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Research Article

Macroeconomic determinants of food inflation in Türkiye: Empirical evidence from RALS-based time series analysis

Türkiye'de gıda enflasyonunun makroekonomik belirleyicileri: RALS tabanlı zaman serisi analizinden ampirik bulgular

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Abstract

This study aims to analyse the macroeconomic determinants of food price inflation in Türkiye using monthly data for the period 2015:01–2025:03. Fluctuations in food prices have significant impacts, particularly on the quality of life and food security of low-income households. In this context, food price inflation is used as the dependent variable. In contrast, the agricultural input price index, commercial loan interest rate, exchange rate, and oil prices are employed as explanatory variables. The stationarity properties of the series are examined through the Zivot-Andrews test and the RALS-LM test with structural breaks. The presence of a long-run cointegration relationship among the variables is tested using the RALS-EG test, and long-run coefficients are obtained via the DOLS method, which addresses endogeneity and serial correlation by augmenting the levels equation with leads and lags of first differences. Empirical findings suggest that agricultural input prices, interest rates, and exchange rates have a positive and significant impact on food inflation. Based on the results, reducing agricultural production costs, expanding the availability of low-interest farm loans, and effectively managing energy subsidies are critical to controlling food inflation.

Anahtar Kelimeler: Food Inflation, RALS Cointegration Analysis, Turkish Economy

Jel Kodları: E0, C32, E31

Öz

Bu çalışma, Türkiye'de 2015:01–2025:03 döneminde aylık veriler kullanılarak gıda fiyat enflasyonunun makroekonomik belirleyicilerini analiz etmeyi amaçlamaktadır. Gıda fiyatlarındaki dalgalanmalar, özellikle düşük gelirli hane halklarının yaşam kalitesi ve gıda güvenliği üzerinde önemli etkiler meydana getirmektedir. Bu çerçevede, çalışmada bağımlı değişken olarak gıda fiyatları enflasyonu; açıklayıcı değişkenler olarak ise tarımsal girdi fiyat endeksi, ticari kredi faiz oranı, döviz kuru ve petrol fiyatı kullanılmıştır. Serilerin durağanlık özellikleri Zivot-Andrews testi ve yapısal kırılmalı RALS-LM testi ile analiz edilmiştir. Değişkenler arasında uzun dönemli eşbütünleşme ilişkisi olup olmadığı RALS-EG testi aracılığıyla sınanmış, uzun dönem katsayılar DOLS yöntemiyle araştırılmıştır. Ampirik bulgular, tarımsal girdi fiyatları, faiz oranları ve döviz kurunun gıda enflasyonu üzerinde pozitif ve anlamlı etkilere sahip olduğunu göstermektedir. Elde edilen bulgular doğrultusunda, tarımsal üretim maliyetlerinin azaltılması, düşük faizli tarım kredilerinin yaygınlaştırılması ve enerji sübvansiyonlarının etkin biçimde yönetilmesi gıda enflasyonunu kontrol altına almak açısından önem arz etmektedir.

Keywords: Gıda Enflasyonu, RALS Eşbütünleşme Analizi, Türkiye Ekonomisi

Jel Codes: E0, C32, E31

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Introduction

Inflation is defined as a persistent increase in the general price level over time. Although it affects all economies to varying degrees and intensities, its social and economic consequences are often more profound in developing countries. Recent global developments, such as the pandemic, geopolitical conflicts, and rising production input costs, particularly in the energy sector, have collectively driven inflation upward worldwide, affecting even advanced economies (Sarı, 2024). Food inflation refers explicitly to the rise in prices of food products and is typically measured by the food component of the Consumer Price Index (CPI). In other words, food inflation occurs when the rate of increase in food prices included in the CPI exceeds the overall increase in the general CPI. Regardless of their level of development, food inflation remains one of the most pressing issues on the agenda of policymakers around the world (Yavuz, 2021). Within the framework of economic theory, specifically in the context of this study, food inflation can be explained by the interaction of various factors, including demand-side pressures, cost elements, external shocks, and inflation expectations (Blanchard and Johnson, 2013). Demand-pull inflation arises when aggregate food demand exceeds supply due to rapid increases in money supply or income levels (Mankiw, 2022). Under such circumstances, growing demand for food may lead to upward pressure on prices. In line with the monetarist perspective, the impact of increases in money supply on prices has been frequently emphasised. On the other hand, cost-push inflation explains rising prices as a consequence of increased production costs. Rising prices of inputs used in agricultural production, such as fertiliser, fuel, animal feed, labour, and energy, are likely to be reflected in final food prices, thereby contributing to food inflation (Samal, Ummalla & Goyari, 2022). Although the underlying causes vary across countries, food inflation is also associated with structural issues, such as inefficient domestic financial markets, production shocks, low agricultural productivity, and excessive monetary expansion to finance fiscal deficits (Kuma and Gata, 2023). Following major global events such as the 2008 Global Financial Crisis, the COVID-19 pandemic, and the Russia–Ukraine conflict, volatility in food prices and persistent food inflation have increasingly undermined the purchasing power of lower- and middle-income groups. According to a 2020 report by the World Bank, the poorest households in Türkiye allocate approximately 29% of their total expenditures to food. Consequently, surges in food prices disproportionately impact these households by eroding their real income, diminishing dietary quality, and adversely affecting overall living standards. High food prices have emerged as a significant concern in both underdeveloped and developing economies. This concern is particularly acute because low-income individuals typically allocate nearly three-quarters of their income to essential food items. Such a disproportionate expenditure not only intensifies existing income inequality but also fuels inflationary pressures. Consequently, low-income households are often compelled to rely on less diverse and nutritionally inadequate diets, which negatively impact their overall well-being (Food and Agriculture Organisation, 2024). In recent years, the sharp rise in food prices in Türkiye has raised growing concerns regarding its potential negative implications for household consumption patterns and living standards. These developments have increasingly drawn the attention of policymakers, the media, and the broader public discourse.

