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Agricultural commodities' price transmission from international to local markets in developing countries

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ABSTRACT

The transmission of commodities prices from international to local markets is an interesting and deeply investigated topic. A fast and strong link between the two levels of the market is seen by economists as a sign of local market efficiency, allowing actors to respond fast to signals coming from the international market. However, empirical evidence on the topic is mixed, ranging from a very weak linkage between prices in the two markets to a high-speed and almost complete transmission. The present paper aims to advance the knowledge on the topic by focusing on the price transmission of four main cereals – maize, rice, sorghum, and wheat – in 23 developing and fragile economies. Employing a recent World Bank dataset with prices for several local markets in select countries, we estimate panel vector autoregressions (PVAR) to analyze the pass-through effects of international price shocks on local food prices. We find evidence for a relatively strong price transmission elasticity for all commodities except sorghum. Furthermore, the observed transmission of shocks is almost immediate. We present the policy implications of these findings.

1. Introduction

The price of agricultural commodities is crucial in determining economic and welfare conditions in developing countries. In a large household survey on the Indonesian island of Java, poor families were found to spend 75% of their budget on food products (Block and Webb, 2009), while Meyimdjui and Combes (2021), analyzing several developing countries, found income shares dedicated to food expenditures comprised between 40.1% and 56.4%. Emediegwu (2022) observes that an average household in Nigeria spends 56.4% of its income on food, whereas an average household in the UK spends only 8.2%. Moreover, the price of agricultural commodities affects households in developing countries not only in their role as consumers but also as producers. Agriculture absorbs a significant fraction of the workforce (Gollin et al., 2007) and may constitute a substantial portion of a household's income. According to World Bank data, the share of Gross Domestic Product (GDP) from agriculture, forestry, and fishing in several developing countries is above 25%, peaking beyond 50% for countries such as Somalia and Sierra Leone.

Agricultural commodities are traded internationally, and their prices are often determined in dedicated markets such as the London Commodity Exchange (LCE). The price in local markets and the revenue received by farmers in developing countries are likely to be influenced by the international price of a commodity. For certain tradeable products, such as cash crops, the link between international and local prices is expected to be very strong. For staples, such as grains, the link may be weaker. On one side, several developing countries, especially in Africa, are net importers of cereals and other essential food products, raising concerns related to the diminished availability of grains due to the Russo–Ukrainian war (Behnassi and El Haiba, 2022), and most recently due to the untimely collapse of the Black Sea agreement (Emediegwu, 2023c).[1] This fact may imply a strong dependence of local prices on global food prices. However, other studies like Fjelde (2015) and Ivanic et al. (2012) evidence that changes in international prices may not be fully transmitted to local producers and consumers as this pass-through depends on a host of local factors such as openness of the domestic markets, distance to capital, etc. Also, Gollin et al. (2007) show that low-income countries, on average, import less than 5% of their total calorie intake, with few exceptions reaching a maximum of 15%. The authors explicitly state that "it is reasonable to view most economies as closed, from the perspective of trade in food" (Gollin

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[1] On 22 July 2022, Russian and Ukrainian officials signed the Black Sea Grain Initiative in Istanbul, Turkey. This agreement, brokered by the United Nations (UN), permits the safe passage of Ukraine's grain exports through three ports: Chornomorsk, Odesa, and Yuzhny/Pivdennyi. Unfortunately, Russia pulled out of the deal on 17 July 2023 (barely a year after its inception).

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et al. 2007; p. 1234). These authors push the notion that the impact of international prices on local ones may be relatively modest for some agricultural commodities, contrasting some authors (e.g., Bazzi and Blattman (2014)) who use international prices as proxies for local ones. However, proxies are valid only insofar as they have a reasonable link with their proxied items. As noted by Brown et al. (2012), the use of local food prices rather than international prices to build early warning systems for food security significantly improves performances, implying that international prices might not be good proxies in some circumstances.

Due to the importance of agricultural commodity prices for the livelihood of millions of people in developing countries, it is essential to investigate their relationship with international prices. Several papers have analyzed this connection. For example, Arnade et al. (2017) investigate the transmission mechanism between the international price of some agricultural products and the local prices in the Chinese domestic markets. Baffes and Gardner (2003) consider the effect of policy reforms on local food prices in developing countries. Equally, Baquedano and Liefert (2014) analyze the strength of the price transmission mechanism for major cereals in several developing countries. Willing to summarize the main findings, we can say that local prices respond to shocks in international prices. Still, the link is often loose, and fluctuations in international prices are generally slow in affecting local prices.

The present paper is part of the literature investigating the nexus between international and local food prices. Two significant novelties characterize the current work. First, we use a recent World Bank dataset offering local (market-level) monthly market prices for some food commodities in 23 developing and fragile economies. To our knowledge, this dataset has not been used for this type of analysis. Multiple local markets – all georeferenced – are considered for each covered country. Overall, we examine monthly price series consisting of four staple food products from more than 1200 markets from five developing regions of the world. This dataset allows us to use a panel setting rather than simple time series used in previous studies, thereby enriching the quantity of our observations and improving the quality of the estimation. Second, we estimate panel vector autoregressions (PVAR) to analyze the pass-through effects of international price fluctuations on local food prices. Our findings are partially in line with the existing literature, with the significant difference that we find, in general, a stronger and faster pass-through of international price shocks for rice, maize, and wheat. On the other hand, we find that shocks to the international price of sorghum do not significantly affect sorghum prices in developing economies' local markets.

Section 2 provides a synthetic review of the relevant literature, Section 3 describes the data and methodology, and Section 4 is dedicated to the results of the econometric estimation and their discussion. The last section is devoted to the conclusion with important policy suggestions.

2. Literature review

Fast transmission of prices across markets is generally considered positive by economists because it helps to improve market efficiency (Arnade et al., 2017). However, price stability, particularly of food and other necessary goods, is an objective pursued by several countries, particularly developing ones (Baffes and Gardner, 2003). While the liberalization programs that occurred in several low-income countries during the 80s and 90s should have increased the speed of price transmission for agricultural commodities, most of such countries have retained some degree of intervention to stabilize prices, motivated either by electoral, humanitarian, or efficiency concerns (Timmer, 1989). The level of market integration, its role in economic performance, and the effect of policy reforms on such market integration are all aspects that have received wide attention in the economic literature.

The early literature on the topic that focuses on price transmission in developing countries when liberalization programs have not started or are in their infancy does not provide a clear view of price transmission. Contrary to expectations, given the strong interventionism of several countries during the analyzed period (1968–78), Mundlak and Larson (1992) find a strong linkage between international and local prices. Hazell et al. (1990) partially contradict this view, sustaining that the variability in global prices is transmitted to developing countries in the dollar value of their exports but far less strongly to average producer prices. Morisset (1998), despite analyzing commodity markets in industrialized nations, also finds a far-from-perfect price transmission mechanism with significant asymmetries.

In more recent studies, findings about the strength of the price transmission mechanism in commodity markets have been equally ambiguous. Investigating the Chinese economy, Arnade et al. (2017) find a relatively strong transmission of prices for soybeans, soy meal, and chicken but a much weaker one for rice. In addition, they find that the pass-through effect is stronger in the long run than in the short run, explaining this behavior with the limited capacity of price stabilization policies to operate effectively beyond the short run. Baffes and Gardner (2003), analyzing eight developing countries, find evidence of significant price transmission only in three. Furthermore, they reject the idea that liberalization reforms have significantly increased the strength of price transmission. On their part, Baquedano and Liefert (2014) show a certain degree of price transmission for several widespread cereals in a large set of developing countries. However, the transmission and the adjustment rate after a shock are relatively slow. Subervie (2011) points out that liberalization programs affect price transmission but mainly on the convergence speed of price decreases. Finally, Bekkers et al. (2017) find a stronger transmission mechanism for commodities in developing rather than industrialized countries, underlying the negative implications regarding food security for the former.

Unlike the large variance in findings, the methods of investigation and the unit of observations have been relatively homogeneous. Most empirical literature adopts time-series data and techniques such as error correction models (ECMs). Arnade et al. (2017) use an ECM for their estimation, while Balcombe et al. (2007) and Subervie (2011) employ a threshold ECM. Baquedano and Liefert (2014) adopt a single equation ECM, whereas Esposti and Listorti (2013) utilize a vector error correction model (VCEM). Finding no evidence for cointegration in most of the examined countries, Bekkers et al. (2017) rely on a vector autoregression (VAR) model. In contrast to prior studies, we employ a new market-level, monthly database of food prices for developing regions around the world, granting us more information, variability, and efficiency than pure time series data used in previous works. Consequently, we are able to model both the common and individual behaviors of groups that affect commodity prices.

3. Data and methods

3.1. Data sources

Our analysis focuses on developing and fragile economies. Fig. 1 shows the countries included in our sample, while Table A.1, in the Appendix, lists their names. Most countries fall under the UN definition of developing economies, while others, such as Afghanistan, Syria, and Nigeria, have very challenging situations due to internal conflicts. The monthly local market food prices data have been obtained from a recent World Bank dataset (available here) that covers 1331 markets from January 2007 to December 2021. In the spirit of Emediegwu and Nnadozie (2023), all food prices are collected at retail level to capture the pass-through effect of international food price shocks to household welfare.

