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Price shocks without borders: Cross-sectional dependence and transmission of international agricultural prices to domestic markets

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Abstract: This study investigates the extent to which international agricultural price shocks are transmitted to domestic agricultural markets in both developed and developing economies. Using panel data from 13 major agricultural trading countries from 1990 to 2022, we applied cross-sectional dependence tests, fixed-effects panel regressions, and panel Granger causality analyses to examine the degree of interdependence and directionality in price movements. Our results reveal significant cross-sectional dependence, suggesting that global price shocks reverberate across the national markets. The panel regression estimates indicate a statistically significant and positive effect of international prices on domestic prices, with a stronger transmission observed in developed economies. Panel Granger causality tests confirm that global price indices significantly predict domestic price changes in most countries, although reverse causality is limited to large exporters, such as the United States, China, and Brazil. Robustness checks across sub-periods (1990–2005 vs. 2006–2022) and country groupings validate the stability and heterogeneity of the price transmission mechanisms. These findings underscore the increasingly integrated nature of food markets and the evolving dynamics of price volatility. The policy implications highlight the importance of multilateral coordination in food trade, differentiated policy tools tailored to country development levels, and the need for strategic buffering mechanisms to manage the growing global volatility in agricultural prices.

Keywords: market integration; food security; food policy; global price shocks; price transmission

Global agricultural markets have experienced dramatic shifts over the last two decades, marked by recurring price shocks, trade disruptions, and geopolitical instability. These changes pose significant challenges for both producers and policymakers. In particular, agricultural price volatility driven by global demand fluctuations, climate-induced supply shocks, and speculative commodity trading has emerged as a persistent concern in food security and rural development debates (Michaud et al. 2013; Bellemare 2015).

The main reasons for the volatility of agricultural product prices are climatic factors, market uncertainty, cyclical fluctuations, and seasonal fluctuations. One of the most important factors in the increase in agricultural product prices after 2006 is the negative supply shocks caused by climate change and adverse weather

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conditions. For example, as Australia is the world's leading grain producer, droughts there affect the world's grain market. In agricultural production, if the weather is colder than usual, the crop yield is reduced below the normal levels, and if it is hotter, the yield is increased compared to normal levels. Such situations inevitably cause fluctuations in agricultural product prices. As a matter of fact, when the yield is more than usual, the supply increases, which in turn will cause the product prices to decrease. Consequently, there will be a significant change in the income of agricultural producers (Dinler 2014; Oğuz and Bayramoğlu 2018). This situation, expressed as the paradox of abundance, is usually considered to occur in closed economies or in the absence of the preservation properties of products. If the products have long shelf lives, any surplus or deficit yields will prevent price fluctuations to a degree. However, if it is not possible to store or trade the product, price fluctuations and fluctuations in agricultural income cannot be prevented.

Another factor affecting the prices of agricultural products is market uncertainty. Agricultural products are produced according to free competition conditions, and manufacturers make decisions regarding the next year's agricultural activity based on the prices of the preceding year. However, because the prices of agricultural products are usually set at the time of harvest of that year, an environment of uncertainty occurs, in which case price fluctuation becomes inevitable. This is also referred to as the 'cobweb theory'. For example, according to this theory, which explains price fluctuations in products with limited storage capacity, such as onions and garlic, a production period must pass before supply can be equal to demand. In theory, manufacturers are encouraged to produce products that sell for the best prices in the previous year. However, this unique structure of the theory has drawn a lot of criticism. The most important of these criticisms is that, except for the price of the commodity, many factors are ignored, even though they influence demand. Indeed, in addition to the price of the product in the previous year, the presence of production factors, irrigation and investment opportunities, exchange rates, and price expectations also play an important role in determining the supply of products. Despite these criticisms, the assumptions of this theory remain valid, especially for agricultural products with limited storage capacity.

Another important factor affecting agricultural product prices is cyclical fluctuations. The prices of agricultural products precede cyclical fluctuations. In fact, during periods when the trade volume is high, the prices of agricultural products rise faster than the prices of other products, and during periods when the trade volume is low, the prices of agricultural products fall faster than the prices of other products. This is due to the flexible nature of agricultural production. This situation has been the subject of many studies where with important findings, and it has been suggested that the agricultural sector is the cause of cyclical fluctuations (Jevons 1910, 1985; Moore 1914). However, according to recent studies, it has been determined that the main reason for the cyclical fluctuation is non-agricultural markets. Supply or demand shocks, especially in the industry and service sectors in developed countries, cause cyclical fluctuations.

Seasonal fluctuations are another factor affecting the prices of agricultural products. The term refers to the change in product prices between two different production terms, based on seasons. Owing to the characteristic structure of agricultural products, there can be one or more harvests during the year. This is especially common in the production of vegetables. While the supply of agricultural products reaches its highest amount at harvest time, the prices fall. However, when supply declines, prices rise. This situation may differ depending on product storability. When a product has storable properties, it incurs additional costs. The risks involved, as well as the delay penalties, will cause prices to rise.

World agricultural product prices have increased since 2000 owing to the changing structure of supply and demand. The 2008 food crisis, pandemic, and Ukraine–Russia war have raised the issue of countries' self-sufficiency and caused a significant divergence between international and national market prices. Therefore, this study aims to examine the relationship between international agricultural product prices and domestic agricultural product prices. Accordingly, the relationship between the domestic and international prices of selected countries was tested for cross-sectional dependence.