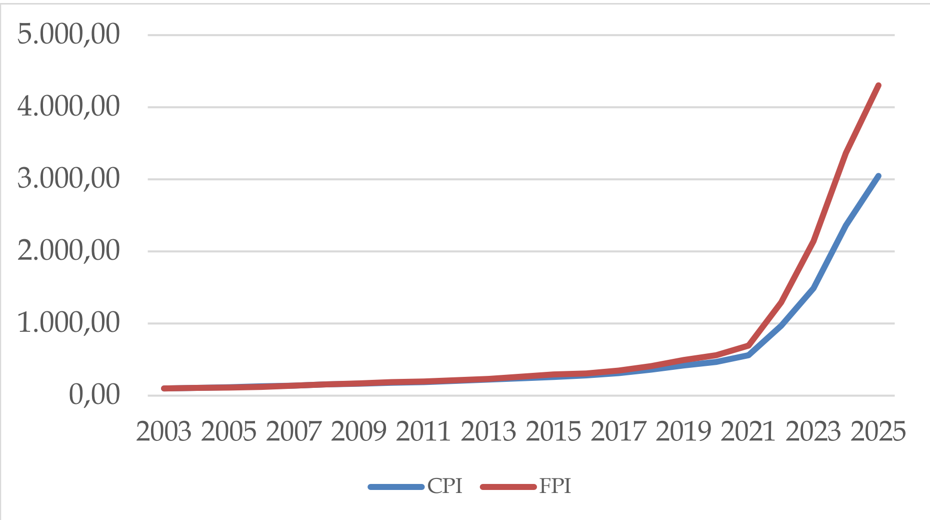

Figure 1: CPI and Food CPI in Türkiye

Source: (EVDS, 2025), https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket

Figure 1 presents a comparative overview of the development of the CPI and the CPI for food and non-alcoholic beverages in Türkiye over the period 2003–2025. Both indices are rebased to the year 2003, allowing for a clear illustration of their divergent trends over time. The food and non-alcoholic beverages sub-index, which constitutes approximately one-quarter of the overall CPI basket in Türkiye, represents a critical component in understanding the country's inflation dynamics. Between 2003 and 2018, the general CPI and the food CPI followed a relatively parallel trajectory. However, a noticeable divergence emerges after 2018, with food prices increasing at a markedly faster pace than the overall price level. This divergence becomes more pronounced from 2020 onward, and the gap between the two indices widens rapidly after 2021. Factors such as supply chain disruptions triggered by the COVID-19 pandemic, exchange rate shocks, and expansionary monetary policies have exerted upward pressure on food prices during this period. As of 2025, the general price level has increased approximately 30-fold compared to 2003, while food prices have risen nearly 42-fold. This indicates that the rate of increase in food prices has significantly outpaced the general rate of inflation, highlighting the structural role of food inflation in driving the overall price level. Given that low-income households allocate a substantial portion of their expenditures to food, the sharp rise in food prices poses serious challenges in terms of income distribution, poverty, and food security. Based on the theoretical arguments and prior evidence discussed above, this study empirically examines the long-run and short-run relationships between exchange rates, input costs, oil prices, interest rates, and food prices. While no formal hypotheses are explicitly stated, the analysis implicitly tests the expectation that cost-push and external dependence channels are central to the dynamics of food inflation.