We also rely on the World Bank Commodity Market Data for monthly international prices (available here). The analyzed commodities are four cereal crops widely used as staples, namely maize, rice,

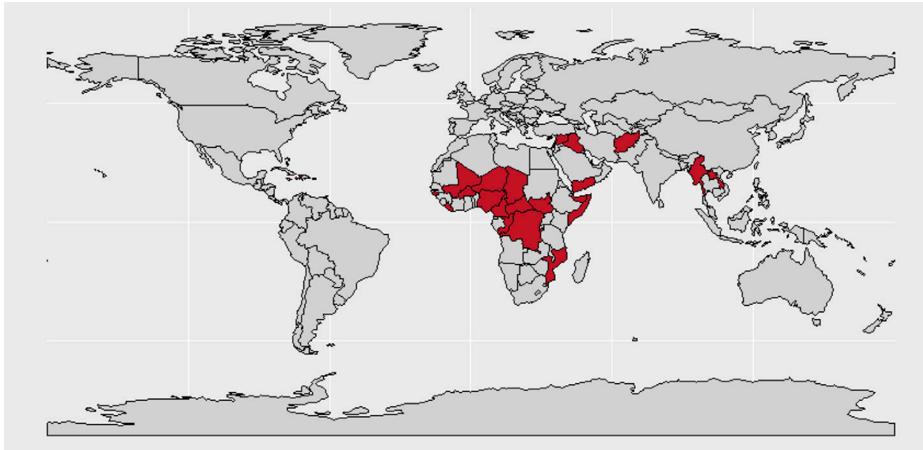

Fig. 1. World map with sampled countries (in red). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

sorghum, and wheat, chosen for their importance in food security and due to data availability. Various types of rice and wheat are traded internationally. Wheat is divided into soft and hard, with the former preferred because it is typically grown in hot climates, characteristic of all countries under investigation (Posner, 2000). Equally, we have chosen the price of Thai rice 5% (Thai rice with 5% maximum of broken grains) over other rice types: Thai rice 25%, A1, or Vietnam rice 5%. Broken rice is often used as animal feed; therefore, types such as 25% or A1 (100% of broken grains) may be less indicative of the price of rice for human consumption (Filgueira et al., 2014). Thai rice has been preferred to Vietnamese rice since Thailand is a greater exporter of this commodity; thus, its price should be more representative. The correlation between the two types of wheat and the various types of rice shown in Fig. A.1 in the Appendix is generally strong (except for rice A1); ergo, this choice is not so crucial. Besides, the discarded types are used for robustness analysis.

Local market prices, expressed in local currencies, have been converted into PPP dollars, and, together with international prices, they have been deflated to obtain real prices. We transformed the real prices to their month-on-month (MoM) logarithmic values to ease the interpretation of the impulse-responses in percentage terms. We present the summary statistics of the main variables used in the study in Table 1.

Over the period under consideration, average real prices of maize and rice are highest in the Middle East and North Africa (MENA). Latin America and the Caribbean (LAC) have the least variation for most food prices, perhaps because they have the lowest number of markets sampled. Aside from West Africa, where most of the average food prices are below the general average, other regions experience higher than the total sample's average price. Table 1 also shows that most observations come from the West Africa subregion (>60%). Our sensitivity analysis shows that our results are robust to the inclusion or exclusion of the subregion.

Fig. 2 illustrates the annual trends for both international and local prices of the four commodities under investigation. The Figure reveals some degree of comovement between local and international food prices for all food types, with the exception of sorghum. The Figure further shows that international food prices sit approximately somewhere in the middle of domestic prices.

3.2. Empirical strategy

We employ a panel VAR approach to investigate the impact of shocks in international food prices (P) on local food prices (p) in developing economies. The following reduced model is estimated:

$$y_{it} = \beta_i + A(L)y_{it} + \varepsilon_{it} \tag{1}$$

where y_{it} is a two-variables vector (P, p) in market i at month t, and β_i is a diagonal matrix of market-specific intercepts (fixed effects), capturing time-invariant factors that affect food prices (the Russo–Ukrainian war, for example). $A(L)$ is a matrix polynomial of lagged coefficients with $A(L) = A_1L^1 + A_2L^2 + \cdots + A_qL^q$, with q being the autoregressive order. Here, we choose q=1 following extant empirical works as well as under the assumption that food prices are very volatile to macroeconomic shocks (see, Fig. A.3 in the Appendix for results with alternative lags). A are parameters to be estimated, whereas ε_{it} is a vector of idiosyncratic errors. In subsequent analysis, we estimate Eq. (1) for the prices of four food commodities separately — maize, rice, sorghum, and wheat.

Love and Zicchino (2006) note that the fixed effects are likely correlated to the lags of the outcome variable due to the dynamic nature of Eq. (1). Hence, the standard method of eliminating fixed effects, mean-differencing, would produce biased results. To overcome this empirical challenge, we use the forward mean-differencing or orthogonal deviation (Helmert transformation) approach proposed in Arellano and Bover (1995) as an alternative elimination strategy. This "orthogonal deviation" approach eliminates the average of all future observations for each market-month rather than using deviations from historical observations. This transformation allows the use of lagged covariates as instruments since it retains the orthogonal structure between the lagged covariates and the transformed variables (Baltagi, 2008). Hence, the model coefficients can be jointly estimated using system GMM.

It is important to state that the estimates of the fitted model are not informative, as the coefficients on the reduced-form panel VARs cannot be interpreted as causal influences without imposing identifying restrictions on the parameters (Emediegwu and Nnadozie, 2023; Love and Zicchino, 2006). To compute the impulse-response functions (IRFs), we apply Cholesky decomposition to the residuals to orthogonalize them. Given that the intent of our paper is to measure the pass-through impact from international prices to local prices, we allow international food prices (P) to have a contemporaneous effect on local food prices (p) in the Cholesky ordering and not the other way around. By construction, such arrangement means that the variable that appears earlier (P) is weakly exogenous with respect to the rest of the covariates in the short run.

Finally, we construct the IRFs using the method described in Love and Zicchino (2006), where the confidence intervals are estimated using Monte-Carlo simulations. These estimations were done using the *pvar* package in Stata, developed by Abrigo and Love (2016).

Table 1
Summary statistics of local food prices (in US$) across regions.

	Maize			Rice			Sorghum			Wheat		
	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs
Central Africa	0.43	0.11	2,964	1.06	0.32	2,470	0.37	0.15	3,110	0.69	0.02	45
Eastern Africa	0.68	0.22	3,179	1.53	0.25	3,325	0.83	0.36	1,489	–	–	–
Southern Africa	0.48	0.70	2,780	0.99	0.54	2,665	–	–	–	–	–	–
Western Africa	0.37	0.12	15,810	0.77	0.16	18,541	0.37	0.12	18,565	0.85	0.23	207
Middle East & North Africa (MENA)	0.73	0.04	8	1.69	0.61	2,327	0.73	0.31	448	0.52	0.17	191
East Asia & Pacific	0.66	0.21	238	0.68	0.28	4,271	–	–	–	–	–	–
Latin America & Caribbean	–	–	–	1.22	0.19	535	0.43	0.09	508	–	–	–
Southern Asia	–	–	–	0.80	0.22	984	–	–	–	0.45	0.08	882
Aggregate sample	0.43	0.29	24,979	0.94	0.42	35,118	0.41	0.20	24,120	0.53	0.19	1,325

Note: The above table represents monthly observations from Jan 2007 to Dec 2021. More information regarding the number of countries and markets in each subregion is reserved in the Appendix section. SD denotes standard deviation. Observations are US$ in real terms.

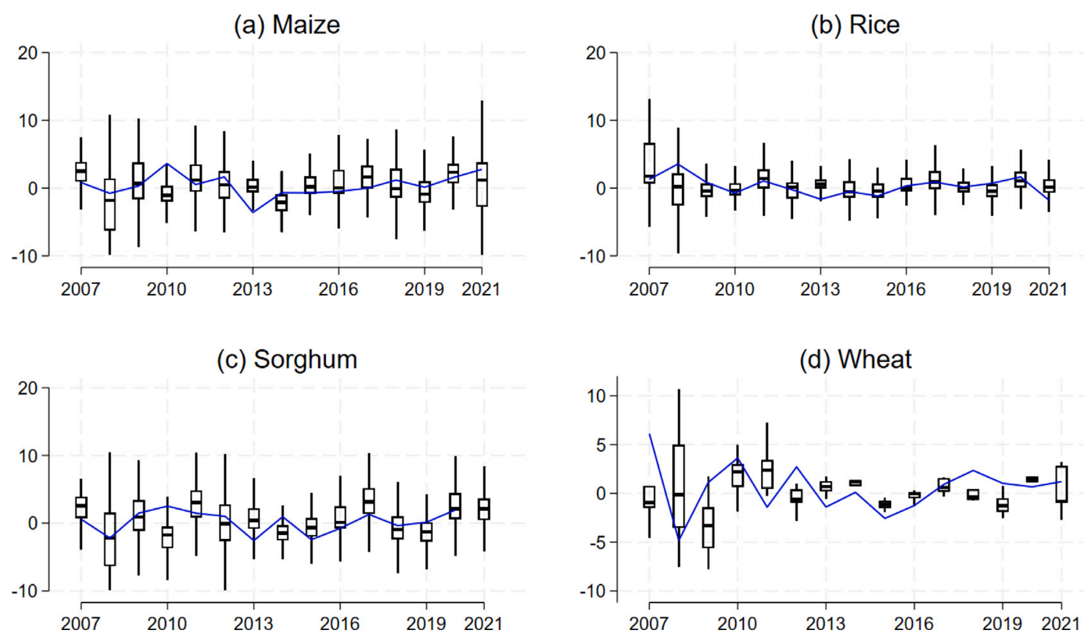

Fig. 2. Trend analysis of international and local food prices. Analyzed by year, the box plots represent cross-sections of locally observed prices, while the blue line graphs denote average international food prices. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Practically, we re-estimated the IRFs by randomly building a draw of coefficients A of Eq. (1) using the estimated coefficients and the associated variance–covariance matrix. We repeat the entire procedure 1000 times to construct the 5th and 95th percentiles of the distribution used as confidence intervals of IRFs. The IRFs in this paper describe the response of local food prices over time to shocks to international food prices within the system for 12 months ahead.

