Quantifying the impact of international food price spillovers on South Africa domestic market: Short- and long-term dynamics and transmission channels

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INTRODUCTION

- The concept of price stability dates back centuries, the recent COVID-19 pandemic and the Russia-Ukraine war re-validated the notion of macroeconomic interconnectedness.

- The reality of spillover effects, and the need to be cautious of transmission channels that tend to import potential instruments of destabilization, such as inflation.

- The extent to which international food price spillovers impact the domestic economy varies with country characteristics; hence, there is a need to quantify the impact at the country level.

- Though South Africa is the most self-sufficient country for most food crops in the SADC region, it is still exposed to global food import shocks.

- Quantifying the impact of food import shocks is relevant for South Africa as a country and to the region that depends on South Africa for monetary stability and agricultural supplies.

INTRODUCTION Cont....

- Four key factors - impact of international food price spillovers on domestic markets: a) market integration and supply chain efficiency, b) economic factors such as exchange and inflation rates, c) government interventions, and d) geopolitical stability.
- Apartheid era, South Africa has registered geo-political tensions which include: xenophobic violence attacks, labour strikes and industrial actions, political fragmentations, as well as global shocks such as the global financial crisis, the covid-19 pandemic, and the Russia-Ukraine War.
- Inflation in South Africa rose by about 120% from 3.2% in 2020 (the wake of the Covid-19 pandemic) to 7% in 2022 (World Bank, 2024)
- Such a huge increase in inflation has the potential to increase unemployment, dependency ratio, poverty, reduce welfare, and create civil unrest.
- The dangers of international food price spillovers on domestic economies are: **Short run**

❖ Intensify inflationary pressures in the South African economy leading to monetary policy challenges (Ha et al., 2019; Adams & Ichino, 2020),

❖ Reduces purchasing power leading to consumer hardship (Timmer, 2015; World Bank, 2021), and can translate into social unrest and political instability (Bellemare, 2015).

INTRODUCTION Cont....

- **In the long run**

❖ It could lead to food insecurity issues (Rakotoarisoa, et al., 2011)

❖ Exacerbate economic inequality and rural poverty (Ivanic & Martin, 2008)

❖ High Level Panel of Experts on Food Security and Nutrition, 2011),

❖ Could spur up structural economic issues such as deterring investors and/or the need for resource re-allocation (von Braun, 2008; FAO, 2011).

- The key empirical studies on food price inflation in South Africa that are close the focus of this study, only include Van Wyk, and Dlamini, (2018), Iddrisu and Alagidede (2020) Sikuka (2021) and Nell (2000).
- Several empirical works highlight key determinants of inflation in South Africa, but the quantification of the impact of international food price spillovers on South Africa is not yet adequately clear.
- And in any case, needs to be re-investigated in light of the current macroeconomic realities and global connectedness.

INTRODUCTION Cont....

- It is on this premise that this study's objectives are:

➢To assess the level of international food price spillovers on domestic food inflation in South Africa, distinguishing short-term from longer-term dynamics.

➢To examine the various channels through which changes in international food prices are transmitted to South Africa, including exchange rates, equity markets, commodity markets, and geopolitical tensions.

➢To provide policy recommendations based on the findings to help policymakers in South Africa mitigate the adverse effects of international food price fluctuations on domestic food inflation.

- Our study contributes:

❖ It employs the novel Time-Varying Parameter Vector Autoregressive (TVP-VAR) based frequency Connectedness to quantify the level of international food price spillovers on domestic food inflation in South Africa, distinguishing short-term volatility from longer-term structural effects.

❖ It also identifies the transmission channels through which international food inflation contributes to domestic food inflation using Quantile regression.

Theoretical Literature

Theory	Description
Cost of Production Theory	• Tested by Cobb and Dougles in 1928. • The theory asserts that prices are influenced by the costs incurred by producers in producing goods and services.
Cost push theory	• Developed by John Maynards Keynes who focussed more on the demand side in his work "The General Theory of Employment, Interest and Money (1936). • Authors such as Gordon (1985) added to the theory focusing on the supply side highlighting how an increase in the cost of production may lead to an increase to the final goods.
Price transmission theory	• Theory developed and studied by various economists such as (Baffes and Gardner, 2003), and (Posner (2014). • It argues that changes in international food prices can have a direct impact on domestic prices through a variety of mechanisms. • The inter-commodity price transmission theory posits that price changes in one commodity can affect prices in another related commodity.
Volatility transmission theory	• Evolved through the contribution of various researchers such as Gardner (1975), Heien (1980), Wohlgenant (1989), Holloway (1991) and McCorriston et al. (1998; 2001) • Explains how uncertainty in one market, such as currency, commodities, and shocks, can spill over and influence volatility in another.

Empirical Literature Cont...

Author & Year	Topic	Method	Results	Period of Analysis
Fasanya and Odudu (2020)	Modeling return and volatility spillovers among food prices in Nigeria	GARCH	An evidence of interdependence among the main selected agricultural commodities.	January 1980 to June 2017
Ramoroka and Muchopa (2022)	Inter-commodity Price Transmission between Maize and Wheat in South Africa	VAR Granger Causality Test	No bidirectional causality relationship between maize and wheat producer prices	1990-2018
Ertu˘grul and Seven (2023)	Dynamic spillover analysis of international and Turkish food prices	Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and Markov Switching Regression (MSR).	• Found a structural shifts in the dynamics of the international/domestic food price relationship, and the relationship varies across the low and high volatility regimes. • Exchange rate significantly affects the growing difference between Turkish and international food prices, while oil prices reduce that difference.	2003 to 2019 Monthly Data

Empirical Literature Cont...

Author & Year	Topic	Method	Results	Period of Analysis
Monteiro and Jammer (2024)	Price dynamics in South African agriculture: A study of cross-commodity spillovers between grain and livestock markets	VECM	A long-run relationship among the study variables, with consistently low error correction terms indicating slow short-term adjustments.	January 2018 to October 2023.
Umoru and Amedu (2022)	How do variations in dollar exchange rate impact food commodity prices in selected African countries?	GMM GARCH	The dynamic GMM results reveal exchange rate and interest rate variations taken together had positive effects on commodity prices. GARCH estimates demonstrate significant volatility growth using both normal and t multivariate distributions.	1990-2021
Balcilar and Bekun (2020)	Do oil prices and exchange rates account for agricultural commodity market spillovers? Evidence from the Diebold and Yilmaz Index	Forecast error variance decomposition (FEVD) framework	The empirical findings of the study revealed that the total spillover effect was approximately 75 percent, suggesting a high interconnection of the prices of selected commodities (groundnut, soybeans, sorghum barley, maize, cocoa, rice, and wheat) commodity prices and inflation.	2006Jan to 2016Jul.

DATA AND EMPIRICAL METHODS

- **The Time-Varying Parameter Vector Autoregression (TVP-VAR)-based frequency connectedness model**
- To assess the level of international food price spillovers on domestic food inflation in South Africa, distinguishing short-term from longer-term dynamics, the TVP-VAR
- The TVP-VAR starts with a VAR technique; the TVP-VAR-based frequency connectedness model evolves as follows:

$$x_t = \Phi_t x_{t-1} + \epsilon_t, \qquad \epsilon_t \sim N(0, \Sigma_t)$$

$$vec(\Phi_t) = vec(\Phi_{t-1}) + v_t, \qquad v_t \sim N(0, R_t)$$

- Following the Generalized Forecast Error Variance Decomposition (GFEVD) of koop et al. (1996) and pesaran and Shin (1998), the estimated TVP-VAR model may be transformed into a moving average (TVP-VMA).
- This method was advanced by Chatziantoniou et al. (2023) to enable the decomposition of the connected measures into long and short-term frequencies.

DATA AND EMPIRICAL METHODS

- **The Time-Varying Parameter Vector Autoregression (TVP-VAR)-based frequency connectedness model**

Two metrics, TO, and FROM, capture the total directional connectedness, respectively expressed as: N

$$TO_{it}(H) = \sum_{i=1, i \neq j}^{N} \tilde{\theta}_{jit}(H) \qquad FROM_{it}(H) = \sum_{i=1, i \neq j}^{N} \tilde{\theta}_{ijt}(H)$$

where the first metric (TO) accounts for the degree to which shocks in variable i propagate to all others j, while (FROM) is associated with the extent to which variable i is influenced by shocks in all other variables j.