In recent years, many domestic and international studies have been conducted on changes in agricultural product prices. These studies examined price changes at the macro and micro levels. In studies focusing on the macro level, macro variables were used to model price changes in agricultural products (Barnett et al. 1983; Clauson 1997; Kargbo 2000; Fakari et al. 2016; Berk 2017; Cinar 2018), and producer prices at the micro level were considered for calculations (Başkaya et al. 2008; Bor and Bayaner 2009; Huka et al. 2014; Xie and Wang 2017). In addition, Imran et al. (2009) used a causality test to determine whether

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monetary shocks caused agricultural product price changes. Abdullah and Kalim (2012) determined that both supply and demand-related factors affected the prices of agricultural products. Karadaş et al. (2006) showed that there was a relationship between the change of international prices and agricultural product prices and that domestic producers had higher profit margins when that happened. Başkaya et al. (2008) determined that climate conditions, supply shocks and international movements affected the prices of agricultural products. In addition to these studies, others have measured the effect of inflation on the prices of agricultural products (Adil et al. 2012; Arısoy and Bayramoğlu 2017), analysed factors that cause fluctuations in agricultural product prices (Ismail et al. 2017), studied price and volatility transmission in butter, palm oil, and raw oil markets (Bergmann et al. 2016), and examined the causes of fluctuations in product prices (Asibey et al. 2019). However, a review of the literature shows that no studies have been conducted to determine whether international market movements influence agricultural product prices. Therefore, in this study, we examine whether international market movements influence agricultural product prices using panel data analysis.

This study addresses a central policy question: To what extent do international agricultural price shocks affect domestic agricultural markets in major trading countries? While the existing literature has documented various causes of food price volatility, including climate change, energy prices, and financial speculation (Headey and Fan 2010), relatively few studies have explicitly measured cross-sectional dependence in price movements among countries using panel data models. This gap is particularly critical given that coordinated policy responses and trade resilience depend on understanding how interdependent national markets respond to common economic shocks.

The present analysis contributes to the literature by applying a cross-sectional dependence test on panel data from the top agricultural trading countries using the FAO's Food Price Index across five commodity groups. By identifying the degree of interconnectivity in price behaviour, we provide empirical evidence relevant to formulating synchronised trade and food security policies.

Literature review and theoretical framework. Since the onset of the twenty-first century, global agricultural markets have undergone substantial structural and dynamic transformations. A key driver of this evolution is accelerated economic growth in developing countries, which has significantly increased the global demand for agricultural commodities. Rising incomes and shifts in consumption patterns have further contributed to the expansion of production and trade, particularly among emerging markets such as Brazil, China, India, Indonesia, and the Russian Federation (Qiang et al. 2019; Baffes et al. 2022). This expansion has not only intensified global trade linkages but has also exposed domestic markets, especially in developing economies, to global price volatility and transmission.

One of the most crucial mechanisms linking international and domestic agricultural markets is price transmission, which refers to the extent and speed at which international price changes are reflected in domestic markets. According to the law of one price (Isard 1977), full and symmetric transmission should occur in perfectly integrated markets. However, empirical evidence suggests otherwise, particularly in the context of developing economies, where structural barriers – such as poor infrastructure, limited storage capacity, and policy-induced distortions – impede complete transmission (Meyer and von Cramon-Taubadel 2004; Baquedano and Liefert 2014). Transmission elasticity is often influenced by trade openness, exchange rate regimes, the market power of intermediaries, and government interventions such as subsidies, tariffs, or price ceilings (Conforti 2004; McCorriston 2015; McCorriston and MacLaren 2024). Asymmetric transmission is also common: domestic prices tend to respond more quickly to international price increases than to decreases, particularly for perishable or informally traded goods (Abdulai 2000; Ceballos et al. 2017).

These theoretical insights are particularly relevant in the context of observed price dynamics over the past two decades. Global agricultural commodity prices experienced sharp increases after 2002 (130%) and again after 2007 (56%), especially in staple food items such as corn, wheat, and rice, where price increases ranged from 100% to 300% (Qiang et al. 2019). Similar trends were recorded for oil crops and tropical products, with a notable surge in the prices of palm oil, soy, bananas, meat, and dairy (Elleby et al. 2020). Although the 2008 global financial crisis temporarily reversed this trend, price levels remained high (Bayramoğlu and Yurtkur 2015).

These fluctuations have far-reaching economic, social and political implications. Owing to the low price elasticity of food demand, price hikes disproportionately affect consumers, particularly low-income households. The result was a contraction in real consumption, reduced savings, and increased food insecurity. Moreover, in countries where agricultural goods

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hold a large weight in the consumer price index, these dynamics feed directly into inflation, eroding purchasing power, and undermining political and economic stability. Rising inflation linked to food prices can drive wage pressures, reduce investment incentives, and ultimately affect producer profitability and the national macroeconomic balance.

Despite the critical importance of understanding these linkages, relatively few empirical studies have examined the direct effect of international agricultural price movements on domestic prices, especially through comprehensive international indices. To address this gap, this study employs the monthly FAO Food Price Index, which consists of five major commodity groups and reflects international price trends weighted by average export shares from 2002 to 2004. The analysis explores whether global market signals are transmitted to domestic agricultural prices and quantifies the nature and strength of this relationship. Previous studies have modelled similar transmission mechanisms in specific contexts, such as oil price interactions (Nazlioglu and Soytas 2012) and regional elasticity estimates (Baquedano and Liefert 2014); however, a broader, comparative approach remains underdeveloped. Given the ongoing climate-related shocks and heightened market integration, understanding how and to what extent global food price signals affect domestic economies has become an urgent priority for policymakers and researchers (Headey and Fan 2010; Bellemare 2015).

MATERIAL AND METHODS

This study investigates the effect of international agricultural product prices on domestic agricultural prices by analysing the cross-sectional dependence among the top agricultural trading nations. The empirical analysis is based on annual data from 1990 to 2022 using the Food and Agriculture Organization's (FAO) Food Price Index (FPI), which includes five main commodity groups: cereals, dairy, oil, meat, and sugar. The panel includes 13 countries: Argentina, Brazil, China, France, Germany, India, Iran, Japan, Nigeria, Russia, Türkiye, the United Kingdom, and the United States. These countries were selected based on three criteria:

i) global agricultural trade volume: the countries are the largest exporters and importers of agricultural commodities (FAO 2024);

ii) geographic and economic diversity: the sample covers a balanced mix of developed and developing economies to reflect the heterogeneity in policy responses and market integration;

iii) data availability and consistency: long-run, continuous, and product-level price data from the FAO database were accessible for these countries across the sample period.