4. Results of the econometric analysis

We begin by showing that the GMM-estimated Eq. (1) is stable because Fig. A.2 in the Appendix reveals that the modulus of each eigenvalue of the fitted model lies inside the unit circle, implying they are strictly less than one. The stability of the estimated model suggests that shocks will eventually converge towards zero; hence, the PVAR model is invertible, making the estimated IRFs interpretable.

4.1. Impulse response functions

To appreciate the PVAR model, we turn to the interpretation of the impulse response functions (IRFs). Fig. 3 presents the IRFs graphs and the associated 95% confidence intervals generated *via* Monte Carlo simulations with 1000 repetitions. We interpret the Figure as the effect of a shock in international food prices on local prices for 12 months after introducing the shock. Except for sorghum, we find that a positive shock to international prices of maize, rice, and soft wheat is associated with a positive impact on the respective local prices in developing economies, as seen in panels a, b, and d in Fig. 3. These results confirm that most local staple prices are closely linked to fluctuations in their international prices.

One possible explanation for the different behavior of the price of sorghum may come from its use in industrialized countries and internationally traded quantities. Sorghum is scarcely used as food for human consumption in high- and upper-middle-income countries, except for a marginal use in gluten-free products for coeliacs. Its main use is as animal fodder in industrialized countries, whereas it is a staple food in several developing nations, where roughly 80% of world production is located (Hariprasanna and Rakshit, 2016). When comparing the percentage of internationally traded quantities (import or export) over the total production quantity of our commodities of interest, we can see that sorghum is the second lowest after rice: maize (14.3%),

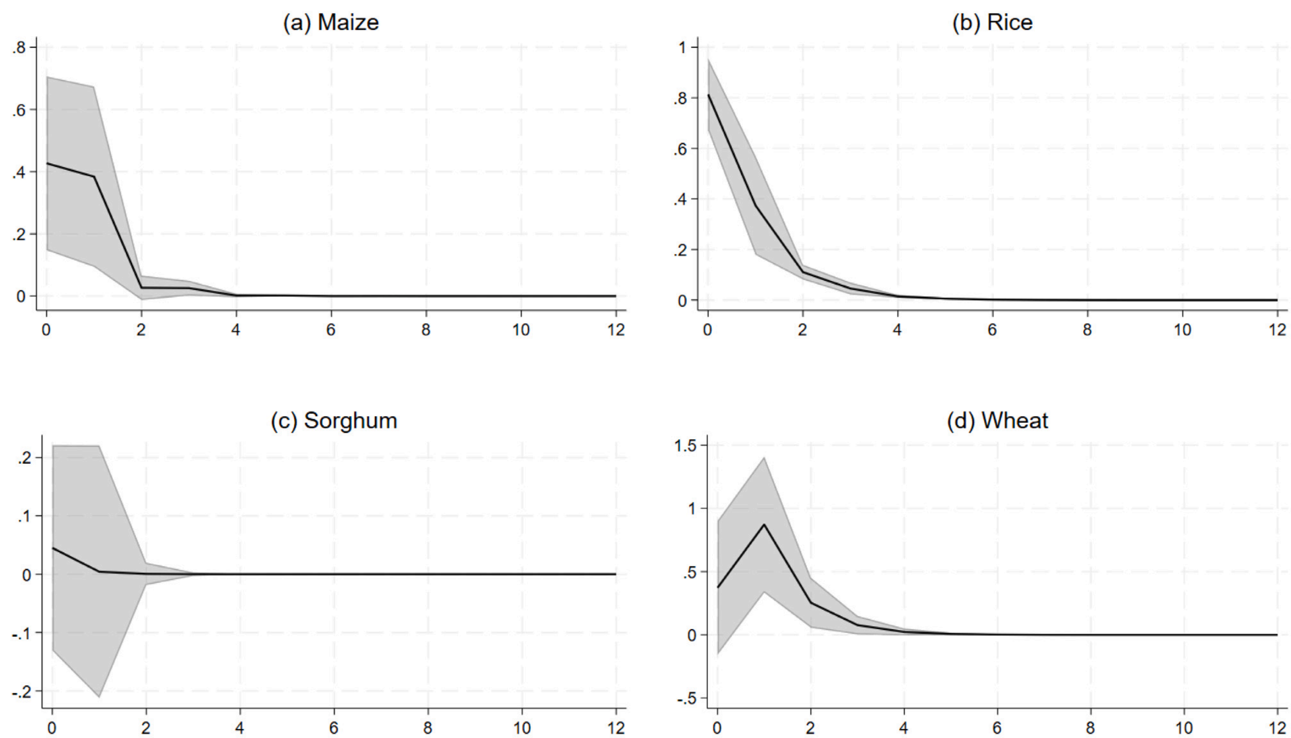

Fig. 3. Global-to-local price transmission: An impulse-response analysis. Impulse-response functions computed from GMM Panel VAR. The gray areas, representing the 95% confidence bounds, are generated by Monte Carlo with 1000 repetitions.

rice (24.8%), sorghum (12.6%), wheat (24.2%).[2] If we consider only Africa as a proxy for developing countries and examine the ratio of the sum of imported and exported quantities over domestic production, the gap between sorghum and the other crops increases: maize (26.3%), rice (91.9%), sorghum (4.1%), wheat (170.8%). Therefore, despite the percentage of internationally traded sorghum being similar to maize at the world level, it seems that the share imputable to developing countries is far lower for sorghum than maize. Once again, this could be because the international market of sorghum deals mainly with the portion of this crop dedicated to animal feed, while the production in developing countries is mainly for local human consumption. Indeed, sorghum is a crop commonly grown in Africa (where most of the investigated countries are located) as a staple (Hadebe et al., 2017). Thus, we have cause to believe the continent is more self-sufficient with regard to this crop, whose price is then less affected by shocks in the international price. To verify this hypothesis, regional prices could be used instead of the US-based international price of sorghum. However, lack of data prevents us from further investigating the mechanism.

The high responsiveness of local rice prices to international price movements is also explicable with the relatively high proportion of traded versus domestically produced quantities. When considering quantities at world level, we have a ratio of 24.8%, but when only Africa is examined, such ratio increases to 91.9%. The lower ratio at world level is probably due to China. According to FAOSTAT data, China is the largest importer of rice globally,[3] with 2.62 million metric tons imported in 2022 (11% of world imports). It is also the sixth world exporter, with 1.03 million metric tons in the same year. However, domestic production in 2022 totaled more than 208 million metric tons, such that the ratio of traded over domestically produced quantity is a mere 1.75%. On the other hand, when only Africa is considered, thus excluding China, traded over produced quantities become much more significant, explaining the strong link between local and international prices.

Further, we find that most impacts peak at the inception of the shock, except wheat prices, which peak after one month before they start plateauing from the fourth month. These findings imply that the pass-through effect of shocks in international food prices to local prices is almost immediate. A ‘mere’ announcement or news of a macroeconomic adjustment or political action that threatens the stability of international food prices can send an immediate signal to local food prices. For example, some commentators attribute the pre-Black Sea Grain Initiative fall in the FAO food price index to the role of expectations of a grain deal being signed (Emediegwu, 2023c).[4]

We present the cumulative IRF in Fig. 4 to show the effects in levels rather than in log-differences. We achieve this task by aggregating the impacts over the forecast horizon (12 months). Although it appears that the form of Fig. 4 differs from Fig. 3, both exhibit similar interpretations. Specifically, wheat prices have the highest total amount of pass-through effect from international price shocks (1.5.%), followed by rice (1.38%), and maize (0.82%). These figures are comparable but slightly higher than findings from previous studies. For example, Arnade et al. (2017) report an estimate of less than 1% for the short-run

[2] Data obtained from FAO (FAOSTAT). The reported percentages are averages over the years 2010–2021.

[3] For both imports and exports, different categories of rice are considered: rice, rice paddy, rice broken, rice milled and rice milled (husked).

[4] Although the Black Sea Grain Initiative was signed on 22 July 2022, Emediegwu (2023c) shows that the FAO food price index had started falling following the proposition of the Initiative in April 2022.

