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Will the financialisation of agricultural products exacerbate food security risks? Empirical analysis from major grain-producing countries worldwide

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Abstract: Based on data from 10 countries from the Chicago Mercantile Exchange (CBOT) wheat futures market for the period from 2000 to 2021, this study examines the impact of the financialisation of agricultural products on food security and its mechanism of action. We found that the higher the degree of financialisation of agricultural products, the stronger the negative effect on food security, which is more prominent after the financial crisis in 2008, and the effect on developing countries is more obvious than that on developed countries. The test results of the mediation effect model showed that the financialisation of agricultural products affects food security by increasing the volatility of futures prices. The test results of the moderating effect model showed that the rise of the US dollar index and loose monetary policy will exacerbate the impact of the financialisation of agricultural products on food security. Still, the increase of the self-sufficiency rate of food can effectively inhibit this impact. The study's conclusions supported the government's optimising macro policies and promoting food security.

Keywords: agricultural product financialisation; grain price volatility; speculation

Food security is one of the significant issues humanity faces (Fei et al. 2023). The '2022 State of Food Security and Nutrition in the World' report released by the United Nations in 2022 stated that the number of people affected by hunger globally had reached 828 million in 2021, an increase of about 46 million from 2020. The prevalence of undernourishment rose from 8% in 2019 to 9.8%, with basic food prices climbing more than 40%. Additionally, compared to the developed regions, a larger proportion of the population in economically backward areas faces food insecurity. The global food crisis, marked by shortages and rising food prices, affects global stability, especially in low-income, food-importing countries (Neik et al. 2023).

The financialisation of agricultural products, especially the futures market for these products, is a significant factor affecting the global supply and demand of food and food security. Since the enactment of the Commodity Futures Modernization Act in 2000, which significantly deregulated commodity futures trading in the United States, commodity futures trading has essentially evolved into a platform for financial speculation. Agricultural products have become targets of extensive capital pursuit, leading to shorter price fluctuation cycles and increased volatility. Financial

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speculation in agricultural products has become a critical factor affecting food prices (Bredin et al. 2021). Speculation in food commodities, particularly harmful speculation, has distorted market prices, exacerbated price volatility, and led to the formation of price bubbles (Wahl 2009). With significant capital inflows into the agricultural market, speculative behaviour, especially related to financial crises, is a decisive factor in creating price bubbles in agricultural products (Ghosh 2011; Tadesse et al. 2016). In the current context of countries stimulating their economies through quantitative easing monetary policies, financial speculation in agricultural products will inevitably increase the risk of food price volatility and threaten food security (Clapp and Isakson 2018; Fama and Conti 2022).

Therefore, while there is a wealth of research on the financialisation of agricultural products and food security, empirical studies specifically addressing this topic are relatively rare, and even fewer explore the transmission mechanisms between the two. Additionally, scholars have different definitions for the concept of agricultural product financialisation. In this study, financialisation is defined as the degree of speculation in the agricultural product futures trading market. To measure this, we construct a comprehensive speculation index using Working's *T* index, speculative pressure indicators, and speculative size indicators, and use the Food Price Index published by the United Nations Food and Agriculture Organization as a proxy variable for food security. By selecting annual data from 10 major countries from 2000 to 2021, this study empirically tests the factors of agricultural product financialisation that affect food security, the transmission mechanisms, and key moderating variables, aiming to address the gaps in the existing literature.

The innovations of this study include: First, compared to previous studies that examined a single dimension of agricultural product financialisation, this study measures agricultural product financialisation from three comprehensive dimensions. Second, it investigates the differential impacts of agricultural product financialisation on food security before and after the financial crisis and across economies with different levels of development. Finally, in terms of transmission mechanisms, this study employs a mediation effect model to test the mediating role of futures prices in the impact of agricultural product financialisation on food security, as well as the moderating effects of the US dollar index, monetary policy, and food self-sufficiency rate on the impact of agricultural product financialisation on food security.