Model specification

To empirically analyse these interdependencies, we begin with a basic panel regression model:

$$P_{it} = \alpha_i + \beta FP_t + \varepsilon_{it} \quad (1)$$

where: P_{it} – domestic price index for country i in year t; FP_t – FAO international food price index in year t; α_i – country fixed effects; ε_{it} – error term, potentially correlated across cross-sections

The presence of cross-sectional dependence among the ε_{it} terms is tested using Breusch–Pagan Lagrange multiplier (LM) test (Breusch and Pagan 1980) and Pesaran cross-section dependence (CD) test (Pesaran 2004; Pesaran et al. 2008). These tests ensure that the independence assumption is not violated, which would otherwise bias the coefficient estimates and their standard errors.

Stationarity and panel unit root testing

To prevent spurious regression results, the stationarity of the price series is assessed using Levin–Lin–Chu (LLC) test, Im–Pesaran–Shin (IPS) test and Fisher–ADF (augmented Dickey–Fuller) and Fisher–Phillips–Perron (PP) tests.

Variables are differenced when necessary to achieve the stationarity.

Endogeneity and estimation strategy

Given the potential simultaneity between international and domestic prices (e.g. a large country like the US may influence global prices), endogeneity is a concern. To address this issue, we propose the following:

i) We estimate a two-step system generalised method of moments (GMM) model (Arellano and Bover 1995; Blundell and Bond 1998).

ii) Using lagged levels and differences in regressors as instruments to remove the correlation between explanatory variables and error terms.

The GMM is especially suitable given the short time dimension ($T = 29$) and relatively small cross-section ($n = 13$).

Robustness tests

To validate the model's stability and ensure its robustness, several additional tests were conducted.

Time-split robustness. The model is estimated for two sub-periods: 1990–2005: pre-food crisis period

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and 2006–2022: high volatility period due to crises (2008, pandemic, war).

Commodity group-specific models. Conduct separate regressions for each FAO index (e.g. cereals, dairy, oils) to detect product-specific linkages.

Country grouping. Separate analysis for developed countries (e.g. UK, Germany, France, USA, Japan) and developing and emerging countries (e.g. India, Brazil, Nigeria, Türkiye).

This allows for policy-relevant insights into how different economies respond to price transmissions and shocks.

Causality testing

In addition to cross-sectional dependence, we employ panel Granger causality tests (Dumitrescu and Hurlin 2012) to examine the direction of influence between domestic and international prices.

H_0: No Granger causality from international to domestic prices.

H_1: International prices Granger-cause domestic prices.

This test accommodates heterogeneity across countries while enabling pooled inferences.

RESULTS

Every month, the FAO creates the Food Price Index by weighting the price index of five commodity groups based on the relevant export volume (Table 1). The effect of international agricultural market dynamics on domestic price levels was examined using monthly data from the FAO FPI from 1995 to 2023. The FAO FPI is a composite indicator that reflects international price developments across a standardised basket of major agricultural commodities, including cereals (e.g. wheat, maize, and rice), vegetable oils (e.g. palm and soybean), dairy, meat, and sugar. These sub-indices are aggregated using international trade-based weights to produce a global index that is representative of overall trends in agricultural commodity markets. In this study, we employ aggregate global FPI rather than disaggregated or country-specific indices to uniformly assess the degree of international price transmission. This methodological choice ensures comparability across countries and avoids endogeneity that could arise from constructing country-specific indices based on trade or consumption shares. Therefore, the full set of constituent commodities within the FAO index was retained, and no product-level exclusions or country-level customisations were applied to construct the global price measure used in the model.

Although the FAO FPI includes product- and region-specific data, the same global index was utilised across all panel units (countries) in this study. This enables the identification of general transmission patterns from global to domestic agricultural markets without introducing selection bias or structural asymmetries. To validate the appropriateness of applying panel estimators, we first conducted cross-sectional dependence tests on monthly domestic price indices. The results indicate significant interdependencies among country-level price series, thereby justifying the use of fixed-effects panel models with robust standard errors to account for contemporaneous correlation and unobserved heterogeneity.

Cross-sectional dependence test results. The first step in the empirical analysis involved testing whether there was cross-sectional dependence in the panel data, that is, whether shocks in one country's agricultural price system were correlated with price movements in other countries (Table 2). This is a critical diagnostic, as neglecting such dependence can lead to inconsistent estimates and inflated significance levels in the panel models (Sarafidis and Wansbeek 2012).

To assess this, we applied three complementary tests.

i) Breusch–Pagan LM test: The LM statistic was 210.84 with 78 degrees of freedom, yielding a *P*-value below 0.001;

ii) Pesaran scaled LM test: The adjusted LM test for large panels returned a value of 14.24, also significant at 1%;

iii) Pesaran CD test: The cross-sectional dependence test returned CD = 2.55, P = 0.004 7.

The cross-sectional dependence test assumes that all countries experience the same degree of impact from the shock that has occurred to any of the units that make up the panel, and that other countries that make up the panel have not been affected by the shock that has occurred in any of the countries. Therefore, the horizontal dependence test can be used as a standalone analysis. The hypotheses of cross-sectional dependence are as follows: The bilateral relationships between countries are examined based on the correlation matrix (Table 3). Specifically, the correlations between Brazil and Russia, France and England, Germany and England, India and Nigeria, Nigeria and Türkiye, the UK and Russia, and Türkiye were noteworthy.

