B. Q., & Le, T. T. (2023). Measuring the energy-related uncertainty index. *Energy Economics*, *124*, 106817. https://doi.org/10.1016/j.eneco.2023.106817

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, *93*(2), 345–368. https://doi.org/10.1016/S0304-4076(99)00025-1

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, *68*(3), 575–603. https://doi.org/10.1111/1468-0262.00124

Mirza, N., Naqvi, B., Rizvi, S. K. A., & Boubaker, S. (2023). Exchange rate pass-through and inflation targeting regime under energy price shocks. *Energy Economics*, *124*, 106761. https://doi.org/10.1016/j.eneco.2023.106761

Soon, S. V., Baharumshah, A. Z., & Wohar, M. E. (2018). Exchange rate pass-through in the Asian countries: does inflation volatility matter? *Applied Economics Letters*, *25*(5), 309–312. https://doi.org/10.1080/13504851.2017.1319553

Taylor, J. B. (2000). Low inflation, pass-through, and the pricing power of firms. *European Economic Review*, *44*(7), 1389–1408. https://doi.org/10.1016/S0014-2921(00)00037-4

Usman, O., Oztan, O., Koy, A., & Adebayo, T. S. (2024). Energy-Related Uncertainty Shocks and Inflation Dynamics in the US: A Multivariate Quantile-on-Quantile Regression Approach. *Structural Change and Economic Dynamics*, *71*, 235–247. https://doi.org/10.1016/j.strueco.2024.07.012

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data* (pp. 279–291). MIT Press.