This study investigates the determinants of food inflation in the Turkish economy for the period between January 2015 and March 2025 using time series methods. To the best of our knowledge, it represents the first attempt to examine the underlying drivers of food inflation in Türkiye by employing RALS (Residual Augmented Least Squares -Lagrange Multiplier) based econometric techniques, which account for structural breaks and deviations from normality. Therefore, the study is expected to contribute meaningfully to the existing literature. The structure of the paper is as follows: after introducing the research problem and its relevance, a comprehensive literature review is presented. This is followed by a detailed explanation of the variables used in the analysis and the methodological framework adopted. The subsequent part discusses the empirical findings in depth. The final part concludes the study and outlines policy implications derived from the results.

Literature review

In recent years, the fluctuating trend in food prices has created significant challenges for both producers and consumers, positioning food inflation as a central topic of economic research. This section reviews previous studies that seek to identify the determinants of food inflation, which encompasses both financial and social dimensions. The existing literature indicates that the macroeconomic and structural variables influencing food prices exhibit considerable heterogeneity across countries and country groups. Furthermore, the choice of time period and econometric model used in the analysis often leads to divergent findings.

Following the sharp rise in U.S. food price inflation in 2007, Baek and Koo (2010) analysed the effects of market factors, namely energy prices, agricultural commodity prices, and exchange rates, on food prices in the United States using monthly data for the 1989–2008 period. The results indicate that agricultural commodity prices and exchange rates play a key role in determining the short and long-term movements of U.S. food prices. As the value of the U.S. dollar fluctuates against the currencies of its major trading partners, it is believed that uncertainty regarding commodity prices in the U.S. increases. Moreover, while energy prices have been identified as an essential determinant of food prices in the long run, they are found to exert only minimal influence on food prices in the short run. This finding reveals a strong long-term linkage between energy and agricultural markets in recent years. In their study focusing on identifying the key determinants of food price inflation in Pakistan, Abdullah and Kalim (2012) examined the period from 1972 to 2008. Employing the Johansen cointegration technique, their empirical findings confirm the existence of long-run relationships between food price inflation and its determinants, namely money supply, per capita GDP, support prices, food imports, and food exports. In the short run, however, only inflation expectations, support prices, and food exports were found to influence food price inflation. These results suggest that both demand-side and supply-side factors play a significant role in determining food price inflation in Pakistan.

In another study using annual data from 1980 to 2007, Guloğlu and Nazlıoglu (2013) investigated the effects of inflation rates on agricultural prices across 28 developed and 83 developing countries using the panel smooth transition regression (PSTR) approach. Their findings reveal that during periods of low inflation, the impact of inflation on agricultural prices is weak, whereas during periods of high inflation, the effect becomes negative. Accordingly, in developed countries, where inflation rates tend to be low, the impact of inflation on agricultural prices is positive. Conversely, in developing countries, where inflation rates are typically higher, the effect is adverse. Irz, Niemi & Liu, (2013) examined the relationship between food prices and agricultural commodity, labour, and energy prices in Finland using monthly data from the period 1995–2010 through a Vector Error Correction (VECM) model. The findings reveal a statistically significant long-run cointegration relationship among these variables, with farm prices identified as the strongest determinant of food prices. The model also indicates that food prices adjust to shocks within six to eight months. Similarly, Tadesse, Algieri, Kalkuhl & von Braun, (2014) analysed the determinants of food prices in Finland using monthly price indices from 1995 to 2010 and employing a VECM model. Their results also support the existence of a long-run cointegration relationship between food prices and agricultural commodities, labour costs, and energy prices. According to their study, farm prices exert the most significant influence on food prices, followed by wages in the food retail sector and energy prices. Additionally, the response of food prices to shocks converges to equilibrium within a period of six to eight months.

Bayramoğlu & Koç Yurtkur (2015) examined the international economic factors affecting food industry product prices and agricultural producer prices in Türkiye using monthly data from the 1999–2014 period within a Vector Autoregression (VAR) framework. The empirical findings indicate that, in the short run, the most influential variable on food industry product prices is the exchange rate. In the long run, although short-term variables remain relevant, oil prices, international food prices, and agricultural producer prices have a limited impact on food industry prices. The key determinants of agricultural producer prices are, in order of importance, the food industry price index, oil prices, and exchange rates. These results suggest that imported price pressures and import dependency significantly influence price increases in Türkiye.