Consequently, the total net directional connectedness, calculated as

NETit(H) = TOit(H) − FROMit(H)

NETit > 0 suggests that variable i mostly influences the other variables j instead of being influenced by them, making it a net transmitter of shocks.

In contrast, NETit < 0 indicates that variable i is more influenced by other variables j, making it a net shock receiver.

DATA AND EMPIRICAL METHODS Cont...

Similar indicators of connectedness may be derived, with similar interpretations while conforming to frequency connectedness that proffer valuable insights about spillovers at a specific frequency horizon d:

$$NPDC_{ijt}(d) = \tilde{\theta}_{ijt}(d) - \tilde{\theta}_{jit}(d)$$

$$TO_{it}(d) = \sum_{i=1, i \neq j}^{N} \tilde{\theta}_{jit}(d)$$

$$FROM_{it}(d) = \sum_{i=1, i \neq j}^{N} \tilde{\theta}_{ijt}(d)$$

$$NET_{it}(d) = TO_{it}(d) - FROM_{it}(d)$$

$$TCI_t(d) = \frac{N}{N-1} \sum_{i=1}^{N} TO_{it}(d)$$

$$= \frac{N}{N-1} \sum_{i=1}^{N} FROM_{it}(d)$$

DATA AND EMPIRICAL METHODS Cont…

- **The quantile regression (QR) model**
- The second phase of our empirical analysis relates to identifying the factors that drive the evolution of spillovers among global food prices and domestic food prices in South Africa.
- We rely on the QR analysis of Koenker and Bassett (1978).
- The QR follows a similar structure to linear regression analysis, which permits us to explore the existence of asymmetric effects of the selected factors on multiple quantiles of the level of spillovers among global food prices and domestic food prices in South Africa.
- Among other advantages, Conyon and He (2017) the QR technique permits the prediction of specific parts of the distribution of the explained variable, including the conditional median effect on Y of a change in the independent variable X.
- This study uses three quantiles ($\tau = 0.25, 0.50, 0.75$), which enables us to capture crucial quantiles of the distribution of the retrieved TCI.

Data Sources and Description

To analyse the degree of spillovers among global food prices and domestic food prices in South Africa, we use monthly from January 2010 to December 2023.

Category	Variable/Index	Description	Source
Global Food Prices	FAO Food Price Indexes	Monthly international prices of five main food classes. A composite Global Food Price Index (GFPI) is derived using Principal Component Analysis.	FAO United Nations World Food Situation
	Meat (Meatw), Dairy (Dairyw), Cereal (Cerealw), Oil seed (Oilsw), Sugar (Sugerw)	Commodity-specific world food price indexes used for connectedness analysis.	FAO United Nations
Domestic Food Prices	Barley-SA, Maize-SA, Oats-SA, Sorghum-SA, Soybeans-SA, Sunflower-SA, Wheat-SA	Monthly domestic prices for major food types in South Africa.	FAO
Spillover Factors	GPRI, USMPU, FTSESA	Geopolitical Risk Index, U.S. Monetary Policy Uncertainty, and South African equity market index.	Policy Uncertainty reports of Baker et al. (n.d.)
Macro-Financial Variables	RNDUSD, TBLRT, GLDPR, OILPR	Exchange rate (Rand/USD), interest rate, gold price, and oil price—all factors influencing price spillovers.	Refinitiv Eikon Datastream

RESULTS AND DISCUSSION

Table 1: Descriptive statistics

	Variable	Mean	Median	S.D.	Min	Max
Return						
	Barley SA	0.00405	0	0.155	-0.688	0.635
	Maize SA	0.00568	0.0078	0.0992	-0.491	0.42
	Oats SA	0.00604	0.00117	0.11	-0.422	0.417
	Sorghum SA	0.00568	0.00862	0.132	-0.456	0.309
	Soyabeans SA	0.00608	0.000904	0.108	-0.442	0.611
	Sunflower SA	0.00667	0.00507	0.0997	-0.34	0.471
	Wheat SA	0.00647	0.00657	0.0893	-0.235	0.449
	Meat w	0.00163	0.00307	0.0196	-0.0561	0.0478
	Dairy w	0.000512	0.0015	0.0341	-0.089	0.105
	Cereals w	0.00133	-0.00316	0.038	-0.122	0.17
	Oils w	0.000795	-0.00712	0.0547	-0.227	0.222
	Sugar w	-0.00119	-0.00332	0.0695	-0.309	0.191
Volatility						
	Barley SA	0.024	0.00284	0.0631	0	0.474
	Maize SA	0.00982	0.00261	0.0268	0	0.241
	Oats SA	0.0121	0.00184	0.0273	0	0.178
	Sorghum SA	0.0173	0.00383	0.0333	0	0.208
	Soyabeans SA	0.0116	0.00169	0.0368	0	0.373
	Sunflower SA	0.00993	0.00239	0.0242	1.04E-07	0.222
	Wheat SA	0.00797	0.00228	0.0189	7.63E-06	0.201
	Meat w	0.000386	0.00015	0.000533	4.39E-12	0.00315
	Dairy w	0.00116	0.000517	0.0018	1.39E-08	0.011
	Cereals w	0.00144	0.000407	0.00362	1.37E-07	0.0289
	Oils w	0.00297	0.000957	0.00622	2.34E-06	0.0514
	Sugar w	0.00481	0.00164	0.00998	1.03E-06	0.0957

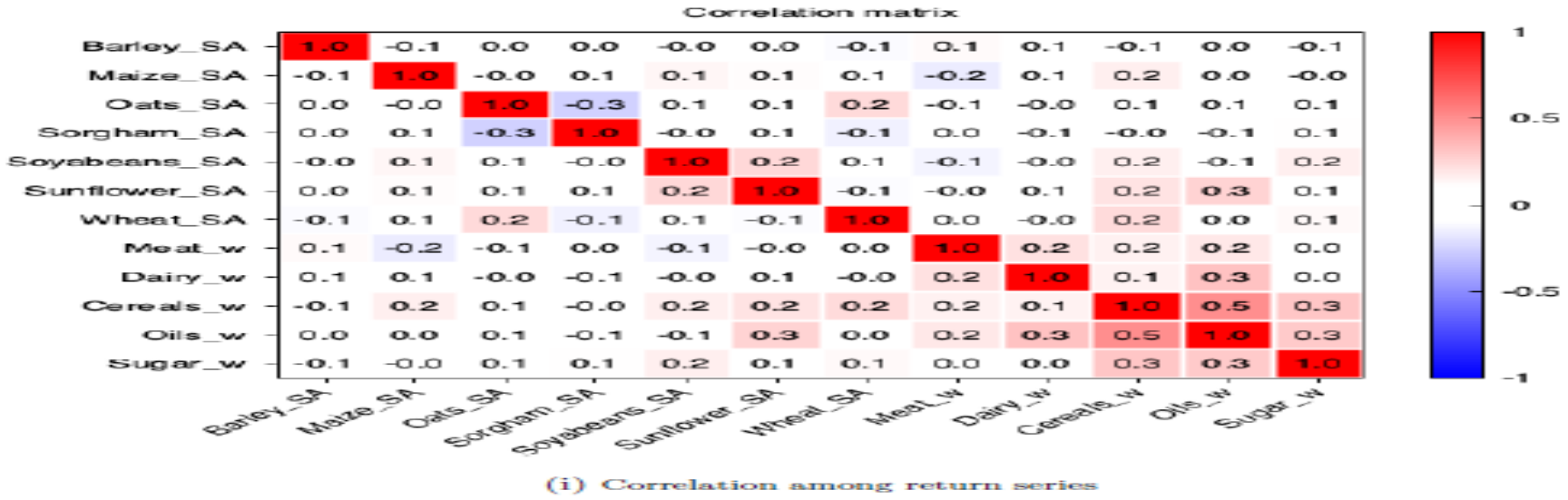
Table 1 presents the descriptive statistics for both return and volatility of food prices.