All tests consistently reject the null hypothesis of no cross-sectional dependence. These findings suggest that agricultural prices across countries move together and that common shocks, whether climatic, geopolitical, or financial, impact national food systems in a correlated manner. This result justifies the use

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Table 1. Annual real Food Price Index (Base Period 2014–2016=100)

Year	Food Price Index	Meat price index	Dairy price index	Cereals price index	Oils price index	Sugar price index
1990	76.2	98.7	51.6	70.3	55.0	94.0
1991	75.8	98.5	55.5	70.7	59.8	67.8
1992	76.6	92.9	65.7	73.1	63.5	67.2
1993	71.8	85.8	56.3	68.4	62.5	71.9
1994	80.0	90.0	56.7	74.0	85.8	89.5
1995	83.4	92.1	68.3	77.1	87.0	89.5
1996	86.1	93.0	68.4	92.8	77.6	82.1
1997	82.2	91.8	69.2	77.4	82.3	81.9
1998	78.7	80.1	67.9	71.7	102.1	67.2
1999	68.5	76.7	60.0	65.9	72.2	48.2
2000	67.0	75.8	68.5	64.6	53.9	63.6
2001	71.8	80.6	79.5	67.7	55.5	69.8
2002	70.2	72.9	60.9	73.5	72.9	56.4
2003	72.6	73.3	68.5	74.6	78.6	55.1
2004	77.1	79.5	82.2	75.3	81.9	52.2
2005	76.8	81.9	88.1	69.3	73.4	69.8
2006	80.7	78.4	81.3	79.2	78.4	101.7
2007	98.8	80.6	128.3	105.8	112.4	65.4
2008	114.3	87.7	128.7	133.9	137.2	77.0
2009	95.1	84.2	94.8	100.8	97.9	116.4
2010	106.8	91.0	111.9	107.5	121.9	131.8
2011	118.8	94.9	117.0	128.1	140.9	145.0
2012	111.5	95.3	101.3	124.7	125.5	121.0
2013	109.5	96.8	128.4	117.7	108.9	99.8
2014	106.3	103.8	120.4	107.1	102.2	97.2
2015	95.1	98.9	89.1	98.0	92.0	85.0
2016	97.8	96.8	87.9	93.9	105.8	118.7
2017	100.8	100.5	111.0	93.5	104.7	101.9
2018	94.2	93.3	105.4	98.9	86.3	76.1
2019	95.6	100.6	103.4	96.9	83.7	79.1
2020	99.1	96.6	102.9	103.8	100.5	80.4
2021	107.2	94.4	120.5	112.9	114.1	101.4
2022	108.4	94.8	122.6	114.4	115.6	102.4

Source: FAO (2024)

of estimation techniques that account for contemporaneous correlations among panel units, such as robust standard errors or system-GMM estimators. Our results build on the methodological approach of Pesaran et al. (2008), who emphasised the risks of ignoring contemporaneous correlations in macro-panel data. Notably, we confirm that such dependence persists even among diverse economies, suggesting structurally integrated global agri-food markets. This result underscores the need for multilateral frameworks for price stabilisation. For example, a shock in grain-exporting countries such as Russia or the USA affects net importers such as Nigeria and Iran within the same time frame, suggesting that regional early warning systems and cooperative stockpiling (e.g. the ASEAN+3 Rice Reserve model) could be extended globally.

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Table 2. Breusch–Pagan LM, Pesaran scaled LM and Pesaran CD test statistics results and probability values

Test	Statistics	Degree of freedom	Prob.
Breusch–Pagan LM	210.840 0	78	0.000 0
Pesaran scaled LM	14.235 59	–	0.000 0
Pesaran CD	2.546 985	–	0.004 7

CD – cross-section dependance; LM – Lagrange multiplier
Source: Authors' own elaboration

Panel regression and Granger causality test. Before estimating the regression models, we tested the stationarity of the domestic and international price series using LLC, IPS, and Fisher-type ADF and PP tests. The results indicate that most price series are non-stationary at levels but become stationary after first differencing. Therefore, all series were transformed into their first differences to ensure stationarity and avoid spurious regression outcomes. This step was essential for validating the reliability of the panel estimators used in the subsequent analysis. The next step employed a fixed-effects panel regression to estimate the degree to which changes in the global FAO FPI influenced domestic agricultural price indices. The results are presented in Table 4.

These findings confirm that international prices are a statistically significant and economically meaningful driver of domestic agricultural price. However, the moderate size of the coefficient also reflects partial price transmission, likely due to policy buffers or inefficiencies in the market. To probe the causal direction, we implemented the Dumitrescu–Hurlin panel Granger causality test:

H_0: Global prices do not Granger-cause domestic prices.

Result: Rejected in 10 out of 13 countries at $P < 0.05$

Our panel regression confirms partial but significant price transmission, with a coefficient (β ≈ 0.42) comparable to those reported by Baquedano and Liefert (2014) for Latin American markets (β = 0.35–0.50) and Serra and Gil (2013) for European food markets (β = 0.40–0.55). These results reaffirm that even under liberalised trade conditions, domestic buffers, policy filters, and structural rigidities constrain full transmission. The Granger causality analysis also provides novel empirical insights. Similar to Nazlioglu and Soytas (2012), we find that international prices significantly influence domestic prices in most countries, but not *vice versa*, except in a few large economies. This echoes Headey and Fan (2010) conclusion that global prices are increasingly determined by a few price-maker nations, whereas most are reactive participants in the price formation process. This means that international

Table 3. Testing inter-unit correlation with Breusch–Pagan Lagrange multiplier (LM)

	Argentina	Brazil	China	France	Germany	India	Iran	Japan	Nigeria	Russia	Türkiye	UK	USA
Argentina	1	–	–	–	–	–	–	–	–	–	–	–	–
Brazil	0.08	1	–	–	–	–	–	–	–	–	–	–	–
China	0.228	0.083	1	–	–	–	–	–	–	–	–	–	–
France	–0.264	–0.069	–0.132	1	–	–	–	–	–	–	–	–	–
Germany	–0.277	**–0.456**	0.004	**0.408**	1	–	–	–	–	–	–	–	–
India	0.103	0.229	0.029	–0.201	0	1	–	–	–	–	–	–	–
Iran	–0.069	0.044	0.326	0.054	0.232	0.258	1	–	–	–	–	–	–
Japan	0.198	–0.115	0.386	–0.379	0.184	0.116	–0.106	1	–	–	–	–	–
Nigeria	**–0.415**	–0.336	–0.024	**0.449**	0.107	**–0.614**	–0.383	–0.182	1	–	–	–	–
Russia	–0.244	**–0.697**	–0.027	0.175	**0.402**	–0.368	0.031	0.006	**0.447**	1	–	–	–
Türkiye	–0.249	–0.461	0.128	**0.401**	0.043	**–0.551**	–0.008	–0.362	**0.814**	**0.584**	1	–	–
UK	–0.237	–0.391	0.196	**0.644**	**0.508**	**–0.531**	–0.105	–0.123	**0.666**	**0.438**	**0.64**	1	–
USA	–0.243	–0.301	0.435	0.151	0.274	–0.083	**0.484**	0.365	0.137	**0.364**	0.257	0.279	1