Norazman, Khalid & Ghani, (2018) investigated the supply-side determinants of food prices in Malaysia from a price transmission perspective using monthly data from the period 1991–2013 and employing VECM. The findings confirm that global food commodity prices and the real effective exchange rate are the main determinants of food prices in Malaysia. However, changes in the vertical transmission channel may have been neutralised by factors such as government price controls, subsidy programs, or the structural organisation of the food sector. Ismaya and Anugrah (2018) investigated the determinants of food inflation in Indonesia using quarterly data from 2008 to 2017 and applying the Generalised Method of Moments (GMM) estimator. Their findings indicate that past inflation and inflation expectations exert a strong influence on food inflation. Aytekin and Hatırlı (2021), using monthly data for the period 2016–2020 and applying the Autoregressive Distributed Lag (ARDL) method, analysed the factors affecting unprocessed food inflation in Türkiye. The results reveal that variables such as food manufacturing, the agricultural input price index, and agrarian producer prices all have a positive and statistically significant long-run effect on unprocessed food inflation. Yıldırım (2021) examined the determinants of food prices in the Turkish economy for the period between January 2011 and March 2021 using the Structural Vector Autoregression (SVAR) method. The study included variables such as oil prices, global food prices, interest rates, exchange rates, the growth rate of money supply, and producer prices of agricultural products. The findings reveal that, except for oil prices, all other variables have a statistically significant and positive effect on food prices.

Güngör and Erer (2022) investigated the dynamic relationship between food inflation, exchange rates, and oil prices in Türkiye using monthly data from 2006 to 2021 through the Time-Varying Parameter Vector Autoregression (TVP-VAR) method. Their findings indicate that during the COVID-19 period, the impact of the real exchange rate on food inflation was particularly pronounced. Moreover, starting from October 2021, fluctuations in the exchange rate had a heightened influence on food inflation. Additionally, the discovery of the COVID-19 vaccine and the initiation of vaccination campaigns led to increased demand and production activities, which in turn caused a rise in oil prices, significantly contributing to the escalation of food inflation. Inal, Canbay & Kırca, (2023) investigated the impact of consumer interest rates, the absolute effective exchange rate index, and the food production index on the food price index in Türkiye using annual data from 2008 to 2020. The cointegration test results reveal that all three variables consumer interest rates, real effective exchange rates, and the food production index significantly influence food prices in the long run. Kuma and Gata (2023) analysed the determinants of food inflation in Ethiopia for the period 1990–2021 using the ARDL approach. Their findings indicate that while real GDP and world food prices exert a negative and statistically significant impact on food inflation, money supply, interest rate, rainfall, and domestic food prices have a positive and significant effect. The study concludes with policy recommendations aimed at enhancing food supply security and reinforcing monetary discipline.

In their study, Oral, Cakıcı, Yıldız & Alayoubi, (2023) attempted to identify the global and macroeconomic drivers behind the rise in food prices in Türkiye during the post COVID-19 period. To measure the global influence on food price increases, the authors employed variables such as oil prices, the global fertiliser price index, and the world food price index. For assessing macroeconomic effects, they utilised the M2 money supply and the exchange rate. Using annual data covering the period from 2003 to 2022 and employing the SVAR method, the study found that both global and macroeconomic factors significantly influenced food prices during the analysed period. Accordingly, it was concluded that fluctuations in food prices in Türkiye are driven not only by global developments but also by changes in domestic macroeconomic indicators. Kornher, Balezentis & Santeramo, (2024) analysed food price inflation across 27 EU countries during the periods of the COVID-19 pandemic and the 2022 Russia–Ukraine war. Their findings reveal that global market fluctuations, geopolitical risks, and armed conflicts significantly contributed to rising food inflation. In particular, increases in energy costs and fertiliser prices were identified as the primary drivers of food inflation in Europe during 2021–2022. Komurcuoglu and Artan (2024) show that climate change generates long-run inflationary pressures on both food and consumer prices in Türkiye during 1990–2021. Using ARDL bounds testing and Toda–Yamamoto causality analysis, they also find a bidirectional causal link between climate change and inflation, underscoring the need for monetary policy to account for climate-related risks to price stability.

Bozkurt and Mutlu Çamoglu (2025) investigated the determinants of food inflation in the Turkish economy using the Fourier Bootstrap ARDL approach. The study identified a cointegrating relationship among variables, including the food CPI, food PPI, food industry production index, policy interest rate, and exchange rate. The empirical results indicate that especially increases in food producer prices and the exchange rate exert strong and positive effects on food inflation. Tumturk (2025) analyses the determinants of food inflation in Türkiye using quantile regression over the period 2011M1–2024M8, with variables including food and non-alcoholic beverage prices, monetary policy, real exchange rate, national energy prices, and the global food price index. The findings indicate that contractionary monetary policy exerts destabilising effects on food inflation, as positive interest rate shocks increase food prices. Moreover, both national energy costs and global food prices are found to drive domestic food inflation, underscoring the strong linkage between food prices and international economic conditions. In contrast, no significant relationship is identified between food inflation, the real exchange rate, and domestic demand structure.