As may be seen, all food prices exhibited positive return during the period under study except the price of Sugar in the global market.

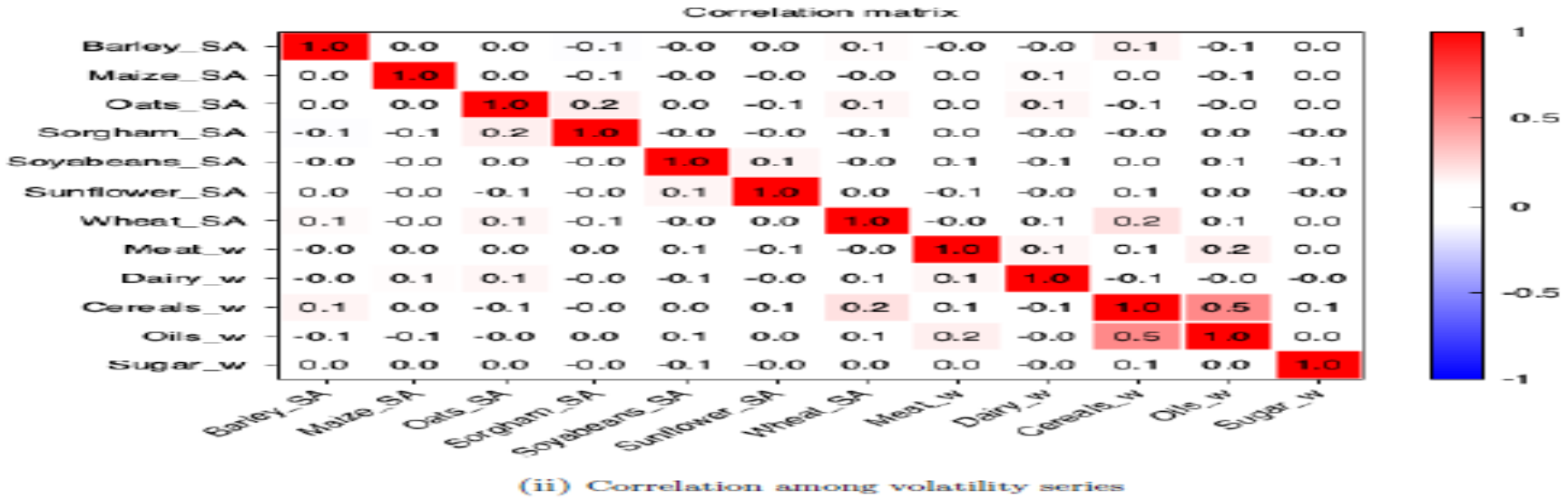
Also, Sunflower has the highest price return while Sugar has the least.

In terms of volatility, Barley market in South Africa appears to be the most volatile while Meat prices in the world market is the least.

RESULTS AND DISCUSSION



(i) Correlation among return series



(ii) Correlation among volatility series

Fig. 1 shows the correlation matrix using heat maps for both return and volatility in Panel (i) and (ii), respectively.

correlations among the food markets are stronger in terms of returns than in terms of volatility.
The strongest correlation is positive and between the Oil seeds and Cereals prices in the global market both in terms of returns and volatility.

This is followed by a negative correlation between Oats and Sorghum prices in the South African market.

RESULTS AND DISCUSSION

Table 2: Return connectedness between global food price index and food prices in South Africa

	Barley_SA	Maize_SA	Oats_SA	Sorgham_SA	Soyabeans_SA	Sunflower_SA	Wheat_SA	GFPI	FROM
Barley_SA	77.80	5.39	1.02	1.26	4.18	4.73	3.77	1.85	22.20
	57.55†	4.92†	0.87†	0.63†	3.55†	3.35†	3.54†	1.33†	18.18†
	20.25‡	0.47‡	0.15‡	0.63‡	0.63‡	1.38‡	0.23‡	0.52‡	4.02‡
Maize_SA	2.86	79.25	3.27	3.19	7.20	1.68	1.15	1.40	20.75
	1.57†	44.53†	2.54†	1.46†	2.40†	1.17†	0.97†	0.38†	10.48†
	1.30‡	34.72‡	0.73‡	1.73‡	4.80‡	0.51‡	0.18 ‡	1.02‡	10.27‡
Oats_SA	1.08	0.75	71.46	7.24	10.14	3.79	4.70	0.83	28.54
	0.72†	0.59†	44.66†	3.41†	5.98†	3.31†	3.71†	0.23†	17.95†
	0.36‡	0.16‡	26.80‡	3.84‡	4.16‡	0.48‡	0.99‡	0.60‡	10.59‡
Sorghum_SA	1.11	2.48	9.49	71.09	10.98	1.87	2.15	0.84	28.91
	0.98†	1.16†	8.48†	48.50†	9.22†	1.26†	1.57†	0.29†	22.96†
	0.12‡	1.32‡	1.01‡	22.59‡	1.76‡	0.61‡	0.58‡	0.55‡	5.95‡
Soybeans_SA	2.73	2.06	1.33	0.85	83.86	3.82	3.87	1.48	16.14
	1.42†	0.92†	0.87†	0.59†	49.05†	2.02†	2.01†	0.64†	8.48†
	1.31‡	1.13‡	0.46‡	0.27‡	34.81‡	1.80‡	1.86‡	0.84‡	7.66‡
Sunflower_SA	1.43	3.55	2.18	2.14	7.01	79.24	0.72	3.72	20.76
	1.14†	2.25†	1.42†	1.20†	3.24†	48.37†	0.63†	2.02†	11.91†
	0.29‡	1.30‡	0.76‡	0.93‡	3.77‡	30.87‡	0.09‡	1.70‡	8.85‡
Wheat_SA	3.19	0.82	5.92	2.95	4.42	1.79	78.50	2.41	21.50
	2.84†	0.63†	5.17†	2.51†	3.70†	1.42†	54.66†	0.97†	17.23†
	0.35‡	0.19‡	0.76‡	0.45‡	0.72‡	0.36‡	23.84‡	1.44‡	4.26‡
GFPIF	0.44	0.23	0.40	0.20	1.54	3.00	2.82	91.35	8.65
	0.24†	0.06†	0.20†	0.11†	0.57†	0.93†	0.66†	24.26†	2.76†
	0.20‡	0.17‡	0.21‡	0.09‡	0.97‡	2.08‡	2.17‡	67.10‡	5.88‡
TO	12.84	15.28	23.62	17.83	45.47	20.69	19.19	12.54	167.45
	8.92†	10.53†	19.55†	9.90†	28.66†	13.46†	13.09†	5.86†	109.96†
	3.93‡	4.75‡	4.07‡	7.94‡	16.81‡	7.23‡	6.09‡	6.68‡	57.49‡
Inc.Own	90.64	94.53	95.07	88.92	129.33	99.93	97.69	103.89	
	66.46†	55.05†	64.20†	58.40†	77.72†	61.83†	67.75†	30.12†	TCI
	24.18‡	39.47‡	30.87‡	30.52‡	51.61‡	38.10‡	29.94‡	73.77‡	
Net	**-9.36**	**-5.47**	**-4.93**	**-11.08**	**29.33**	**-0.07**	**-2.31**	**3.89**	**20.93**
	-9.26†	**0.05†**	**1.60 †**	**-13.07†**	**20.19†**	**1.55†**	**-4.14 †**	**3.10†**	**13.75†**
	-0.09‡	**-5.52‡**	**-6.52‡**	**1.99‡**	**9.14‡**	**-1.62‡**	**1.83 ‡**	**0.79‡**	**7.19‡**

Table 3: Return connectedness among world food prices and food prices in South Africa