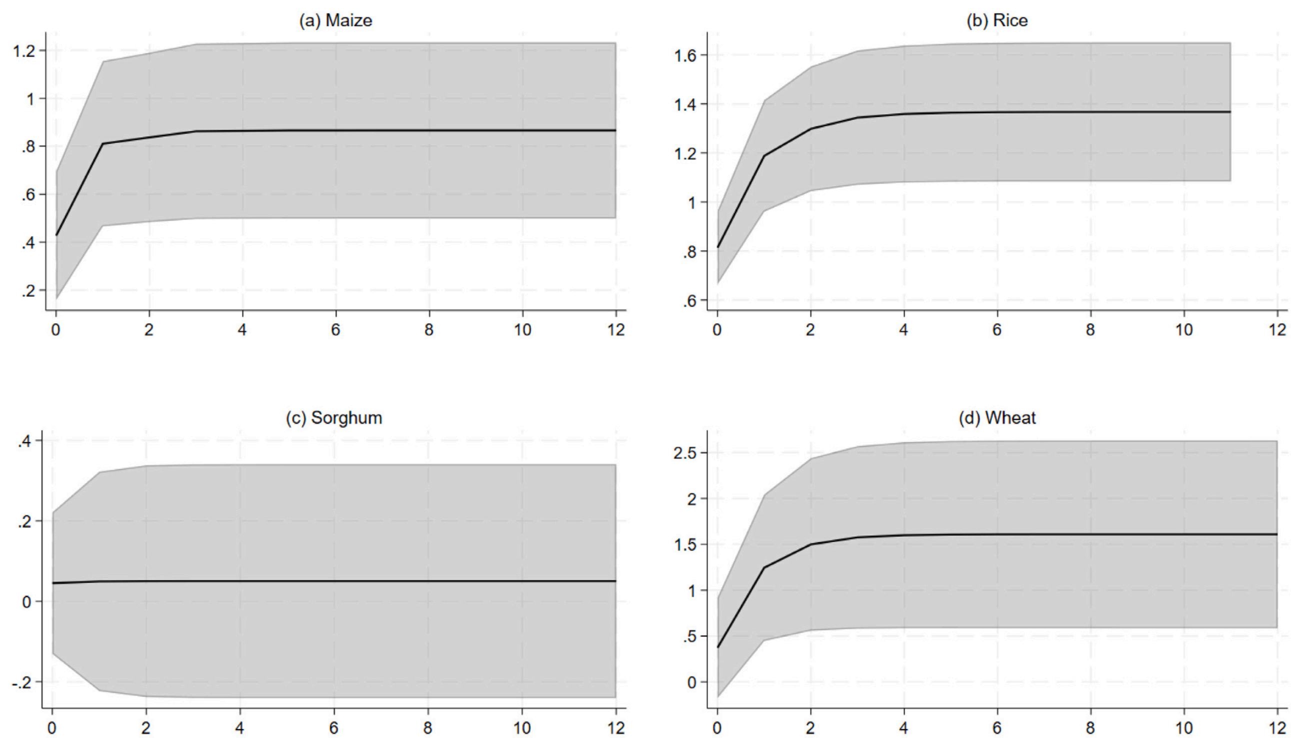

Fig. 4. Global-to-local price transmission: A cumulative impulse-response analysis. Cumulative IRFs computed from GMM Panel VAR. The gray areas, representing the 95% confidence bounds, are generated by Monte Carlo with 1000 repetitions.

pass-through of international rice price shocks to rice prices in China. Focussing on developing economies, Baffes and Gardner (2003) find short-run pass-through percentages generally lower than one, except for maize in Egypt and Colombia. In like manner, Dillon and Barrett (2016) find that a marginal change in international food prices is associated with a 0.22% change in maize prices in Kenya. We conjecture that our slightly higher value than most previous works could be attributed to the use of panel data in detecting and measuring statistical effects that pure time series data cannot. Additionally, our focus on least developed and fragile countries may also be a reason for such higher pass-through. While several countries tend to pursue price stabilization policies for food commodities, countries with problematic financial situations may be prevented from doing so. Alternatively, it could also be due to our use of a recent dataset that captures the effects of recent liberalization programs. It is also essential to state that while the impact appears marginal when translated to additional cents, they may not be negligible when translated to local currencies.[5]

4.2. Robustness checks

In this subsection, we use several alterations of Eq. (1) to ascertain the robustness of our baseline results. Specifically, our sensitivity analysis involves re-modeling Eq. (1) with more aggregated panel samples, with alternative international food prices for rice and wheat,[6] as well as with different alterations of standard errors correction.

Country-level analysis: Here, we rescaled our unit of observations from market-level to country-level by taking the average value of food prices in all markets within a country per month. Hence, our cross-sectional units fall from 1209 markets to 23 countries, as shown in Table A.1 in the Appendix. Fig. 5 shows that our findings are unaffected by the choice of observational unit as the country-level impacts (denoted by the red lines) follow a similar pattern as in the main results (represented by the black lines) except for sorghum prices. We have a positive transmission mechanism when considering country-level sorghum prices, which is absent when local market prices are used. In this case, the different number of local markets considered for each country may play a role. Countries with a weak link between their local market prices and the international price of sorghum may have more observed prices. For example, countries where sorghum is a largely cultivated staple will easily have more observed local prices. Roughly 70% of observed market prices in our dataset come from three Western African countries: Burkina Faso, Mali, and Niger. However, these may also be countries with low import dependence and, thus, a low pass-through. Once averaging the prices at country level, its over-representation in the sample disappears — the classic case of aggregation bias, consequently increasing the pass-through estimate.

Different varieties of food items: In the main analysis, we provided reasons for using certain classes of international food prices. For example, we show that Thai rice 5% is preferable and more consumed in developing economies such as SSA than other rice varieties (e.g., Thai

[5] A simple back-of-the-envelope calculation reflects this point. For example, for a country that exchanges 1000 units of its currency for $1, a 1.25% increase in food prices would translate to an additional 12.5 units of the local currency. The final price will then be 1012.5 units of the local currency.

[6] Unfortunately, we do not have data for alternative maize and sorghum prices to conduct similar analysis.

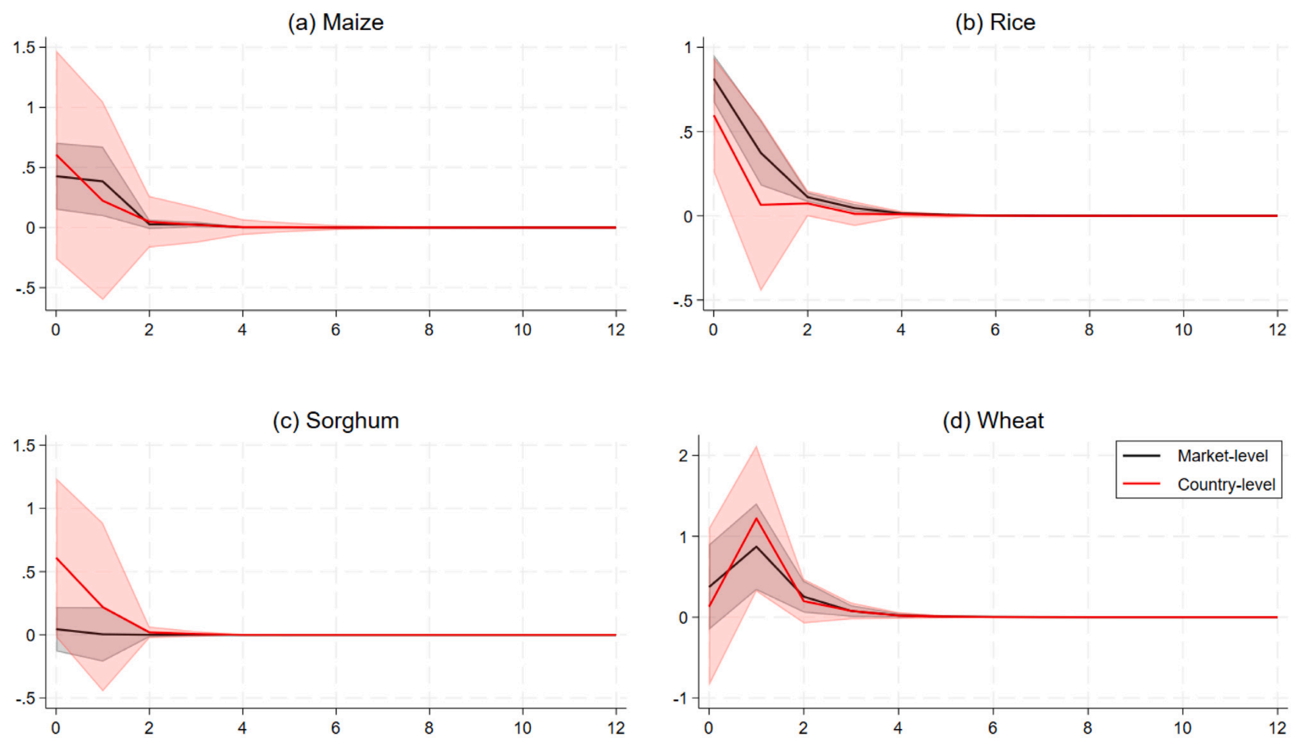

Fig. 5. Global-to-local price transmission: An impulse-response analysis. Black lines represent the baseline IRFs from market-level and IRFs from country-level food prices are denoted by the red lines. 95% confidence bounds are represented by shaded areas. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

rice 25%, A1, or Vietnam rice 5%). The same applies to the choice of soft wheat above hard wheat. Here, we show that our results retain their interpretation regardless of which variety of food prices we employ. Fig. 6 displays the IRFs. Using other rice varieties does not change the original findings of a positive impact. Although certain varieties, like Vietnam rice and Thai rice 25%, present a lower pass-through effect than Thai 5% rice. On the other hand, using hard wheat or soft wheat makes no significant difference as they produce very similar IRFs.

Alternative standard errors correction: Eq. (1) is analyzed with spatially-clustered standard errors at market-level (ML). As part of the robustness tests, we re-estimated Eq. (1) with alternative standard error correction: country-level (CL) clustering, clustering by year, bootstrapping, and unadjusted standard errors. Fig. 7 shows that, except for unadjusted and by-year clustering, other standard errors correction techniques produce analogous IRFs.

Summarily, the results from the various sensitivity tests show that our findings regarding the impact of global food price fluctuations are robust.

4.3. Investigating channels and sources

Next, we investigate where the impacts are coming from. Are there areas or periods where the effects of shocks on international food prices are greater? We conduct this exercise by showing the results of the estimated model specific to (i) each region, (ii) political regimes, and (iii) the non-COVID-19 era.