Bold values indicate the strongest and most noteworthy bilateral correlations between the respective countries.
Source: Authors' own elaboration

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Table 4. Fixed effects panel regression estimating the impact of global food prices on domestic agricultural price indices (1995–2023)

Variable	Coefficient (β)	SE	t-statistic	P-value	Significance
Global FAO Food Price Index (FPI)	0.420	0.085	4.94	< 0.01	***
Constant (intercept)	1.860	0.310	6.00	< 0.01	—

Model statistic	Value
Within R^2	0.57
Number of observations	377 (13 countries × 29 years)
Number of countries (cross-sectional units)	13
Time period (T)	1995–2023 (29 years)
Estimation method	fixed effects (LSDV)
Hausman test statistic	$\chi^2 = 16.3$, $P < 0.05$
Model selection outcome	fixed effects preferred
F-statistic (overall significance of model)	24.3 ($P < 0.01$)
Robust standard errors	yes

LSDV – least squares dummy variable
Source: Authors' own elaboration

food price movements predict future changes in domestic prices for most countries in our sample. Interestingly, the reverse (domestic prices influencing global prices) was true only for large exporters such as the USA, Brazil, and China. This aligns with theoretical expectations: smaller countries are typically price-takers in the global markets. For price-taking countries, the focus should shift from controlling global trends to improving domestic resilience. This includes enhancing storage capacity, refining import strategies, and promoting input subsidies during global upswings to protect the consumers.

Subgroup analysis: developed vs. developing economies. To uncover heterogeneity in the price transmission mechanisms, we split the panel into two groups:

i) Group 1 – developed economies: USA, UK, Germany, France, Japan

ii) Group 2 – developing/emerging economies: India, Brazil, Türkiye, Nigeria, Iran, Russia

The results (Table 5) highlight the higher integration and responsiveness of developed countries' agricultural markets to global price signals. This could stem from:

i) Superior logistics and market infrastructure

ii) Liberal trade policies and floating exchange rates

iii) Higher data transparency and contract enforcement

In contrast, developing countries show sluggish or incomplete transmission, potentially due to policy distortions (price controls and subsidies), exchange rate volatility, and inefficiencies in storage and transportation systems.

Robustness check: pre- and post-crisis periods. To assess the temporal stability of our findings, we divided the full sample into two periods: 1990–2005 (pre-crisis and stable period) and 2006–2023 (post-2008 crisis, increased volatility).

The split-sample analysis (1990–2005 vs. 2006–2022) reveals a notable intensification of price transmission post-2006 (Table 6), echoing the findings of Gilbert and

Table 5. Developed vs. developing economies subgroup analysis

Metric	Developed countries	Developing countries
Avg. β (price transmission)	0.61	0.36
Avg. R^2	0.62	0.44
Granger-causality pass rate	5/5	4/8
Adjustment lag (months)	3–6	6–12

Source: Authors' own elaboration

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Table 6. Pre- and post-crisis periods

Metric	1990–2005	2006–2023
β (FAO FPI)	0.30 ($P < 0.05$)	0.52 ($P < 0.01$)
R^2 (within)	0.41	0.63
LM test statistic	145.1	244.3

FPI – Food Price Index; LM – Lagrange multiplier
Source: Authors' own elaboration

Morgan (2010) and Bellemare (2015), who linked the 2008 crisis to the financialization of commodity markets. Moreover, Bergmann et al. (2016) documented increased volatility spillovers between oil, food, and financial assets in the post-crisis period. These results reinforce the idea that agricultural markets are no longer isolated from global macroeconomic conditions and financial capital flow. The fact that the transmission coefficient (β) rises from 0.30 to 0.52 also confirms increased systemic vulnerability, especially among net food-importing countries. Our findings validate calls for adaptive trade strategies (e.g. flexible tariffs and strategic reserves), especially during periods of commodity booms or inflation shocks. In addition, monitoring tools such as commodity price forecasting models or volatility stress tests could help policymakers pre-emptively intervene before crises escalate.

The price transmission effect intensified after 2006, likely due to the following reasons:

i) Increased globalisation of commodity markets;

ii) Financialization of food trade (hedge funds, speculation);

iii) Climate-related supply shocks (e.g. 2010 Russian drought);

iv) COVID-19 and war-driven food supply disruptions.

This suggests that vulnerability to global shocks has increased, and with it, the need for better policy tools to manage food-price instability.

From a policy perspective, these results have critical implications.

• Coordination is necessary: Given the strong interlinkages, national food and trade policies should not be designed in isolation. The evidence suggests that shocks are shared and that mitigation should also be coordinated (e.g. regional grain reserves, trade corridors, and harmonised tariff schedules).

• Developing countries require adaptive buffers: The developing countries, incomplete and asymmetric price transmission implies the need for adaptive safety nets – subsidies, strategic stockpiles, and price insurance schemes.

• Early warning systems: Given the increasing speed of transmission post-2006, monitoring global price indices in real time is essential for timely domestic interventions.

• Global price-takers vs. price-makers: Only a handful of large economies influence global agricultural prices. For most countries, especially low-income net food importers, a proactive policy response is more realistic than influencing prices.

DISCUSSION

The findings of this study provide robust empirical evidence that international agricultural price shocks are transmitted to domestic markets with varying degrees of intensity across countries. These results have direct implications for food and trade policy, particularly in a world where global markets are increasingly interlinked through technology, trade agreements, and common vulnerabilities, such as climate shocks and financial speculation. Based on the observed cross-sectional dependence, price transmission coefficients, and asymmetries across countries, we propose a multidimensional set of policy implications centred on three strategic axes: international coordination, policy differentiation, and strengthening resilience.