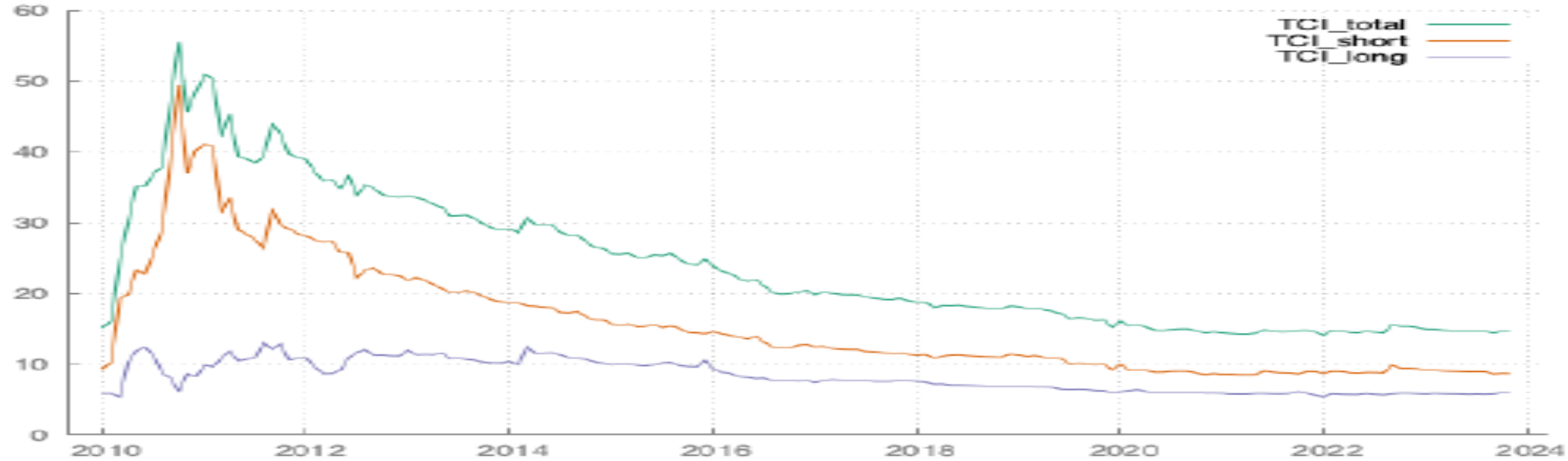
	Barley_SA	Maize_SA	Oats_SA	Sorgham_SA	Soyabeans_SA	Sunflower_SA	Wheat_SA	Meat_w	Dairy_w	Cereals_w	Oils_w	Sugar_w	FROM
Barley_SA	63.93	4.26	1.45	2.15	3.31	4.24	3.30	5.26	1.41	3.90	4.97	1.82	36.07
	46.07†	3.92†	0.91†	1.16†	2.51†	3.27†	2.98†	0.92†	0.47†	2.91†	2.08†	0.92†	22.05†
	17.86‡	0.34‡	0.54‡	0.99‡	0.80‡	0.97‡	0.32‡	4.34‡	0.94‡	0.99‡	2.88‡	0.90‡	14.02‡
Maize_SA	1.90	69.77	3.16	2.61	6.71	1.93	1.64	5.75	1.36	2.28	1.03	1.86	30.23
	0.89†	39.83†	2.16†	1.16†	1.99†	1.01†	1.10†	0.72†	0.54†	0.53†	0.35†	0.70†	11.15†
	1.01‡	29.94‡	1.01‡	1.45‡	4.71‡	0.92‡	0.54‡	5.03‡	0.82‡	1.76‡	0.68‡	1.16‡	19.09‡
Oats_SA	0.60	0.78	68.24	8.91	6.17	2.65	4.24	2.86	2.75	0.77	1.29	0.74	31.76
	0.32†	0.37†	41.90†	4.25†	3.99†	2.35†	2.92†	1.03†	1.86†	0.36†	0.47†	0.31†	18.24†
	0.28‡	0.41‡	26.34‡	4.66‡	2.18‡	0.31‡	1.32‡	1.83‡	0.88‡	0.41‡	0.82‡	0.42‡	13.52‡
Sorghum_SA	0.75	3.10	7.76	67.27	7.72	2.11	2.23	2.47	3.19	1.38	1.10	0.94	32.73
	0.62†	1.77†	6.75†	46.05†	6.64†	1.60†	1.32†	1.55†	2.08†	0.94†	0.62†	0.54†	24.42†
	0.13‡	1.33‡	1.01‡	21.22‡	1.08‡	0.51‡	0.91‡	0.92‡	1.11‡	0.44‡	0.48 ‡	0.40‡	8.32‡
Soybeans_SA	2.16	1.00	1.38	0.77	70.20	4.94	3.23	5.73	1.75	4.05	2.35	2.43	29.80
	1.06†	0.46†	0.65†	0.51†	42.29†	1.77†	1.48†	1.05†	0.44†	1.22†	1.42†	0.83†	10.89†
	1.11‡	0.54‡	0.73‡	0.26‡	27.91‡	3.18‡	1.75‡	4.68‡	1.31‡	2.83‡	0.92‡	1.61‡	18.91‡
Sunflower_SA	0.90	2.98	1.83	2.41	7.07	63.43	1.24	1.64	2.22	5.15	9.02	2.13	36.57
	0.60†	2.05†	1.22†	1.21†	3.73†	38.89†	0.92†	0.51†	1.36†	2.17†	3.54†	1.62†	18.92†
	0.30‡	0.93‡	0.61‡	1.19‡	3.33‡	24.54‡	0.32‡	1.13‡	0.86‡	2.98‡	5.48‡	0.51‡	17.65‡
Wheat_SA	2.44	0.61	6.23	3.06	4.08	1.41	71.04	0.75	1.24	6.67	1.92	0.56	28.96
	2.11†	0.50†	5.45†	2.55†	3.15†	1.16†	49.12†	0.35†	0.61†	3.02†	0.44†	0.29†	19.64†
	0.33‡	0.11‡	0.78‡	0.50‡	0.94‡	0.24‡	21.92‡	0.40‡	0.64‡	3.65‡	1.47‡	0.26‡	9.33‡
Meatw	1.48	0.85	2.06	0.89	2.25	2.40	1.06	67.01	5.64	8.97	6.64	0.76	32.99
	0.45†	0.19†	0.30†	0.20†	0.47†	0.69†	0.12†	12.86†	0.93†	0.31†	0.81†	0.18†	4.66†
	1.03‡	0.66‡	1.76‡	0.68‡	1.78‡	1.71‡	0.94‡	54.14‡	4.71‡	8.66‡	5.83‡	0.58‡	28.34‡
Dairyw	0.86	1.25	2.93	2.06	1.67	1.75	1.63	8.83	67.38	2.62	7.24	1.80	32.62
	0.26†	0.52†	0.52†	1.31†	0.70†	0.27†	0.48†	0.69†	18.87†	0.37†	1.29†	0.42†	6.83†
	0.59‡	0.72‡	2.40‡	0.76‡	0.97‡	1.48‡	1.16‡	8.13‡	48.51‡	2.25‡	5.95‡	1.38‡	25.79‡
Cerealsw	1.15	0.31	0.83	2.00	2.18	3.31	5.73	4.40	1.61	57.33	15.51	5.66	42.67
	0.69†	0.07†	0.22†	0.33†	0.48†	0.84†	1.04†	0.39†	0.24†	15.18†	2.97†	1.75†	9.03†
	0.45‡	0.23‡	0.60‡	1.66‡	1.70‡	2.47‡	4.69‡	4.02‡	1.37‡	42.15‡	12.54‡	3.91‡	33.65‡
Oilsw	0.79	0.48	1.14	0.61	2.88	5.53	1.65	5.31	4.89	14.72	56.89	5.10	43.11
	0.21†	0.19†	0.45†	0.25†	0.92†	2.21†	0.56†	1.15†	0.94†	4.11†	17.93†	0.82†	11.81†
	0.58‡	0.29‡	0.70‡	0.36‡	1.96‡	3.33‡	1.09‡	4.17‡	3.95‡	10.61‡	38.96‡	4.28‡	31.30‡
Sugarw	1.64	1.53	2.33	1.06	4.27	4.57	1.21	3.12	1.26	12.85	8.18	58.00	42.00
	0.78†	0.43†	1.03†	0.68†	1.26†	0.82†	0.27†	0.58†	0.21†	1.49†	1.05†	20.60†	8.62†
	0.86‡	1.10‡	1.30‡	0.38‡	3.02‡	3.74‡	0.93‡	2.54‡	1.04‡	11.36‡	7.12‡	37.40‡	33.39‡
TO	14.66	17.15	31.09	26.52	48.31	34.84	27.16	46.12	27.32	63.36	59.24	23.78	419.54
	8.00†	10.48†	19.66†	13.62†	25.84†	15.99†	13.18†	8.93†	9.69†	17.43†	15.04†	8.38†	166.24†
	6.66‡	6.67‡	11.43‡	12.90‡	22.46‡	18.85‡	13.98‡	37.19‡	17.63‡	45.93‡	44.20‡	15.41‡	253.30‡
Inc.Own	78.58	86.92	99.33	93.79	118.51	98.27	98.19	113.13	94.70	120.68	116.13	81.78	
	54.06†	50.31†	61.56†	59.67†	68.13†	54.88†	62.30†	21.80†	28.56†	32.61†	32.97†	28.98†	**TCI**
	24.52‡	36.61‡	37.77‡	34.12‡	50.38‡	43.39‡	35.89‡	91.33‡	66.13‡	88.07‡	83.16‡	52.81‡	
Net	**-21.42**	**-13.08**	**-0.67**	**-6.21**	**18.51**	**-1.73**	**-1.81**	**13.13**	**-5.30**	**20.68**	**16.13**	**-18.22**	**34.96**
	-14.06†	**-0.67†**	**1.42†**	**-10.80†**	**14.96†**	**-2.93†**	**-6.46†**	**4.28†**	**2.86†**	**8.40†**	**3.23†**	**-0.24†**	**13.85†**
	-7.36‡	**-12.41 ‡**	**-2.09‡**	**4.59 ‡**	**3.55‡**	**1.20‡**	**4.65‡**	**8.85‡**	**-8.16‡**	**12.28‡**	**12.89‡**	**-17.98‡**	**21.11‡**