Fig. 8 shows the IRFs from maize and rice prices. We exclude wheat and sorghum as most of the observations for the local prices of these commodities come from a single region, as shown in Table A.1 of the Appendix, thereby making the heterogeneity analysis impossible. Fig. 8 reveals that East Asia and Pacific (EAP) and the Middle East and North Africa (MENA) are the regions most impacted by global maize price fluctuations. This finding is explained by the fact that these regions are far more dependent on imports of maize than Eastern and Western sub-Sahara African (SSA) countries. Looking at the ratio of net imports (imports minus exports) over the total domestically produced quantity,[7] we observe a value of roughly 201% for Northern African countries, lowering to 26% in South East Asia and 14% in both South and East Asia. This percentage is close to a mere 2% for Western and Eastern SSA countries, testifying to the lower dependence of these subregions on net imports of maize.

On the other hand, SSA countries are more affected by shocks to international rice price than the rest of the regions. Most SSA economies (even in Western Africa, where large-scale production occurs) are yet to attain self-sufficiency in rice production (Emediegwu, 2023a; Emediegwu et al., 2022). Therefore, to augment domestic needs, many rice-producing SSA countries import between 50% and 99% of their rice demand (FAO, IFAD, UNICEF, WFP, WHO, 2018). We also provide further results in the Appendix (see, Fig. A.4) that show that the West Africa subregion is the most impacted in SSA following fluctuations in global rice price. Rice prices in the East Asia and Pacific (EAP) region exhibit a nonlinear pass-through where impact begins at a negative point, picks up in the next period, and fades gradually over time. The heightened effect of international price fluctuations in the region is unsurprising since both rice consumption and export are high in the area, creating a supply-side problem.[8] The export price, strongly linked to the international price, impacts the choice of farmers regarding

[7] We obtained data from FAOSTAT, considering data from 2010 to 2021.

[8] The international price of rice considered in the present study is determined in the Bangkok market (A1, 5%, 25%) or Hanoi (Vietnam rice).

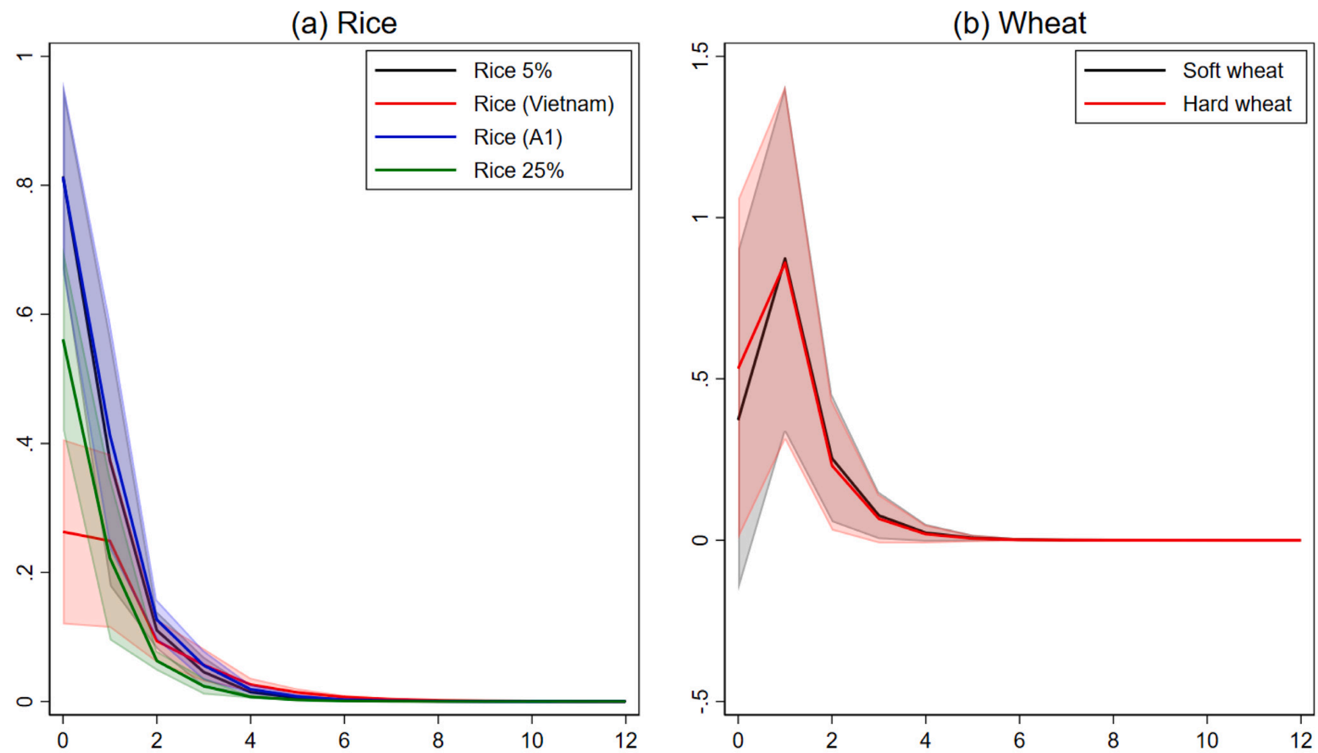

Fig. 6. Global-to-local price transmission: An impulse-response analysis. IRFs from food prices of alternative varieties of rice and wheat. 95% confidence bounds are represented by shaded areas.

where to sell their produce, thereby creating a competing effect with local markets. Such action links the prices in both markets.

Also, we consider the influence of democracies as a potential channel for the heterogeneous effects of international food price fluctuations on local food prices. We use Polity2 scores from the Polity5 database (Marshall and Gurr, 2018) to classify political regimes, which range from −10 (strongly autocratic) to +10 (strongly democratic).[9] Specifically, we classify a country as democratic if the average score over the sample period is positive; otherwise, it is identified as autocratic. Fig. 9 shows that the effect of international food price shocks is higher in autocracies than democracies. In this regard, we contribute to understanding the impact of political regimes (democracy vs. autocracy) on food prices. Our results align with previous findings suggesting that systematic differences in food policy across regimes of different types moderate or amplify the effects of global food price shocks. For example, Hendrix and Haggard (2015) show that democratic economies are more resilient to global food price shocks than autocratic systems because there is a higher possibility of price-induced civil unrest in the former than in the latter. In the same vein, Raleigh et al. (2015) evidence that commodity price fluctuations are less likely to result in violence when a state is democratic because of the positive relationship between democracy and economic growth, a view also shared by Acemoglu et al. (2019).[10] Hence, prospered states develop safety nets and buffers to absorb shocks from global price fluctuations.

Lastly, we investigate whether our results are driven by the emergence of COVID-19 and the attendant restrictions to contain the pandemic. Fig. 10 shows that excluding COVID-19 years (Year 2020+) slightly delays the price transmission mechanism between international and local prices. This observation is valid for maize and rice, which display a similar pass-through between the two samples but with a delay of one time period. In the case of sorghum, the presence of COVID-19 years increases the magnitude of the pass-through. The case of wheat is peculiar since the difference is almost null, but this may be due to a few observations during the COVID-19 period, rendering the two samples somewhat similar. An increase in speed (maize and rice) and magnitude (sorghum) of price transmission during COVID-19 seems odd with expectations that restrictions on movement should cause a fall in international trade, resulting in a weakened pass-through effect. However, as evidenced by Arita et al. (2022), global trade of primary commodities during COVID-19 times has been rather resilient. On the other hand, local production in many developing economies has been impacted mainly due to restrictions on mobility as evidenced in several studies (e.g., Emediegwu and Nnadozie (2023)).[11] Such fall in local production may imply an increase in food dependence in our examined countries, thus explaining the increase in speed and magnitude of price

[9] Polity5 dataset, an extension of the Polity IV dataset, covers all major, independent states (i.e., nation-states with a total population of 500,000 or more in the most recent year) in the global system over the period 1800-2018. The dataset can be accessed *via* https://www.systemicpeace.org/inscrdata.html.

[10] As pointed out by an anonymous reviewer, it is more likely that a democratic state is also more market-friendly. Hence, the market is able to react faster, resulting lower shocks to domestic prices from world market shocks.

[11] Although some studies have argued in favor of resilient agricultural production in some countries due to proactive government interventions. For example, Emediegwu and Nnadozie (2023) show that a positive shock following COVID-19 lockdown announcements positively affects maize and rice prices in India. However, they attribute this impact to human-driven processes, such as hoarding, rather than actual production shortages.