The studies summarised above demonstrate that food inflation is a multidimensional phenomenon shaped by country-specific contexts. While factors such as exchange rates, energy prices, money supply, commodity prices, and production costs are consistently emphasised across the literature, several studies also highlight the significance of government interventions (e.g., price controls, subsidies), climate change, global shocks, and structural breaks. Existing studies on Türkiye have predominantly relied on conventional methodologies (VAR, Johansen, ARDL) that often fail to adequately account for structural breaks and the non-normality of error terms. This oversight can lead to biased test statistics, inaccurate inferences regarding stationarity and cointegration, and consequently, misleading policy recommendations. In this regard, the use of RALS-based unit root and cointegration methods in the present study aims to fill this critical gap.

Data and methodology

This study empirically analyses the determinants of food price inflation in Türkiye using monthly data for the period 2015:01–2025:03. All data used in the analysis were obtained from the Electronic Data Delivery System (EVDS) of the Central Bank of the Republic of Türkiye. Descriptive statistics for the variables included in the study are presented in Table 1. All variables were log-transformed before analysis. Since the food price inflation series exhibits significant seasonal patterns, seasonal adjustment was carried out using the TRAMO/SEATS method. Accordingly, the series used in the analysis has been seasonally adjusted.

Table 1: Descriptive Statistics

Variable	Definition	Mean.	Max.	Min.	Std. Dev.	Jarque-Bera Normality Prob.
lfood	Food and Non-Alcoholic Beverages Price Index	1067.713	4184.949	278.1601	1080.664	0.0000
linput	Agricultural Input Price Index	199.8668	707.8100	56.8600	189.3508	0.0000
lint	Commercial Credit Interest Rate	24.30084	66.77250	9.742000	15.24319	0.0000
lex	U.S. Dollar (Exchange Rate – Selling)	11.51025	37.03730	2.332538	10.52674	0.0000
loil	Europe Brent Crude Oil Spot Price (FOB)	66.57000	125.5300	14.85000	19.60688	0.459457

The descriptive statistics of the variables used in this study reveal substantial volatility across the series. Both the Food Price Index (lfood) and the Agricultural Input Price Index (linput) exhibit high means and wide dispersion ranges, indicating considerable variability. Similarly, lint and the lex have demonstrated significant fluctuations throughout the period under examination. In contrast, the loil has remained relatively more stable and is the only variable that conforms to a normal distribution. According to the Jarque-Bera test, the normality assumption is rejected for all other series. This finding provides a strong justification for employing RALS-based methods that account for non-normal error distributions in the empirical analysis.

Testing the stationarity of time series is a fundamental step in time series analysis. In this study, the Zivot-Andrews Model C unit root test (1992) is initially employed to examine the stationarity properties of the variables. Model C was used, which permits a one structural change in both the intercept and the trend slope, with the break date TB selected endogenously over a trimmed search window by minimising the one-sided t-statistic on the unit-root coefficient (Zivot and Andrews, 1992). The test was estimated via an augmented DF regression,

$$\Delta y_t = \mu + \beta_t + \theta DU_t(TB) + \gamma DT_t(TB) + \alpha y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta_{t-i} + \varepsilon_t \quad (1)$$

where $DU_t(TB)$=1(t>TB) captures a post-break level shift and $DT_t(TB)$=(t-TB) 1 (t>TB) captures a post-break change in trend; k lags were included to whiten residuals. The null hypothesis is a unit root, while the alternative is trend-stationarity. Because the break date is selected endogenously, non-standard critical values are used. Rejection indicates stationarity once a single intercept and slope break is accounted for; failure to reject implies difference-stationarity and motivates first-differencing in subsequent analysis. However, it is well-known that the Zivot-Andrews test does not account for non-normality in the error terms. To address these limitations, the unit root properties of the series are further analysed using the single structural break RALS-LM unit root test proposed by Meng, Lee & Payne, (2017). The RALS-LM test is advantageous in that it provides higher test power under non-normal error distributions and is robust to biases associated with the break date, making it a more reliable approach under such conditions.