Table 4: Volatility connectedness between global food prices and the composite food price index in South Africa

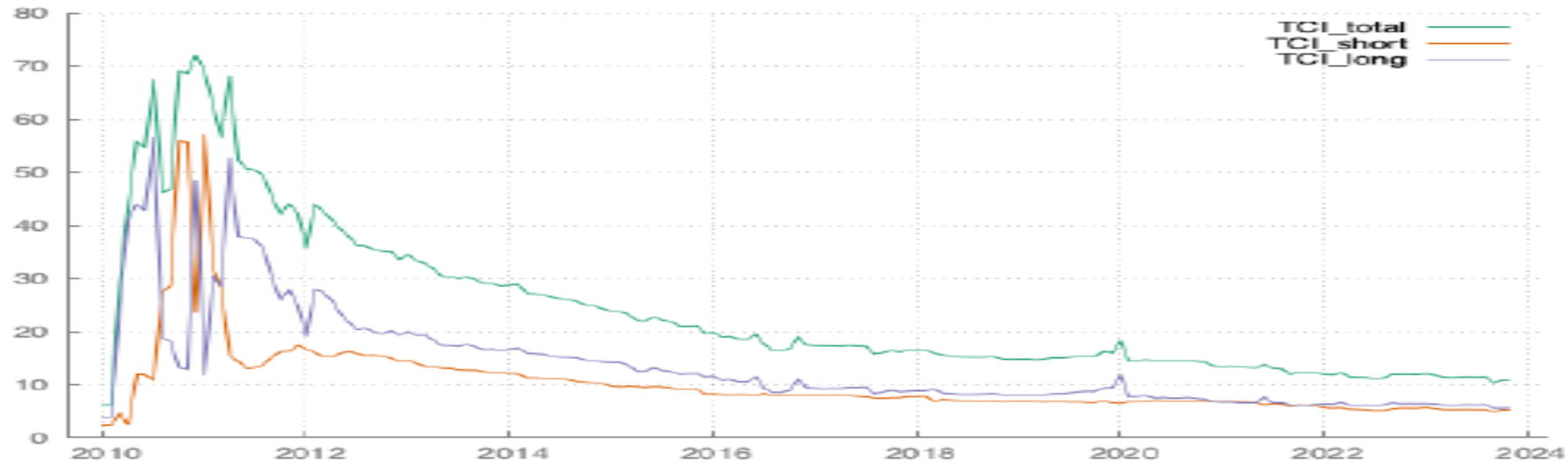
	Barley_SA	Maize_SA	Oats_SA	Sorgham_SA	Soyabeans_SA	Sunflower_SA	Wheat_SA	GFPI	FROM
Barley_SA	71.75	0.46	1.31	1.19	12.87	3.47	5.65	3.30	28.25
	25.27†	0.24†	0.61†	0.45†	1.73†	0.67†	2.78†	0.41†	6.88†
	46.48‡	0.23‡	0.70‡	0.73‡	11.14‡	2.81‡	2.88‡	2.89‡	21.37‡
Maize_SA	3.47	78.17	2.86	1.46	3.16	4.11	5.56	1.21	21.83
	1.31†	44.73†	1.94†	1.08†	1.09†	3.15†	3.22†	0.31†	12.10†
	2.16‡	33.44‡	0.92‡	0.37‡	2.07‡	0.96‡	2.34‡	0.90‡	9.72‡
Oats_SA	4.03	1.20	75.54	4.98	4.10	2.30	3.54	4.31	24.46
	1.53†	0.63†	39.65†	1.81†	1.85†	0.84†	2.33†	1.04†	10.03†
	2.50‡	0.57‡	35.88‡	3.17‡	2.25‡	1.47‡	1.21‡	3.26‡	14.43‡
Sorghum_SA	2.11	0.81	4.53	80.52	7.33	1.10	1.46	2.14	19.48
	0.74†	0.27†	1.78†	34.03†	1.86†	0.41†	0.65†	0.54†	6.26†
	1.37‡	0.54‡	2.76‡	46.49‡	5.47‡	0.68‡	0.81‡	1.60‡	13.23‡
Soybeans_SA	2.16	0.32	0.98	0.84	92.69	1.23	0.75	1.03	7.31
	0.85†	0.10†	0.39†	0.22†	29.36†	0.44†	0.26†	0.12†	2.37†
	1.32‡	0.23‡	0.60‡	0.61‡	63.33‡	0.79‡	0.49‡	0.91‡	4.94‡
Sunflower_SA	4.28	3.87	2.82	1.57	2.45	65.66	17.13	2.22	34.34
	2.71†	1.16†	1.03†	0.82†	0.81†	34.82†	11.60†	0.35†	18.48†
	1.57‡	2.71‡	1.79‡	0.75‡	1.64‡	30.84‡	5.53‡	1.87‡	15.87‡
Wheat_SA	5.14	3.26	1.88	0.73	0.95	4.55	82.25	1.24	17.75
	3.10†	1.96†	1.36†	0.44†	0.43†	2.00†	45.71†	0.36†	9.65†
	2.04‡	1.30‡	0.52‡	0.29‡	0.52‡	2.55‡	36.53‡	0.88‡	8.10‡
GFPIF	3.80	0.22	2.17	0.43	1.33	0.79	5.03	86.24	13.76
	1.82†	0.11†	0.68†	0.19†	0.35†	0.21†	2.79†	33.89†	6.14†
	1.98‡	0.11‡	1.49‡	0.24‡	0.98‡	0.58‡	2.24‡	52.35‡	7.62‡
TO	24.98	10.15	16.56	11.20	32.19	17.55	39.12	15.44	167.19
	12.05†	4.47†	7.79†	5.02†	8.12†	7.71†	23.62†	3.12†	71.91†
	12.93‡	5.68‡	8.77‡	6.17‡	24.07‡	9.84‡	15.50‡	12.32‡	95.28‡
Inc.Own	96.73	88.32	92.10	91.71	124.88	83.20	121.37	101.68	
	37.32†	49.21†	47.44†	39.05†	37.49†	42.53†	69.33†	37.01†	**TCI**
	59.41‡	39.12‡	44.66‡	52.67‡	87.40‡	40.67‡	52.04‡	64.67‡	
Net	**-3.27**	**-11.68**	**-7.90**	**-8.29**	**24.88**	**-16.80**	**21.37**	**1.68**	**20.90**
	5.17†	**-7.63 †**	**-2.24†**	**-1.23†**	**5.76†**	**-10.76†**	**13.96 †**	**-3.02†**	**8.99†**
	-8.44‡	**-4.05‡**	**-5.66 ‡**	**-7.05‡**	**19.13‡**	**-6.03‡**	**7.40‡**	**4.70‡**	**11.91‡**