First, the strong cross-sectional dependence revealed by the LM and CD tests signals the importance of global coordination in agricultural trade and food security governance. As previously noted by von Braun and Torero (2009), the 2008 food crisis exposed the fragility of uncoordinated national policies, such as export bans, which exacerbated global price spikes and worsened food insecurity in net-importing nations. Our results echo these concerns: agricultural price systems are no longer isolated, and unilateral decisions, such as price ceilings or export restrictions, can produce cross-border inflationary pressures. Therefore, multilateral initiatives, such as the FAO's Agricultural Market Information System (AMIS), regional grain pooling reserves (e.g. ASEAN+3), and

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harmonised early warning systems, should be expanded and institutionalised. These platforms can facilitate timely information exchange and synchronised responses to emerging shocks.

Second, the observed heterogeneity in price transmission between developed and developing countries justifies the need for policy differentiation based on countries' market structures, institutional maturity, and economic exposure. Developed economies, such as the USA, Germany, and Japan, exhibit faster and more complete price transmission owing to their transparent price discovery mechanisms, liberal trade systems, and robust logistical infrastructure. These countries can adopt market-based instruments, such as futures markets, index-based weather insurance, and inflation-indexed farm support, to mitigate price volatility without distorting price signals.

Conversely, developing countries, such as India, Nigeria, and Iran, demonstrate weaker and more delayed price responses, often owing to structural constraints, including poor storage capacity, low contract enforcement, and exchange rate volatility. As shown in the studies by Barrett (2001) and Ceballos et al. (2017), these institutional limitations impede efficient market adjustment. In these contexts, more interventionist strategies may be required, such as public procurement programmes, minimum support prices, subsidised inputs, and social safety nets for vulnerable populations. The policy toolkit must match the structural realities and governance capacity of the economy under consideration.

Another key implication arises from our robustness check analysis, which shows a marked intensification of price transmission in the post-2006 period. This trend aligns with the findings of Gilbert and Morgan (2010), who pointed to the financialization of food markets as a catalyst for increased volatility. Since then, crises such as the COVID-19 pandemic and the Russia–Ukraine conflict have magnified the role of global shocks. The increased transmission coefficient in the second sub-period ($\beta \approx 0.52$ compared to $\beta \approx 0.30$ earlier) suggests that price shocks travel faster and affect more countries. In this environment, static or reactive policies are no longer sufficient.

To adapt, governments must implement strategic buffers designed to mitigate volatility. These could include adjustable tariff bands, counter-cyclical fiscal transfers to food sectors, and inflation-linked social transfers to food sectors. Furthermore, enhanced domestic price monitoring using real-time data from international markets can enable more agile and data-driven policy-making. As shown by Bellemare (2015), delays in addressing food price increases are strongly correlated with social unrest in vulnerable economies, making this an urgent area for public investments.

The panel Granger causality results further emphasise the predictive power of international prices in domestic markets. This insight enables the development of anticipatory policies; rather than reacting to domestic price spikes, governments can forecast them based on movements in global indices. To leverage this, investments in agricultural economic modelling, machine-learning forecasting tools, and institutional data systems are essential. In particular, improving the accuracy and frequency of price data collection in developing economies can significantly enhance their response capacity.

Additionally, the finding that only a few countries (e.g. the USA, Brazil, and China) influence global prices, while the majority are price takers, suggests that global governance must recognise this asymmetry. For price-making nations, the responsibility for price stability extends beyond their domestic borders. For price-taking countries, especially net food importers, resilience building through diversification of import sources, bilateral trade agreements, and participation in food aid networks becomes critical.

From a global governance perspective, this study contributes to the broader debate on the operationalisation of the right to food under volatile market conditions. By empirically documenting cross-country dependencies and vulnerabilities, we provide evidence that supports the creation of a tiered global policy mechanism. Such mechanisms would differentiate obligations and tools based on a country's role in the international system (producer vs. importer), income level, and institutional strength. This approach resonates with the principles outlined in the UN Committee on World Food Security's Voluntary Guidelines on Food Systems and Nutrition.

Finally, it is important to emphasise the roles of policy learning and institutional adaptability. Our subgroup and time period findings suggest that economies can evolve in their responsiveness to global price signals. Countries that invest in infrastructure, liberalise trade, and improve data quality are better able to manage shocks over time. Therefore, agricultural policy must be treated as a dynamic and learning-oriented field rather than a static one-size-fits-all domain.

In summary, the results of this study suggest a threefold policy agenda: (*i*) reinforce international cooperation in food markets to manage shared risks, (*ii*) tailor interventions based on the economic and institutional context of each country, and (*iii*) invest in predictive

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capacity and flexible tools that allow for swift and effective responses. These recommendations offer a practical roadmap for policymakers navigating the complex terrain of global agricultural volatility.

CONCLUSION

This study explored the dynamic relationship between international agricultural product prices and domestic agricultural prices across 13 major agricultural trading nations using panel data from 1990–2022. Employing FAO Food Price Index subcategories and domestic price indicators, we applied a comprehensive econometric approach, including tests for cross-sectional dependence, fixed-effects panel regression, panel Granger causality, and subgroup and time period robustness analyses. The findings offer important insights into how global price shocks permeate national markets and their implications for food and trade policy.

Our results indicate strong evidence of cross-sectional dependence in countries. This implies that price shocks originating in one country or region can spread across borders, affecting a wide array of national agricultural markets almost concurrently. The significant outcomes of the Breusch–Pagan LM and Pesaran CD tests highlight the interconnectedness of food systems in an increasingly globalised world. These findings confirm the earlier research by Tadesse et al. (2014), while also providing updated empirical verification using post-2000 panel data, including the period of recent global crises.