The first step of the RALS-LM test involves estimating the regression equation presented in Equation 2.

$$\Delta y_t = \Delta Z_t' \gamma + \vartheta S_{t-1}^* + \varepsilon_t \quad (2)$$

S_{t-1}^* denotes the transformed and detrended series in the LM framework. In the RALS-LM test, the variables $\widehat{w}_{2t}$ and $\widehat{w}_{3t}$, derived from the second and third moments of the error terms, are incorporated into the test regression equation.

$$\Delta y_t = \Delta Z_t' \gamma + \vartheta S_{t-1}^* + +\lambda_2 \widehat{w}_{2t} + \lambda_3 \widehat{w}_{3t} + \varepsilon_t \quad (3)$$

The RALS-LM test statistic is computed using Equation 4.

$$\tau_{RALS-LM} = \rho \tau_{LM} + \sqrt{1-\rho^2} Z \quad (4)$$

In this equation, ρ represents the ratio of the error term variance in the RALS-LM equation to the error term variance in the standard LM equation (Hepsag, 2022). To examine the long-run relationship among non-stationary time series, the RALS-EG cointegration test proposed by Lee, Lee & Im, (2015) is employed. This test represents an extended and enhanced version of the traditional Engle-Granger approach. By accounting for the non-normality of error terms, the RALS-EG test improves the statistical power and reliability of the cointegration analysis, making it a more robust alternative for empirical research involving non-normally distributed residuals.

In the second stage of the classical two-step Engle-Granger cointegration test, a regression is estimated based on the residuals obtained from the first stage.

$$\Delta \hat{u}_t = \phi \hat{u}_{t-1} + \varepsilon_t \quad (5)$$

In the RALS-EG test, this regression is estimated using the RALS method as follows:

$$\Delta \hat{u}_t = \phi \hat{u}_{t-1} + \acute{\psi} \widehat{w}_t + v_t \quad (6)$$

In equation 6, $\widehat{w}_t$ represents the vector of additional information derived from the higher-order moments (specifically the second and third moments) of the error terms. This structure enables the test to mitigate information loss caused by non-normality in the error distribution, thereby enhancing its statistical power.

The asymptotic distribution of the RALS-EG test is expressed as follows:

$$t^*_{EG} \rightarrow \rho Z + (1-\rho) t_{EG} \quad (7)$$

In this equation, Z denotes a standard normal variable, and ρ, represents the ratio of the error term variances from the RALS and conventional tests. This formulation clearly illustrates the variance-reducing effect of the test (Lee et al., 2015).

Finally, the long-run coefficients were estimated using the Dynamic OLS (DOLS) method. DOLS augments the cointegrating levels equation with leads and lags of the regressors' first differences to mitigate endogeneity and serial correlation, thereby isolating the long-run relation. Under standard regularity conditions, the resulting estimators are super-consistent and asymptotically normal, with inference based on HAC standard errors. Deterministic terms (constant/trend) and, where warranted, structural-break dummies are included; in log–log specifications, the estimated coefficients are interpreted as long-run elasticities (Stock and Watson, 1993).

Accordingly, the model analysed in this study is defined as follows:

$$lnfood_t = \beta_0 + \beta_{1t} + \beta_2 linput + \beta_3 lint + \beta_4 lex + \beta_5 loil + \varepsilon_t \quad (8)$$

Food price inflation refers to the rate of increase in the food subcomponent of the CPI. In this study, the dependent variable of the model is the logarithm of the seasonally adjusted food price inflation series. Given the significant seasonal fluctuations in food prices, particularly due to harvest cycles and supply patterns, seasonal adjustment is essential to ensure a more accurate analysis. The variable linput represents an index of input prices used in agricultural production, including fertilisers, feed and energy. Increases in these input costs are expected to elevate the overall cost of food production, which in turn tends to raise final consumer prices for food products (Samal et al., 2022). Therefore, the impact of the input price index on food inflation is theoretically expected to be positive. Interest rates may influence inflation through both demand-side and cost-side channels. On the one hand, higher interest rates could curb consumer demand and thereby ease inflationary pressures. On the other hand, they may increase the financing costs for producers, contributing to upward pressure on production costs. Overall, increases in borrowing costs are expected to have a positive impact on food prices. The exchange rate variable, which reflects the value of the Turkish lira, is significant due to Türkiye's dependency on imported agricultural inputs. A depreciation of the domestic currency (i.e., an increase in the exchange rate) raises the cost of imported goods such as fuel and fertilisers, thus intensifying cost-push pressures on food prices. Consequently, a depreciation of the Turkish lira is anticipated to exert a positive effect on food inflation. Similarly, increases in oil prices are expected to have a positive impact on food production costs through their effect on transportation and input expenses, thus contributing to food price inflation. Within the framework of this model, the presence of unit roots in the time series was first investigated using the Zivot-Andrews test and RALS-LM tests. Subsequently, the existence of a long-run cointegration relationship among the variables was tested using the RALS-Engle-Granger (RALS-EG) approach. These methods account for potential non-normality in the error terms as well as structural breaks, thereby enhancing the robustness and reliability of the empirical findings.