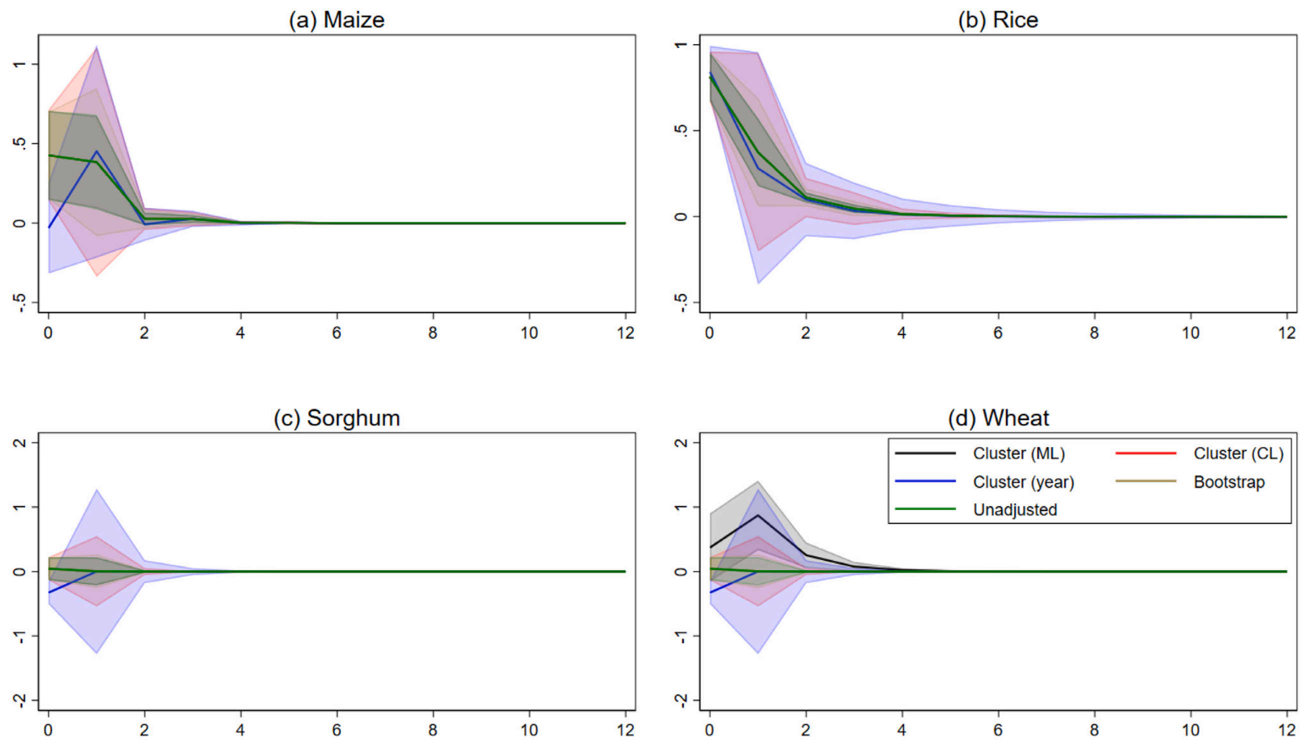

Fig. 7. Global-to-local price transmission: An impulse-response analysis. IRFs from alternative standard error corrections. 95% confidence bounds are represented by shaded areas.

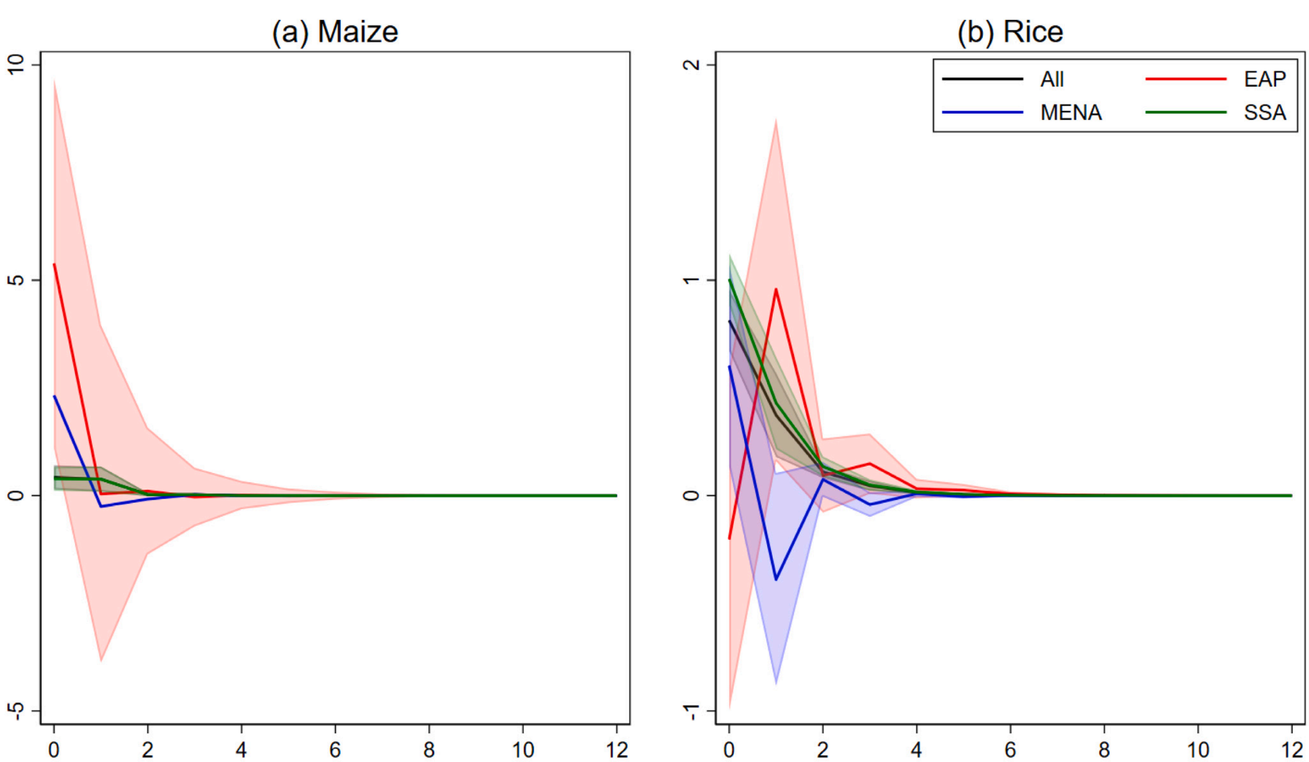

Fig. 8. Global-to-local price transmission: An impulse-response analysis. IRFs from Regional Analysis. 95% confidence bounds are represented by shaded areas.

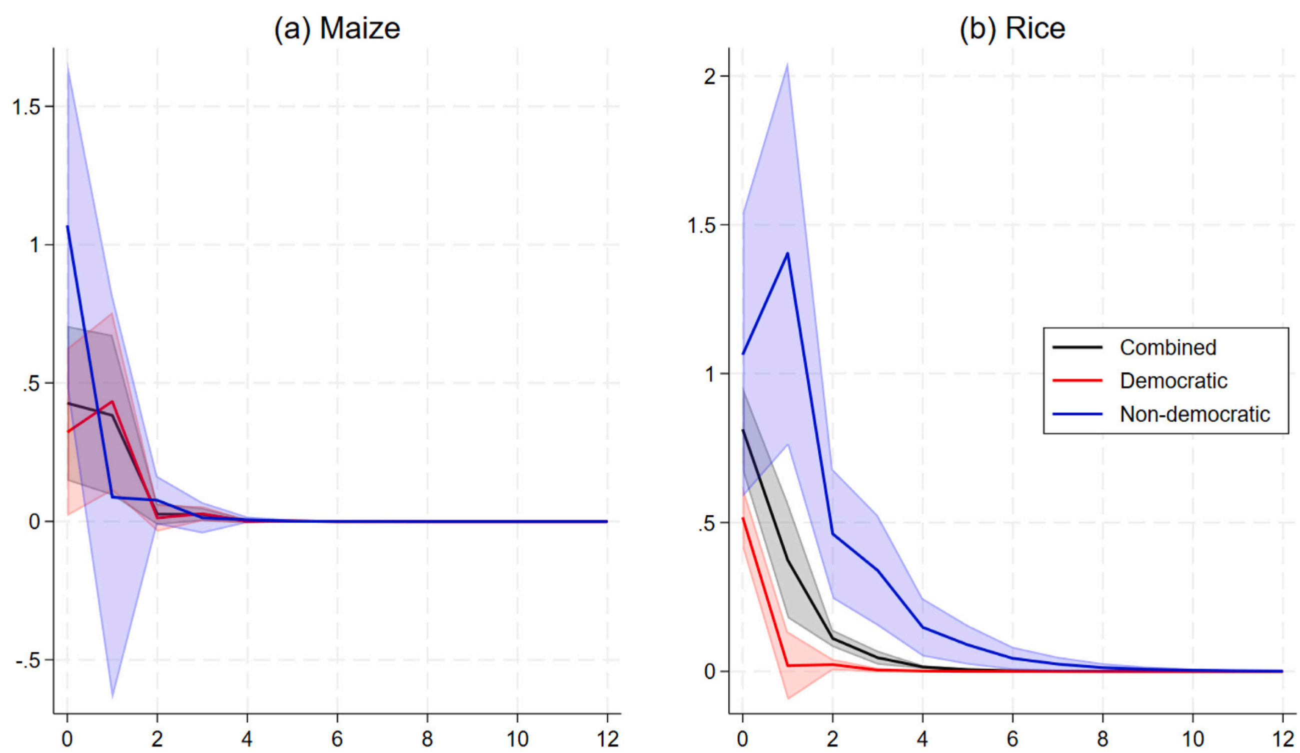

Fig. 9. Global-to-local price transmission: An impulse-response analysis showing the impact of democracies and autocracies. The shaded areas, representing the 95% confidence bounds, are generated by Monte Carlo with 1000 repetitions.

transmission. In the same vein, we suspect that the ongoing Russo–Ukrainian conflict would increase these effects significantly since both countries are major grain exporters in the world.[12] However, we cannot test this assumption as our data do not include the conflict years.