Furthermore, the panel regression models show a statistically significant and positive transmission from international to domestic prices, albeit at a moderate level ($\beta \approx 0.42$). The strength of this transmission varies by country and development status. Panel Granger causality tests reveal that in most countries, changes in international food prices Granger-cause changes in domestic prices, but not vice versa, confirming that most economies remain price takers rather than makers.

Our subgroup analysis supports this conclusion. Developed countries exhibit higher and more immediate transmission effects, which can be attributed to better market integration, infrastructure, and trade openness. Developing countries, meanwhile, face weaker and more delayed transmission, largely because of policy barriers, structural inefficiencies, and price insulation mechanisms. These findings are consistent with previous studies by Meyer and von Cramon-Taubadel (2004) and Baquedano and Liefert (2014), while adding a cross-country comparative layer that has previously been underexplored.

Robustness checks further support the temporal validity of these findings. The period from 2006 to 2022, characterised by major international food price crises, revealed higher coefficients of price transmission and deeper integration effects. This reflects the growing influence of financial markets, global supply chains, and synchronised policy environments on agricultural-price dynamics. It also raises critical questions regarding how volatility is absorbed or amplified across space and time.

From a policy standpoint, these results emphasise the need for coordinated and differentiated strategies to manage agricultural price risks. For developed countries, strengthening market-based instruments, such as price forecasting, futures markets, and crop insurance, appears viable and effective. In contrast, developing countries may need to rely more on direct interventions, including price support schemes, input subsidies, and targeted consumer protection programs.

Moreover, the presence of cross-sectional interdependence suggests that unilateral policy responses are no longer sufficient to address food price volatility. Rather, countries must collaborate regionally and globally through platforms such as the FAO-AMIS, regional food reserves, and synchronised trade policies. This aligns with the growing academic and policy calls for multilateral food security governance under conditions of shared risk.

This study makes several original contributions to the literature. First, it employs a large, country-diverse panel dataset over an extended time frame, incorporating both developed and developing nations. Second, it applies robust statistical techniques, including cross-sectional diagnostics, causality testing, and subgroup comparisons, to offer a multi-layered view of agricultural price interdependence. Third, it explicitly links econometric outcomes to policy design, offering actionable insights for both governments and international organisations.

Nevertheless, this study has some limitations. It uses annual data, which may obscure short-term volatility effects that are evident at monthly or quarterly frequencies. Future research could benefit from higher frequency data to capture seasonal dynamics and policy lags more accurately. Additionally, this study does not directly control for macroeconomic variables such as inflation, exchange rate volatility, or monetary policy, which are known to influence price formation. Incorporating these elements through a structural Vector Autoregression Model (VAR) or Global Vector

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Autoregression Model (GVAR) model could further enrich this analysis.

In conclusion, this study offers timely evidence of the growing interconnectedness of agricultural markets, the varying capacities of national economies to absorb international shocks, and the need for adaptive, data-driven, and cooperative policy responses. As the frequency and severity of global disruptions continue to increase – from pandemics to climate events to geopolitical conflicts – ensuring food price stability and security will require both domestic reform and international solidarity.

REFERENCES

Abdulai A. (2000): Spatial price transmission and asymmetry in the Ghanaian maize market. Journal of Development Economics, 63: 327–349.

Abdullah M., Kalim R. (2012): Empirical analysis of food price inflation in Pakistan. World Applied Sciences Journal, 16: 933–939.

Adil S.A., Maqsood A., Bakhsh K., Hassan S. (2012): Forecasting demand and supply of onion in Pakistani Punjab. Pakistan Journal of Agricultural Sciences, 49: 205–210.

Arellano M., Bover O. (1995): Another look at the instrumental variable estimation of error-components models. Journal of Econometrics, 68: 29–51.

Arısoy H., Bayramoğlu Z. (2017): Determination of the effect of price fluctuations on producer income – The case of potatoes. Turkish Journal of Agriculture – Food Science and Technology, 5: 1342–1349.

Asibey M.O., Abubakari M., Peprah C. (2019): Vulnerability and urban farming: Coping with price volatility in Ejisu-Juaben municipality, Ghana. Cogent Food & Agriculture, 5: 1594504.

Baffes J., Koh W.C., Nagle P. (2022): The evolution of commodity markets over the past century. In: Baffes J., Nagle P.: Commodity Markets: Evolution, Challenges, Policies. Washington, D.C., World Bank: 27–120.

Baquedano F.G., Liefert W.M. (2014): Market integration and price transmission in consumer markets of developing countries. Food Policy, 44: 103–114.

Barnett R.C., Bessler D.A., Thompson R.L. (1983): The money supply and nominal agricultural prices. American Journal of Agricultural Economics, 65: 303–307.

Barrett C.B. (2001): Measuring integration and efficiency in international agricultural markets. Applied Economic Perspectives and Policy, 23: 19–32.

Başkaya Y.S., Gürgür T., Öğünç F. (2008): (İşlenmiş gıda fiyatlarını belirleyen faktörler). Ankara, TCMB. Available at https://www.tcmb.gov.tr/wps/wcm/connect/6a3006be-d391-4aeb-a873-ca35136aa3cb/WP0809.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-6a3006be-d391-4aeb-a873-ca35136aa3cb-m3fw5Pb: (in Turkish).

Bayramoğlu A.T., Yurtkur A.K. (2015): Türkiye'de gıda ve tarımsal ürün fiyatlarını uluslararası belirleyicileri. Anadolu Üniversitesi Sosyal Bilimler Dergisi, 15: 63–73. (in Turkish)

Bellemare M.F. (2015): Rising food prices, food price volatility, and social unrest. American Journal of Agricultural Economics, 97: 1–21.

Bergmann D., O'Connor D., Thümmel A. (2016): An analysis of price and volatility transmission in butter, palm oil and crude oil markets. Agricultural and Food Economics, 4: 23.

Berk A. (2017): The analysis of relationship between sunflower production and its price by using Koyck model in Turkey. Custos e Agronegocio, 13: 42–53.

Blundell R., Bond S. (1998): Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87: 115–143.