Findings

This section presents the empirical findings obtained using monthly data for the period between January 2015 and March 2025 in Türkiye. First, the stationarity properties of the series were assessed using the Zivot-Andrews test and the RALS-LM unit root test. Subsequently, the existence of a long-run relationship among the non-stationary series was examined through the RALS-EG cointegration test.

Table 2: Zivot-Andrews Unit Root Test Result

Variable	Model C	Break Date
lfood / Δlfood	-4.1331 / -6.0466	2020:06 / 2021:12
linput / Δlinput	-4.6276 / -5.6714	2021:10/ 2021:10
lint / Δlint	-4.2624 /-7.1057	2019:07 /2023:07
lex / Δlex	-4.5359 / -9.0474	2021:11 / 2021:10
loil / Δloil	-3.7382 / -7.9556	2021:02 / 2020:05

Note: 5% critical value -5.08.

To determine the stationarity levels of the series, the Zivot-Andrews test was first applied. Under the Model C specification, which allows a single endogenous break in both the intercept and trend, the results show that all variables (lfood, linput, lint, lex, and loil) are non-stationary in levels but become stationary after first differencing. Accordingly, each series can be treated as I(1) with a one structural break. The estimated break dates align with major Turkish and global shocks: pandemic-related disruptions, the Oct–Nov 2021 exchange rate turmoil during the easing cycle, monetary regime shifts and the 2021 commodity upswing in brent crude oil market. Given the limitations of this test which sensitive to non-normal error distributions the stationarity analysis is subsequently corroborated using the RALS-LM unit root procedure, which explicitly incorporates a single structural break and higher-order moments of the error term to deliver more robust inference.

The test results indicate that all variables contain a unit root at the level. The test statistics do not exceed the critical values in absolute magnitude, leading to a failure to reject the null hypothesis of a unit root at the 5% significance level, suggesting these series are non-stationary in levels.

Table 3: RALS LM Test Result

Variable	Break Date	ρ^2 value	Test Stats.	%5 Critical Value
lfood	2020:08	0.63688	-0.68313	-3.352
linput	2020:06	0.66625	-3.21062	-3.458
lint	2022:03	0.77210	-1.36154	-3.554
lex	2021:10	0.71312	-3.30351	-3.458
loil	2020:02	0.76836	-1.46563	-3.554

Moreover, the break dates identified by the test for each variable, such as August 2020 for lfood and October 2021 for lex, correspond to the period in the 2020s during which Türkiye experienced exchange rate-induced inflationary pressures, abrupt shifts in interest rate policies, and substantial fluctuations in oil prices due to the COVID-19 pandemic. RALS-LM unit root test, accounting for structural breaks and non-normal errors, consistently indicated that all variables are integrated of order one, thus validating their suitability for cointegration analysis.

To examine whether a long-run relationship exists among the variables, the RALS-EG cointegration test developed by Lee et al. (2015) was employed. This method enhances the reliability of inference by increasing the power of the test, particularly under conditions where the error terms deviate from normality and provides more robust results compared to the classical Engle-Granger cointegration test. The results of the RALS-EG cointegration test and the corresponding long-run coefficient estimates are presented in Table 4.

Table 4: RALS-EG and DOLS Results

Test Stats.	ρ^2 value		%5 Critical Value	
-4.71045	0.83805		-4.251	
Variable	**Coefficient**	**Std. Deviation**	**t stats.**	**Prob. value**
Constant	2.552417	0.197492	12.92413	0.0000
linput	0.717406	0.045983	15.60137	0.0000
lint	0.180491	0.049884	3.618215	0.0010
lex	0.252932	0.043020	5.879419	0.0000
loil	-0.123743	0.049008	-2.524958	0.0166

The test statistic of (-4.710) exceeds the absolute value of the 5% critical threshold (-4.251), leading to the rejection of the null hypothesis of no cointegration. This finding provides robust evidence for the existence of a long-run cointegrating relationship among the variables. The result is consistent with the empirical evidence reported in previous studies by Abdullah and Kalim (2012), Yıldırım (2021), Kuma and Gata (2023), and Inal et al. (2023).