5. Conclusion

A strong mechanism of commodities price transmission between international and local markets is generally seen as a sign of domestic markets being responsive to international market events. According to the Law of One Price, identical goods sold in different frictionless markets, without transport costs, and operating under perfect competition will have the same price. Therefore, a full and prompt transmission of movements of international prices to local markets is a clear sign of a properly functioning market resembling the ideal type assumed by the Law of One Price.[13] Furthermore, it encourages agents to direct their investments and efforts properly. Conversely delays or partial transmission may cause a misallocation of resources that may have to be subsequently corrected with costly measures. Clearly, a certain sluggishness in the transmission of prices from international to local markets is impossible to eliminate due to several reasons. Ensuring stable prices is crucial to keeping citizens content, particularly in democratic societies. With the power to oust their leaders at the ballot box, hungry citizens may express their frustration if prices of necessary goods (e.g., food) spiral out of control. Hence, governments may pursue price stabilization policies as a crucial step towards appeasing citizens. Also, the scarce integration of a country into the international market due to political or physical barriers could be an additional reason for local prices being relatively unresponsive to international price movements.

How robust and efficient the transmission mechanism is an empirical question that has received consistent interest in the literature. Several authors focused on the effects of the liberalization processes undertaken by several developing countries on this mechanism. In general, results have been very mixed, with some authors claiming that liberalization did not have much effect and others contradicting such findings. Depending on the commodities and the group of countries analyzed, authors have found, generally using VAR or ECM models, either signs of a strong or weak transmission mechanism, if not completely absent. Early post-liberalization studies of price transmission did not find any significant effect because of the delay of reforms to produce effective changes. It is difficult, therefore, to find a clear pattern from the previous literature. Each country-product tuple seems to deserve an ad hoc analysis.

This paper analyzed maize, rice, sorghum, and wheat prices in local markets in 23 developing and fragile countries. Using a panel VAR model, we have found significant price linkages between local and international prices for three of the mentioned crops. The only exception is sorghum, a crop used mainly as animal fodder by industrialized countries, while it is an essential staple for several developing economies. In light of its different use and considering the scarce participation of SSA countries in the global trade of sorghum, it is unsurprising to find no linkage between international and local prices. Moreover, the result obtained for this crop is consistent with the dedicated literature.

[12] Emediegwu (2023b) explains the several channels through which the war in Ukraine influences international and local prices. Chief among the factors is fall in agricultural production (or supply) in the region due to military occupation of farmlands, destruction of farm machinery, and displacement of agricultural population.

[13] We express gratitude to an anonymous reviewer for providing insight on the Law of One Price.

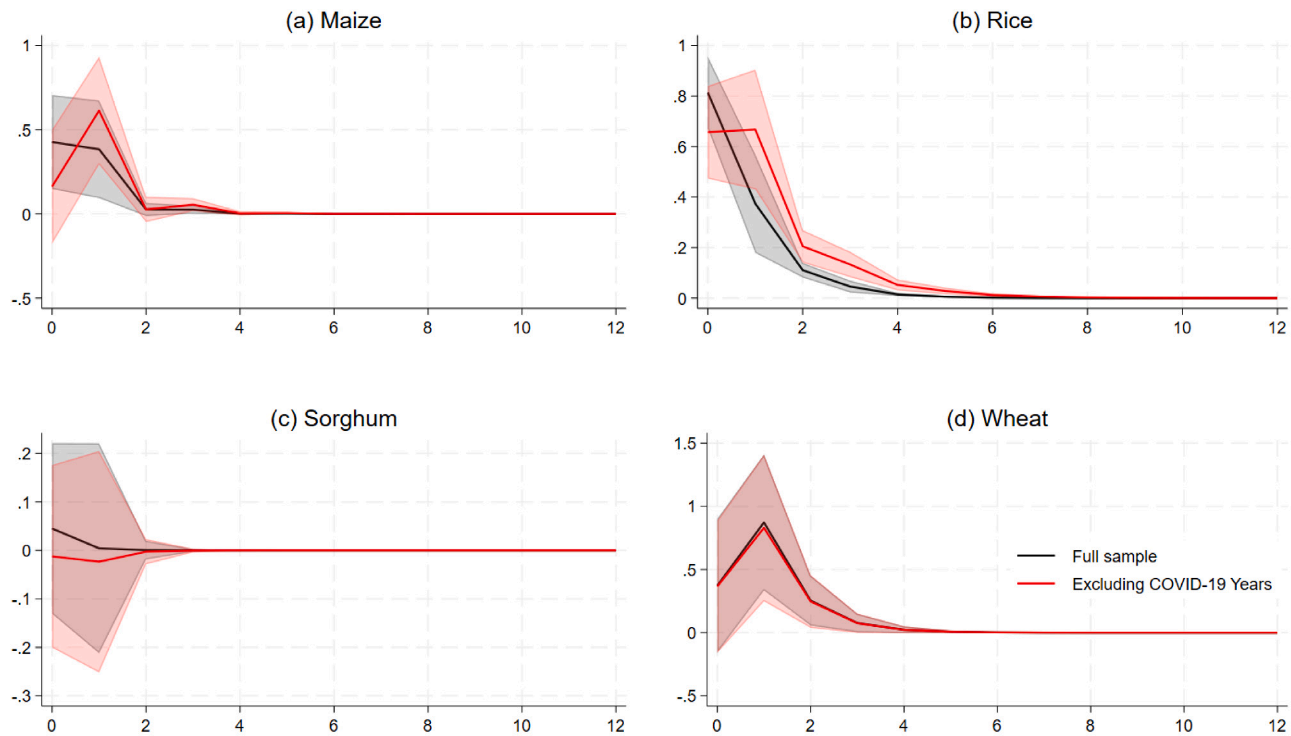

Fig. 10. Global-to-local price transmission: An impulse-response analysis showing the impact of COVID-19. The shaded areas, representing the 95% confidence bounds, are generated by Monte Carlo with 1000 repetitions.

When comparing our results with similar extant studies, we observe a relatively strong transmission mechanism. Previous papers evidence short-term pass-through values that are lower than 1% or even 0.5%, whereas our lowest estimated value is 0.82% (maize). A further difference is the speed of transmission, which, in our case, appears to be fast. The international price shock is passed to local markets in the first two months before its effects begin to vanish. Once again, this differs from the results of other papers, where international price shocks may continue to influence local prices for several months.

One possible explanation for such differences is the use of a panel setting that better captures the transmission of price shocks. Besides, it could also be a sign of greater market integration obtained over time, as testified by the relatively high import ratios of some commodities shown in the present study. Besides, the characteristics of the sampled countries could be another explanation. While a fast and strong transmission of prices is often seen as a signal of a responsive, efficient, and well-integrated market, it may also be a sign of strong dependence on imports. Also, we have mentioned that several countries adopt price stabilization policies, particularly for staples. In this case, a high value of pass-through from shocks in international prices would signal the lack of capability to implement a price stabilization policy rather than the existence of an efficient market.

The policy prescriptions suggested through this analysis depend on the reason for the increased pass-through: better market integration or increased dependence on imports. It also depends on the political objectives to be achieved. Comparing our analysis with previous studies that found coefficients of shock transmission lower than 1%, we have seen that a stronger pass-through has been individuated. This heightened impact may be a sign of better market integration of developing countries over time, which will testify to increased efficiency. If the previous statement is true, then it means that liberalization policies have been, at least partly, successful and would call for further strengthening. However, if the pass-through of prices is caused by an increased dependence of food-insecure countries on global trade, as the analysis of COVID-19 years partly suggests, then it would be advisable to increase the self-sufficiency of the analyzed countries and to strengthen their financial stability for them to gain the possibility of implementing price smoothing policies during critical periods.

CRediT authorship contribution statement

Lotanna E. Emediegwu: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marco Rogna:** Writing – review & editing, Writing – original draft, Validation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

See Figs. A.1–A.4 and Table A.1.

Table A.1
Summary of sampled markets and commodities.

Country	*No of markets*	*Commodities (No)*
Central Africa		
Cameroon	81	maize, rice, sorghum
Central African Republic	42	maize, rice, sorghum
Chad	61	maize, rice, sorghum
Eastern Africa		
Congo	10	rice
Burundi	72	maize, rice, sorghum
South Sudan	28	maize, sorghum
Southern Africa		
Mozambique	98	maize, rice
Western Africa		
Burkina Faso	64	maize, rice, sorghum
Guinea-Bissau	45	maize, rice, sorghum, wheat
Gambia	28	maize, rice, sorghum
Liberia	24	rice
Mali	111	maize, rice, sorghum, wheat
Niger	68	maize, rice, sorghum, wheat
Nigeria	35	maize, rice, sorghum
Middle East & North Africa (MENA)		
Iraq	19	rice
Lebanon	26	rice
Sudan	15	sorghum, wheat
Syria	94	maize, rice
Yemen	24	wheat
East Asia & Pacific		
Lao	17	rice
Myanmar	198	maize, rice
Latin America & Caribbean		
Haiti	9	rice, sorghum
Southern Asia		
Afghanistan	40	rice, wheat
Total: 23	*1209*	

Prices are in US$ in real teams per kg of the above-listed food items.