Table 5: Volatility connectedness among world food prices and food prices in South Africa

	Barley_SA	Maize_SA	Oats_SA	Sorgham_SA	Soyabeans_SA	Sunflower_SA	Wheat_SA	Meat_w	Dairy_w	Cereals_w	Oils_w	Sugar_w	FROM
Barley_SA	57.28	2.18	1.32	5.24	8.23	1.79	5.46	1.24	1.70	6.60	4.01	4.96	42.72
	19.24†	0.40†	0.38†	1.56†	0.95†	0.88†	0.80†	0.29†	1.20†	1.96†	2.16†	2.29†	12.87†
	38.04‡	1.78‡	0.94‡	3.68‡	7.28‡	0.91‡	4.66‡	0.95‡	0.50‡	4.63‡	1.85‡	2.67‡	29.85‡
Maize_SA	1.58	50.16	0.67	10.41	2.86	2.30	5.64	1.12	1.64	8.82	8.41	6.41	49.84
	0.94†	25.76†	0.41†	4.09†	1.57†	1.36†	4.10†	0.40†	1.44†	3.48†	4.18†	2.23†	24.20†
	0.64‡	24.40‡	0.26‡	6.32‡	1.29‡	0.94‡	1.54‡	0.72‡	0.20‡	5.33‡	4.23‡	4.17‡	25.65‡
Oats_SA	1.83	1.14	54.80	6.20	2.79	5.54	4.55	2.10	2.70	4.39	9.94	4.03	45.20
	1.40†	0.76†	27.54†	3.54†	1.25†	3.02†	2.29†	0.93†	2.25†	2.47†	6.05†	2.71†	26.68†
	0.42‡	0.39‡	27.26‡	2.65‡	1.54‡	2.52‡	2.25‡	1.17‡	0.45‡	1.91‡	3.90‡	1.32‡	18.53‡
Sorghum_SA	1.43	1.96	1.72	47.50	2.76	3.59	2.46	1.39	2.54	12.26	10.83	11.56	52.50
	1.05†	1.10†	0.78†	21.29†	1.79†	2.55†	0.65†	0.46†	1.89†	6.56†	6.87 †	5.72†	29.43†
	0.39‡	0.85‡	0.94‡	26.21‡	0.97‡	1.04‡	1.82‡	0.93‡	0.65‡	5.70 ‡	3.95‡	5.83‡	23.07‡
Soybeans_SA	2.30	0.71	0.88	5.88	62.74	3.33	1.61	5.40	1.32	3.42	6.36	6.06	37.26
	1.16†	0.26†	0.31†	0.94†	19.88†	1.24†	0.18†	0.76†	0.70†	0.94†	1.49†	1.96†	9.94†
	1.14‡	0.46‡	0.57‡	4.94‡	42.85‡	2.09‡	1.43‡	4.64‡	0.62‡	2.48 ‡	4.87‡	4.10‡	27.32‡
Sunflower_SA	1.48	1.13	2.21	12.80	5.16	45.42	6.68	1.40	1.21	8.11	8.50	5.91	54.58
	0.62†	0.43†	0.77†	1.29†	1.44†	20.05†	3.95†	0.43†	0.42†	2.20†	2.87†	2.18†	16.61†
	0.85‡	0.71‡	1.44‡	11.50‡	3.72‡	25.37‡	2.73‡	0.96‡	0.79‡	5.91‡	5.63‡	3.73‡	37.97‡
Wheat_SA	1.38	0.86	1.08	3.23	2.08	1.82	74.99	3.76	1.60	2.10	2.48	4.61	25.01
	0.78†	0.35†	0.41†	1.01†	0.62†	0.82†	35.77†	0.69†	1.11†	0.91†	1.24†	2.42†	10.34†
	0.60‡	0.51‡	0.67‡	2.23‡	1.46‡	1.01‡	39.21‡	3.08‡	0.50‡	1.18‡	1.24‡	2.19‡	14.67‡
Meatw	2.57	2.58	1.75	8.56	4.32	4.48	2.08	46.05	6.63	6.52	6.48	7.98	53.95
	0.82†	0.44†	0.58†	1.69†	1.29†	1.76†	0.53†	14.88†	2.67†	2.02†	3.70†	1.69†	17.18†
	1.76‡	2.14‡	1.17‡	6.87‡	3.03‡	2.72‡	1.56‡	31.17‡	3.96‡	4.50‡	2.78‡	6.29‡	36.77‡
Dairyw	2.38	2.27	1.32	10.01	3.97	3.22	2.07	7.23	45.76	6.32	5.47	9.99	54.24
	1.61†	0.84†	0.81†	3.97†	2.30†	2.09†	0.99†	2.08†	21.51†	3.40†	4.14†	3.04†	25.26†
	0.77‡	1.44‡	0.51‡	6.03‡	1.67‡	1.13‡	1.08‡	5.15‡	24.25‡	2.91‡	1.33‡	6.95‡	28.98‡
Cerealsw	1.85	2.68	0.75	10.79	3.23	3.67	30.80	2.39	1.63	24.18	8.00	10.04	75.82
	0.76†	1.60†	0.44†	4.53†	1.20†	2.36†	10.84†	0.32†	1.05†	12.83†	5.83†	4.71†	33.66†
	1.09‡	1.08‡	0.31‡	6.25‡	2.03‡	1.31‡	19.95‡	2.07‡	0.58‡	11.35‡	2.17‡	5.33‡	42.17‡
Oilsw	1.65	3.25	1.23	12.87	5.40	6.56	1.58	3.16	3.78	12.00	36.04	12.48	63.96
	1.36†	1.93†	0.96†	6.40†	2.56†	5.01†	1.19†	0.94†	3.07†	7.34†	20.15†	7.29†	38.05†
	0.29‡	1.32‡	0.27‡	6.47‡	2.85‡	1.54‡	0.38‡	2.22‡	0.71‡	4.66‡	15.89‡	5.19‡	25.91‡
Sugarw	2.20	5.97	0.71	12.45	5.75	5.10	5.72	0.90	2.65	14.95	11.58	32.02	67.98
	1.57†	2.28†	0.44†	5.13†	3.07†	3.49†	1.51†	0.31†	1.99†	6.76†	7.68†	15.90†	34.21†
	0.63‡	3.69‡	0.27‡	7.32‡	2.68‡	1.61‡	4.21‡	0.59‡	0.67‡	8.19‡	3.90‡	16.12‡	33.77‡
TO	20.66	24.75	13.63	98.43	46.55	41.40	68.64	30.08	27.41	85.47	82.04	84.01	623.08
	12.07†	10.37†	6.30†	34.16†	18.02†	24.57†	27.04†	7.60†	17.80†	38.05†	46.20†	36.25†	278.43†
	8.59‡	14.38‡	7.33‡	64.27‡	28.53‡	16.83‡	41.60‡	22.48‡	9.62‡	47.42‡	35.84‡	47.77‡	344.65‡
Inc.Own	77.94	74.91	68.43	145.93	109.29	86.82	143.63	76.13	73.17	109.65	118.08	116.04	
	31.31†	36.12†	33.84†	55.46†	37.91†	44.62†	62.81†	22.47†	39.30†	50.88†	66.35†	52.15†	**TCI**
	46.62‡	38.78‡	34.59‡	90.48‡	71.38‡	42.20‡	80.81‡	53.65‡	33.87‡	58.77‡	51.74‡	63.88‡	
Net	**-22.06**	**-25.09**	**-31.57**	**45.93**	**9.29**	**-13.18**	**43.63**	**-23.87**	**-26.83**	**9.65**	**18.08**	**16.04**	**51.92**
	-0.80†	**-13.83†**	**-20.38 †**	**4.73†**	**8.08**	**7.96†**	**16.70†**	**-9.58†**	**-7.47†**	**4.39†**	**8.16 †**	**2.04†**	**23.20†**
	-21.26‡	**-11.26‡**	**-11.19‡**	**41.20‡**	**1.20‡**	**-21.14‡**	**26.93‡**	**-14.29‡**	**-19.37‡**	**5.25‡**	**9.93‡**	**14.00‡**	**28.72‡**