According to the DOLS long-run coefficient estimates, the coefficient of linput is 0.7174. It is statistically significant at the 1% level, indicating a strong and positive impact of agricultural input costs on food prices. This finding aligns with the results of Aytekin and Hatırlı (2021), reinforcing the notion that rising input costs are a key driver of food inflation. Similarly, the coefficient for the credit interest rate is positive and statistically significant (0.1804), suggesting that increases in financing costs exert upward pressure on production costs and, consequently, on food prices. This result is both theoretically consistent and empirically in line with the findings of Kuma and Gata (2023). The exchange-rate elasticity is 0.253, implying incomplete but material pass-through from depreciation to food prices via the import content of agricultural inputs, tradable food items, and energy-intensive logistics. By contrast, the oil price coefficient is modestly negative (−0.124) once input costs and the exchange rate are controlled for; a plausible interpretation is that oil's direct cost channel is largely intermediated through linput and lex, while the residual oil variation captures episodes of administered fuel pricing, temporary tax adjustments, or demand compression effects that offset the cost impulse. Taken together, the pattern of elasticities suggests a predominantly cost-push structure of Turkish food inflation, characterised by input costs and exchange-rate pass-through, with financing conditions reinforcing these pressures, and global oil prices exerting no independent positive effect once overlapping channels are accounted for. The empirical evidence obtained in this study is broadly consistent with the findings surveyed in the literature, while also revealing some noteworthy divergences. First, the significant exchange rate pass-through to food prices confirms earlier results reported by Bayramoğlu and Koç Yurtkur (2015), Aytekin and Hatırlı (2021), and Baek and Koo (2010), underscoring the importance of external shocks in shaping domestic food inflation. Second, the dominant and positive role of agricultural input costs strongly echoes the cost-push channel highlighted in both Turkish (Aytekin and Hatırlı, 2021) and international studies, reinforcing the structural nature of input-driven price dynamics. The negative impact of oil prices on food prices is consistent with Yıldırım's (2021) study. In contrast, our results for crude oil differ from studies such as Abdullah and Kalim (2012), which identify a direct positive effect; once input costs and the exchange rate are included, oil's independent contribution becomes weak, suggesting its influence operates mainly through indirect channels. Finally, while previous evidence on financing costs has been mixed, our results provide robust support for their inflationary effect via supply-chain and working-capital mechanisms.

Conclusion and policy implications

Inflation, particularly its food inflation component, poses a structural challenge that directly impacts economic stability and social welfare, especially in developing economies. Increases in food prices not only exert upward pressure on the CPI but also significantly undermine the purchasing power of lower-income households by exacerbating income inequality. The literature highlights a range of determinants for food inflation, including cost-side factors, demand-side variables, external shocks, and climatic conditions. In this context, the present study empirically analyses the determinants of food price inflation in Türkiye using monthly data covering the period from January 2015 to March 2025. The explanatory variables selected for the analysis include the agricultural input price index, credit interest rate, exchange rate, and crude oil price, all of which are expected to influence food prices through various channels. The stationarity properties of the series were tested using both the single-break Zivot–Andrews (Model C) test and the RALS-LM test developed to account for non-normal error distributions and structural breaks. The cointegration relationship among the variables was examined using the RALS-EG test. DOLS estimates the cointegrating vector to obtain robust long-run elasticities.

The findings indicate a stable long-run relationship between food prices and key macroeconomic drivers, with a predominantly cost-push structure. The agricultural input price index exhibits the most significant positive elasticity, and the exchange rate displays a positive and economically meaningful pass-through to food prices. Increases in the cost of inputs such as fertilisers, feed, and energy lead to higher production costs, which are eventually reflected in retail food prices. Credit interest rates also display a statistically significant positive relationship with food prices. This indicates that agricultural producers are highly sensitive to changes in financing costs; tighter credit conditions can reduce production volumes, thereby exerting upward pressure on prices. By contrast, once input costs and the exchange rate are conditioned on, the crude oil coefficient is modestly negative, suggesting that the oil channel primarily operates indirectly via imported inputs and exchange-rate movements rather than exerting an independent positive effect on food inflation. Based on these findings, it is evident that controlling food inflation requires comprehensive policies aimed at reducing agricultural production costs. In particular, reducing dependency on imported inputs such as fertilisers, feed, and fuel, promoting domestic production and increasing the use of technology are critical for achieving long-term structural improvements. Implementing subsidised or low-interest agricultural credit schemes and financially supporting producer cooperatives could help reduce input costs and promote price stability. Ensuring exchange rate stability, decreasing reliance on imported inputs, and restructuring pricing mechanisms in energy markets are also vital in mitigating inflationary pressures. Future research may enrich these conclusions by incorporating multiple-break frameworks, product-level heterogeneity in pass-through, and climate and supply shock indicators using higher-frequency or micro-level data.

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