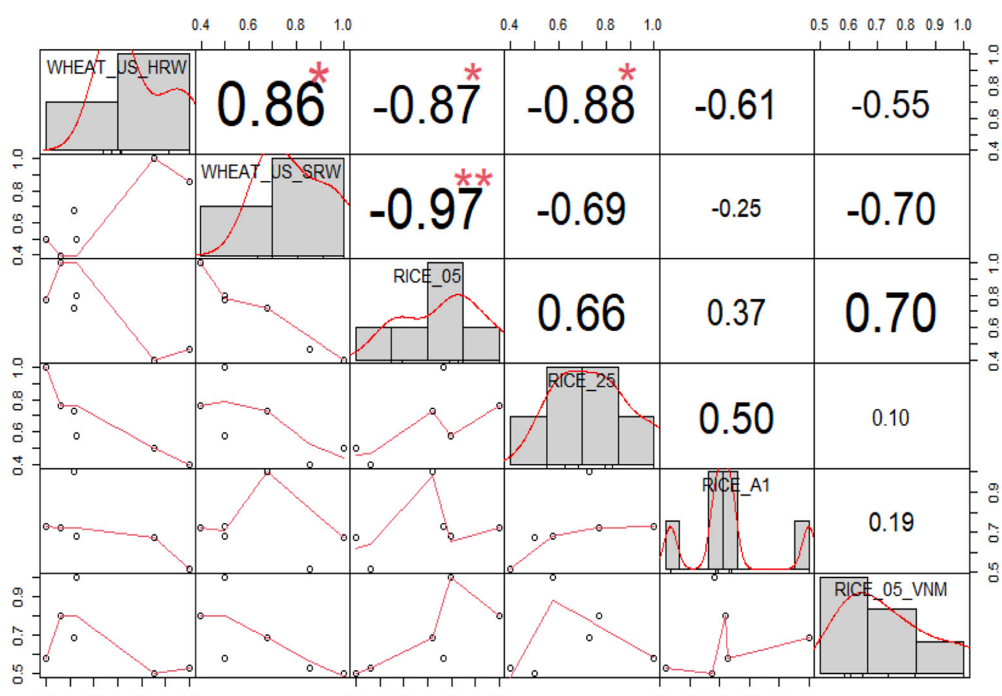
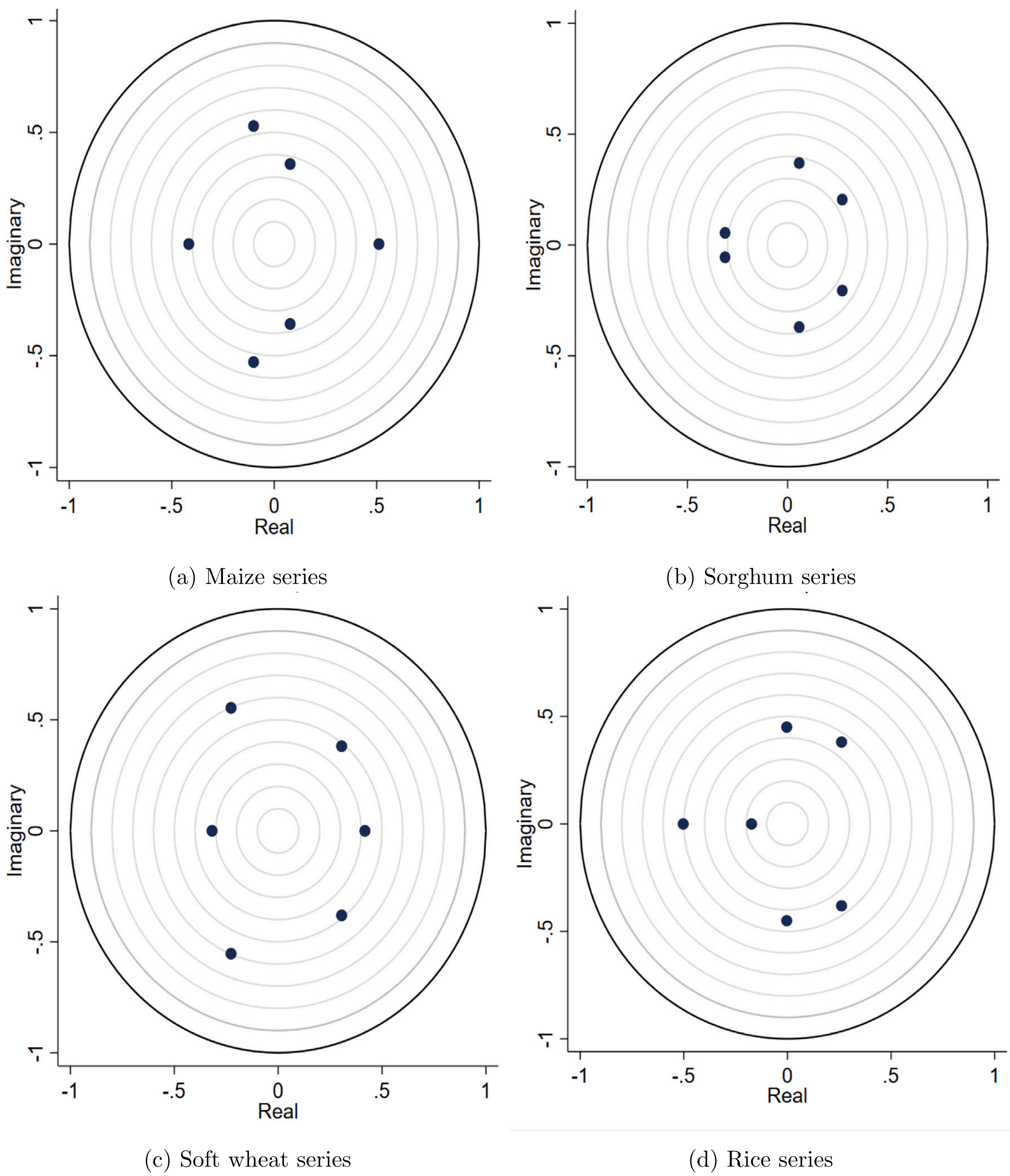


Fig. A.1. Correlation of prices of different types of international commodities.



(a) Maize series (b) Sorghum series

(c) Soft wheat series (d) Rice series

Fig. A.2. Roots of companion matrix.

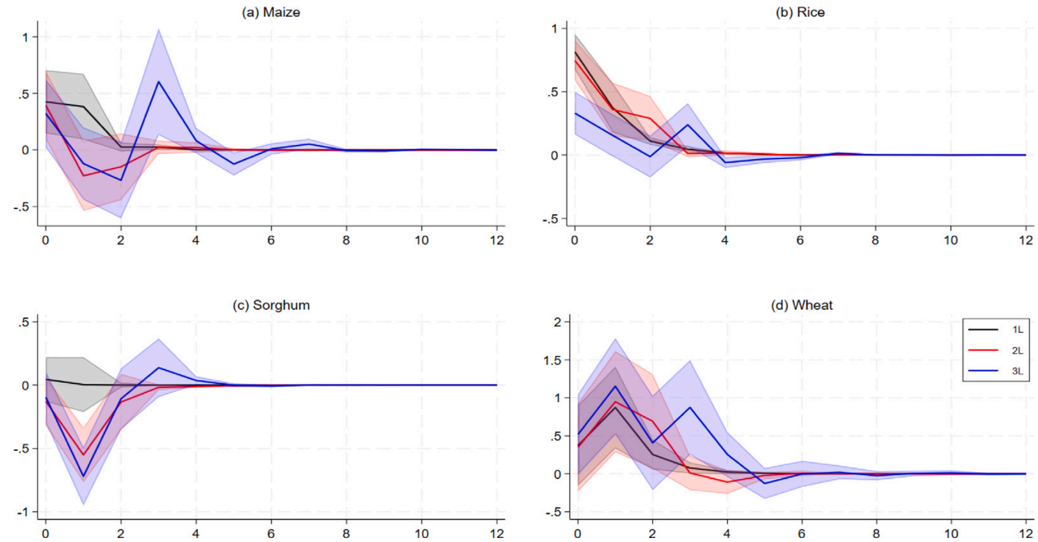


Fig. A.3. Global-to-local price transmission: An impulse-response analysis. IRFs from lag alterations. 95% confidence bounds are represented by shaded areas.

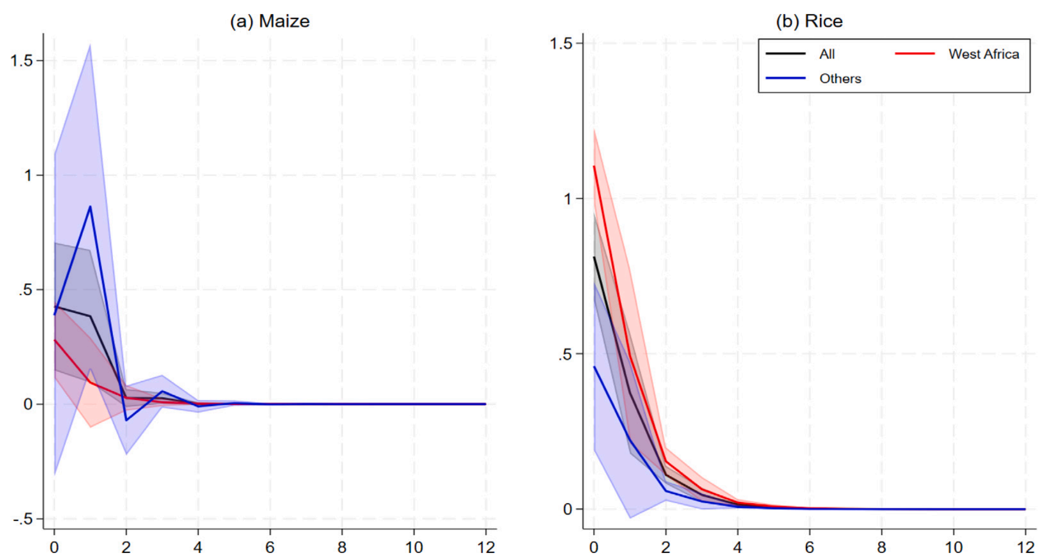


Fig. A.4. Global-to-local price transmission: An impulse-response analysis showing the impact of West Africa. Impulse-response functions computed from GMM Panel VAR. The shaded areas, representing the 95% confidence bounds, are generated by Monte Carlo with 1000 repetitions.

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