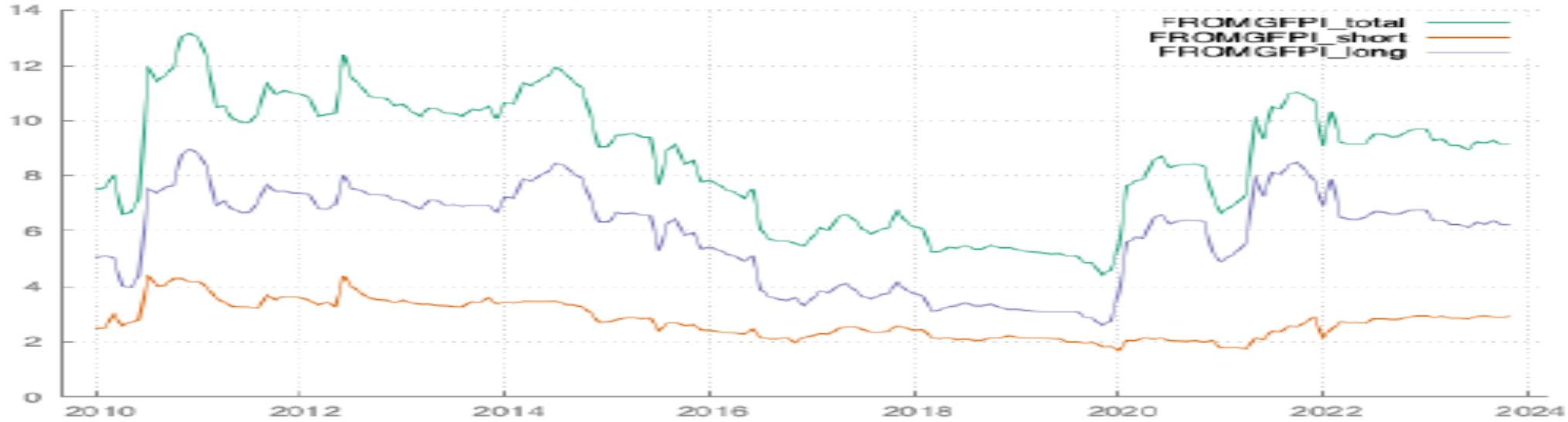


(i) Plot of time-varying total, short- and long-term return connectedness

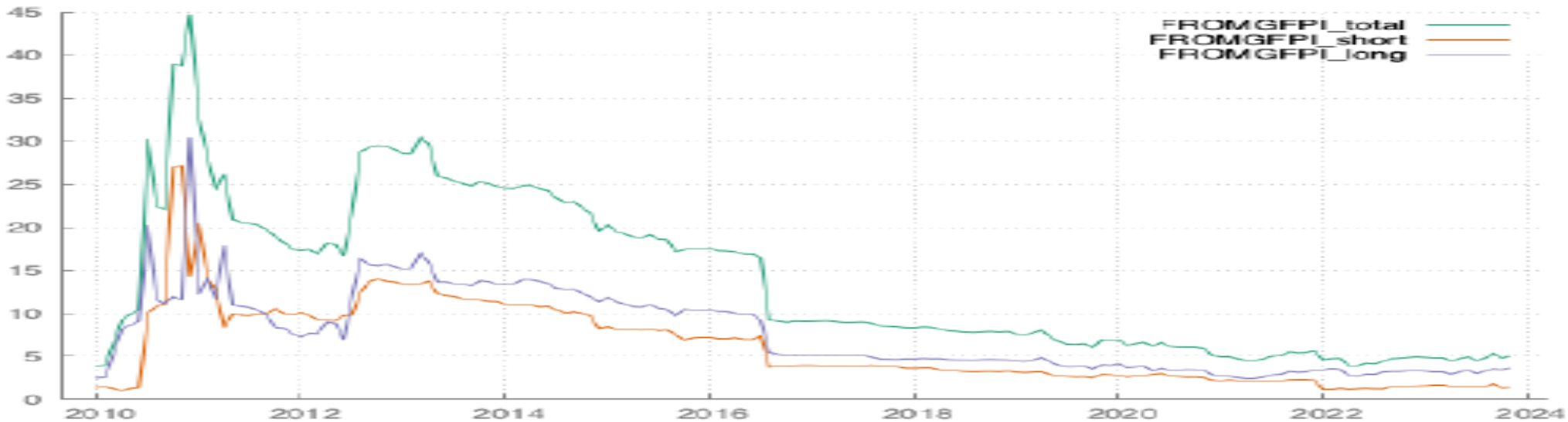


(ii) Plot of time-varying total, short- and long-term volatility connectedness

Figure 2: Evolution of return and volatility connectedness between the composite global food price index and food prices in South Africa



(i) Plot of time-varying return spillover from global food price index



(ii) Plot of time-varying volatility spillover from global food price index

Figure 3: Evolution of return and volatility spillover from global food price index to food prices in South Africa

Table 6: Drivers of frequency-based return spillovers from global food price index to food prices in South Africa

Variables	Return spillover from GFPI_total			Return spillover from GFPI_short-term			Return spillover from GFPI_long-term		
	Quantiles								
	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
Const.	-1.321***	0.837***	1.299***	0.263	0.537*	0.816***	-2.855***	0.028	0.359
	(0.641)	(0.356)	(0.230)	(0.301)	(0.286)	(0.163)	(0.650)	(0.325)	(0.303)
GPRI	0.117	-0.002	0.117***	-0.028	-0.056	-0.005	0.201	0.099	0.194***
	(0.129)	(0.071)	(0.047)	(0.061)	(0.057)	(0.032)	(0.131)	(0.065)	(0.061)
USMPU	-0.101	0.003	0.001	-0.055*	-0.041	-0.014	-0.096	0.005	-0.004
	(0.063)	(0.035)	(0.023)	(0.029)	(0.028)	(0.016)	(0.064)	(0.161)	(0.030)
RNDUSD	-0.043	-0.149**	-0.242***	-0.229***	-0.184***	-0.253***	-0.055	-0.140**	-0.203***
	(0.134)	(0.074)	(0.048)	(0.063)	(0.060)	(0.034)	(0.136)	(0.068)	(0.063)
FTSESA	1.353*	0.861**	0.118	0.805**	0.925***	0.003	1.618**	0.602*	0.259
	(0.709)	(0.395)	(0.255)	(0.333)	(0.317)	(0.180)	(0.720)	(0.361)	(0.335)
GLDPR	-0.226	-0.130	0.326	-0.188	-0.245	0.307*	-0.381	-0.170	0.235
	(0.618)	(0.343)	(0.222)	(0.290)	(0.276)	(0.157)	(0.627)	(0.314)	(0.293)
OILPR	0.787***	0.402***	0.247***	0.385***	0.333***	0.243***	0.953***	0.384***	0.277***
	(0.093)	(0.052)	(0.033)	(0.044)	(0.042)	(0.024)	(0.095)	(0.047)	(0.044)
BNDRT	-0.009	0.038	0.003	-0.027	0.011	-0.001	-0.010	0.031	0.011
	(0.074)	(0.042)	(0.027)	(0.035)	(0.033)	(0.019)	(0.076)	(0.038)	(0.035)
COVID	0.228***	0.180***	0.135***	-0.128***	-0.144***	-0.171***	0.399***	0.319***	0.257***
	(0.088)	(0.049)	(0.031)	(0.042)	(0.039)	(0.023)	(0.089)	(0.044)	(0.041)