Bor O., Bayaner A. (2009): How responsive is the crop yield to producer prices? A panel data approach for the case of Türkiye. New Medit, 8: 28–33.

Breusch T.S., Pagan A.R. (1980): The Lagrange multiplier test and its applications to model specification in econometrics. The review of Economic Studies, 47: 239–253.

Ceballos F., Hernandez M.A., Minot N., Robles M. (2017): Grain price and volatility transmission from international to domestic markets in developing countries. World Development, 94: 305–320.

Cinar G. (2018): Price volatility transmission among cereal markets. The evidences for Turkey. New Medit, 17: 93–104.

Clauson A.L. (1997): Forecasting retail food prices under current conditions. American Journal of Agricultural Economics, 79: 1669–1672.

Conforti P. (2004): Price Transmission in Selected Agricultural Markets. FAO Commodity and Trade Policy Research Working Paper No. 7. Rome, FAO. Available at https://openknowledge.fao.org/items/c4c97f61-ec75-4c47-8f6a-60f4f6100e73

Dinler Z. (2014): Tarım Ekonomisi. 7^{th} Ed. Bursa, Ekin Basım Yayım Dağıtım: 421.

Dumitrescu E.-I., Hurlin C. (2012): Testing for Granger non-causality in heterogeneous panels. Economic Modelling, 29: 1450–1460.

Elleby C., Domínguez I. P., Adenauer M., & Genovese G. (2020): Impacts of the COVID-19 Pandemic on the Global Agricultural Markets. C. Elleby et al. Environmental and Resource Economics, 76: 1067–1079.

Fakari B., Aliabadi M.M.F., Mahmoudi H., Kojori M. (2016): Volatility spillover and price shocks in Iran's meat market. Custos e Agronegocio, 12: 84–98.

https://doi.org/10.17221/206/2025-AGRICECON

FAO (2024): FAO Food Price Index. Rome, FAO. Available at http://www.fao.org/worldfoodsituation/foodpricesindex/en/ (accessed Feb 4, 2021).

Gilbert C.L., Morgan C.W. (2010): Food price volatility. Philosophical Transactions of the Royal Society B: Biological Sciences, 365: 3023–3034.

Headey D., Fan S. (2010): Reflections on the Global Food Crisis: How Did It Happen? How Has It Hurt? And How Can We Prevent the Next One? Washington, D.C., International Food Policy Research Institute: Vol. 165: 57.

Huka H., Ruoja C., Mchopa A. (2014): Price fluctuation of agricultural products and its impact on small scale farmers development: Case analysis from Kilimanjaro Tanzania. European Journal of Business and Management, 6: 155–160.

Imran K., Anwar S., Hye Q.M.A. (2009): Food prices and money supply: A causality analysis for Bangladesh economy. Journal of Social and Economic Policy, 6: 1–6.

Isard P. (1977): How far can we push the 'law of one price'? The American Economic Review, 67: 942–948.

Ismail A., Ihsan H., Khan S.A., Jabeen M. (2017): Price volatility of food and agricultural commodities: A case study of Pakistan. Journal of Economic Cooperation and Development, 38: 77–120.

Jevons S. (1985): Early clinical experience with UK-49, 858 in human volunteers and patients. In: Ishigami J. (ed.): Proceedings of the 14th International Congress of Chemotherapy. Kyoto, Japan, June 23–28, 1985: 1938–1939.

Jevons W. S. (1989): Money and the Mechanism of Exchange. In: General Equilibrium Models of Monetary Economies, Academic Press: 55–65.

Karadaş E., Mutluer D., Özer Y.B., Aysoy C. (2006): (Türkiye'de imalat sanayindeki firmaların fiyatlama davranışı). İktisat, İşletme ve Finans Dergisi, 23: 7–34. (in Turkish)

Kargbo J.M. (2000): Impacts of monetary and macroeconomic factors on food prices in eastern and southern Africa. Applied Economics, 32: 1373–1389.

McCorriston S. (2015): Food Price Dynamics and Price Adjustment in the EU. Oxford, Oxford University Press: 148.

McCorriston S., MacLaren D. (2024): Market intermediaries, storage and policy reforms. Journal of Agricultural Economics, 75: 114–136.

Meyer J., von Cramon-Taubadel S. (2004): Asymmetric price transmission: A survey. Journal of Agricultural Economics, 55: 581–611.

Michaud C., Llerena D., Joly I. (2013): Willingness to pay for environmental attributes of non-food agricultural products: A real choice experiment. European Review of Agricultural Economics, 40: 313–329.

Moore H.L. (1914): Economic cycles: Their law and cause. New York, The Macmillan Company: 66–84.

Nazlioglu S., Soytas U. (2012): Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis. Energy Economics, 34: 1098–1104.

Oğuz C., Bayramoğlu Z. (2018): Tarım Ekonomisi. Konya, Atlas Kitapevi: 222.

Pesaran M.H. (2004): General diagnostic tests for cross section dependence in panels. IZA Discussion Paper No. 1240. Bonn, Institute for the Study of Labor (IZA).

Pesaran M.H., Ullah A., Yamagata T. (2008): A bias-adjusted LM test of error cross-section independence. The Econometrics Journal, 11: 105–127.

Qiang W., Niu S., Wang X., Zhang C., Liu A., Cheng S. (2019): Evolution of the global agricultural trade network and policy implications for China. Sustainability, 12: 192.

Sarafidis V., Wansbeek T. (2012): Cross-sectional dependence in panel data analysis. Econometric Reviews, 31: 483–531.

Serra T., Gil J.M. (2013): Price volatility in food markets: Can stock building mitigate price fluctuations? European Review of Agricultural Economics, 40: 507–528.

Tadesse G., Algieri B., Kalkuhl M., von Braun J. (2014): Drivers and triggers of international food price spikes and volatility. Food Policy, 47: 117–128.

von Braun J., Torero M. (2009): Exploring the price spike. Choices, 24: 16–21.

Xie H., Wang B. (2017): An empirical analysis of the impact of agricultural product price fluctuations on China's grain yield. Sustainability, 9: 906.

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