Note: ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

Table 7: Drivers of frequency-based volatility spillovers from global food price index to food prices in South Africa

Variables	Volatility spillover from GFPI_total			Volatility spillover from GFPI_short-term			Volatility spillover from GFPI_long-term		
	Quantiles								
	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
Const.	8.708***	9.658***	10.79***	10.77***	11.89***	14.58***	6.374***	7.004***	10.52***
	(0.305)	(0.716)	(0.797)	(0.377)	(0.896)	(0.721)	(0.350)	(0.481)	(0.625)
GPRI	-0.129**	-0.082	-0.119	-0.371***	-0.413**	-0.207***	-0.048	0.052	-0.114
	(0.062)	(0.144)	(0.161)	(0.076)	(0.180)	(0.145)	(0.071)	(0.097)	(0.126)
USMPU	-0.095***	-0.186***	-0.199**	-0.126***	-0.220	-0.263	-0.045	-0.175***	-0.217***
	(0.030)	(0.071)	(0.079)	(0.037)	(0.088)	(0.071)	(0.034)	(0.048)	(0.062)
RNDUSD	-1.549***	-1.694***	-1.763***	-1.913***	-2.012***	-2.668***	-1.210***	-1.284***	-1.714***
	(0492)	(0.150)	(0.167)	(0.079)	(0.187)	(0.151)	(0.073)	(0.101)	(0.131)
FTSESA	0.741**	0.771	0.784	0.551	1.741*	1.025	0.688*	0.757	0.002
	(0.338)	(0.793)	(0.883)	(0.417)	(0.992)	(0.799)	(0.388)	(0.533)	(0.693)
GLDPR	0.327	-0.171	-0.967	0.633*	-0.018	-0.360	0.233	-0.360	-0.675
	(0.295)	(0.691)	(0.769)	(0.364)	(0.865)	(0.696)	(0.388)	(0.464)	(0.604)
OILPR	-0.371***	-0.421***	-0.486***	-0.555***	-0.566***	-0.899***	-0.305***	-0.329***	-0.565***
	(0.047)	(0.105)	(0.117)	(0.055)	(0.131)	(0.105)	(0.051)	(0.070)	(0.091)
BNDRT	0.119***	0.124	0.009	0.124***	0.174*	0.165**	0.096**	0.094*	0.002
	(0.035)	(0.083)	(0.093)	(0.044)	(0.104)	(0.084)	(0.041)	(0.056)	(0.073)
COVID	-0.418***	-0.387***	-0.649***	-0.392***	-0.407***	-0.429***	-0.446***	-0.421***	-0.747***
	(0.042)	(0.098)	(0.110)	(0.052)	(0.123)	(0.099)	(0.048)	(0.066)	(0.086)

CONCLUSION

This study quantifies the degree of return and volatility risk transmission from the global food market to the South African food market for the period from January 2010 to December 2023.

It employs the TVP-VAR-based frequency connectedness to quantify and observe the evolution of both return and volatility risk transmission from the global food market to the South African food market.

It also uses the Quantile Regression technique to identify the main driving factors of both return and volatility spillover from the international food market into the South African market.

Return connectedness between global food price index and food prices in South Africa

The results show a slightly higher level of return connectedness than volatility connectedness among the food markets and that shocks from the global food market dominate shocks from the South African food market.

The total connectedness index (TCI) is about 20.93%, wherein 13.8% is associated with the short-term and 7.2% for the long-term.

The Soyabeans market is the main net transmitter of shocks into the system, while the remaining South African food markets (Barley, Maize, Oats, Sorghum, Sunflower and Wheat) are net risk receivers on average.

In the short-term, Oats, Sunflower, and Maize markets are net-transmitters of shocks, while Barley, Sorghum, and Wheat are net-receivers of shocks within the system.

In the long run, only shocks from the Soyabeans market, Sorghum and Wheat markets dominate shocks are net shocks transmitters.

Return connectedness among world food prices and food prices in South Africa

The study also finds that the degree of total connectedness between the degree of interactions using changes in prices of South African domestic food prices and the different five global food prices is about 34.96%, indicating that the degree of spillovers are stronger when we consider interactions with individual global food markets; and its effects are slightly stronger in the long term.

Risk spillovers from the global food market are mainly driven by development in the world market for Cereals, oilseeds, and Meat, while the world market for the remaining foods appears to be vulnerable to shocks from the South African food market, especially the world markets for Sugar and Dairy.

Soyabeans market is not vulnerable to shocks spillovers from the system both in the short-term and long-term while the remaining South African food markets are net-receivers of shocks.

CONCLUSION

Volatility connectedness between global food prices and the composite food price index in South Africa

The composite food price index volatility is a net-transmitter of shocks as well as in the long-term However, unlike return connectedness, the composite global food price index is a net-receiver of shocks from the system in the short-term. The total degree of volatility connectedness is 20.90%. The total volatility connectedness breaks down to 8.99% and 11.91% for short- and long-term connectedness, respectively.

The composite food price index volatility is a net-transmitter of shocks as well as in the long-term However, unlike return connectedness, the composite global food price index is a net-receiver of shocks from the system in the short-term.

The Soyabean market in South Africa appears to be the dominant source of volatility risk transmission within this system followed by the Wheat market while the remaining markets are net-receivers of shocks led by the Sunflower market.

The frequency-based results also suggest that while the Soyabean market in South Africa may lead long-term shocks transmission among these food types, Wheat plays this role in the short-term.

Volatility connectedness between global food prices and the composite food price index in South Africa

The degree of total connectedness is about 51.92%, suggesting that the degree of volatility spillovers is significantly stronger than return spillovers when we consider interactions with the five global food types.

Spillovers among these food markets are mostly driven by long-term interactions, as shown by stronger long-term against short-term

The net total directional connectedness shows that volatility risk spillovers from the global food market is mainly driven by developments in the world market for Oil seeds, Sugar, and Cereals while the remaining world food types appear to be vulnerable to shocks from the system, especially the world markets for Dairy, followed by that of Meat.

Sunflower is a net-transmitter of shocks in the long-term, while the remaining South African food markets are net-transmitters of shocks to the system across both short- and long-term.

Drivers of total connectedness

Increase in geopolitical risks, equity market returns in South Africa, oil prices and the COVID-19 pandemic were the main drivers of return risk transmission from the global food market into the South African food market. However, the depreciation of value of Rand decreased the level of spillovers.

Regarding volatility risk transmission, gold price, the South African equity and the fixed income market return are the main drivers of volatility shocks transmission from the global food market into the South African food market.

RECOMMENDATION

- Strengthen food market resilience through domestic food production and diversification, since South African food markets are largely net receivers of global shocks.
- Special support should target vulnerable markets like Barley, Sorghum, and Wheat, especially in the short term.
- Given the dominance of global shocks in driving domestic prices and the volatility of key markets like soybeans, government should implement or scale up strategic food reserves, buffer stocks, and price stabilization mechanisms for essential staples, there is need to establish strategic reserves and food price stabilization policies.
- Designing short-term risk management tools for farmers and traders, such as short-term insurance products, forward contracts, or weather-indexed insurance, to cushion producers and traders against volatility, especially for those farming seasonal crops.
- Monitor global soybeans, oats, sunflower, and maize markets more closely, as these are significant shock transmitters. Custom trade policies, import buffers, or hedging mechanisms can be designed specifically around these crops.
- Fiscal and monetary policies must incorporate contingency planning for future global events such as pandemics and conflicts and consider creating a food price risk index or early warning system to track incoming shocks.
- Since oil prices influence food price spillovers, there's a need for integrated energy-food policy planning. Subsidies, fuel price smoothing, or investment in alternative fuel sources (e.g., solar irrigation) could reduce the exposure of food markets to oil price spikes.
- Finally, the role of equity market returns suggests that wealth effects and investor sentiment may amplify food price volatility, therefore, regulators should monitor the interlinkages between financial markets and commodity markets, especially in times of crisis, and consider macroprudential tools to dampen excessive risk-taking.

THANK YOU