MATERIAL AND METHODS

Theory and hypotheses

The impact of agricultural product financialisation on food security. With the rapid development of agricultural financial markets, a considerable amount of speculative capital has been concentrated in agricultural futures markets, driving up agricultural futures prices, which, in turn, lead to increases in spot prices for agricultural products. This process has intensified the volatility of food prices, causing them to significantly deviate from actual food supply and demand (Gutierrez 2013; Etienne et al. 2015). Since the financial crisis of 2008, speculation has become a primary reason for the frequent spikes in food prices since the turn of the century (Bredin et al. 2021). Meanwhile, agricultural transnational corporations and capital from developed countries are increasingly concentrated in the global food and agriculture system, leading to developing countries becoming more reliant on imports and more susceptible to the impact of food price shocks (Anderson 2014; Field et al. 2016). Developing countries' agricultural financial markets lag behind, with weaker resilience to risk (Ivanic et al. 2012), making the negative impact of commodity futures speculation on their food security more significant (Sosoo et al. 2021). Therefore, this study proposes the following hypotheses:

H_1: The financialisation of agricultural products exacerbates food price volatility, resulting in adverse effects on food security.

H_2: Following the 2008 financial crisis, the impact of the financialisation of agricultural products on food security became more pronounced.

H_3: The impact of the financialisation of agricultural products on food security is more significant in developing countries while relatively smaller in developed countries.

The mediating effect of futures prices. Speculation in agricultural futures markets is primarily based on expectations of futures price movements. These expectations will influence market expectations of future spot prices, thereby affecting spot price volatility. Moreover, when the spread between futures and spot prices exceeds the difference between holding costs and convenience yields, traders can profit from arbitrage by buying spot and selling futures. The influence of financial capital on futures prices can also be transmitted to spot prices through arbitrage channels (Tang and Xiong 2012). Additionally, information noise generated by futures speculation can dis-

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tort futures price signals, alter investor expectations, and have feedback effects on spot prices (Sockin and Xiong 2015). Therefore, this study proposes the following hypothesis:

H_4: Futures prices of agricultural products exhibit a significant mediating effect in the relationship between agricultural product financialisation and food security.

Moderating effects of the US dollar index and monetary policy. Most international agricultural markets trade in US dollars, and fluctuations in the US dollar are a significant driver of agricultural price volatility (Reboredo and Ugando 2014). Quantitative easing of the US dollar can lead to its depreciation and capital inflows into futures markets, resulting in volatile futures prices (Nazlioglu and Soytas 2012). By buying large quantities of agricultural futures contracts, financial capital investors create significant profits while generating substantial virtual demand, distorting the true supply-demand relationship in agricultural markets. This distortion triggers a significant increase in international food prices, exacerbating the impact of the financialisation of agricultural products on food security (Li et al. 2017). Therefore, this study proposes the following hypothesis:

H_5: The US dollar index and loose monetary policy exacerbate the impact of the financialisation of agricultural products on food security.

Moderating effects of food self-sufficiency rate. The food self-sufficiency rate is an important indicator in measuring food security (Shao et al. 2020). The higher the food self-sufficiency rate, the smaller the speculative space in the agricultural market and the relatively smaller impact of the financialisation of agricultural products on food price volatility. Compared to developed countries, developing countries have lower food self-sufficiency rates and weaker government regulation capabilities over spot and futures markets for agricultural products. Therefore, the impact of financialisation on food price volatility is more significant in developing countries (Ghosh 2011). Hence, this study proposes the following hypothesis:

H_6: The food self-sufficiency rate significantly suppresses the impact of the financialisation of agricultural products on food security, and this suppression effect is more pronounced in developing countries.

Data and variables

Data selection and sources. This study conducted empirical analysis using annual data from ten countries globally from 2000 to 2021. The sample included five developed countries and five developing countries, namely the United States, Australia, Canada, France, Germany, China, Russia, India, Ukraine, and Brazil. These countries are not only major producers and consumers of food but also significant participants in agricultural futures markets. All data used in this study were sourced from the FAO (2022), the World Bank (2022), and the Wind database (2022).

Measurement of the agricultural product financialisation. In this paper, agricultural product financialisation was defined as the degree of speculation in the agricultural product futures trading market. It was measured by a comprehensive speculation index constructed using Working's *T* index, speculative pressure indicators, and speculative size indicators.

i) Working's *T* index (NC_1). Trading positions aimed at speculation will vary with changes in positions aimed at hedging. The commodity futures market is mainly driven by hedging activities. Working's *T* index can compare speculative activities relative to total hedging activities (Working 1960).

$$NC_1 = \begin{cases} 1 + \dfrac{NCS_t}{CL_t + CS_t} \text{if} \left(CS_t > CL_t \right) \\ 1 + \dfrac{NCL_t}{CL_t + CS_t} \text{if} \left(CS_t < CL_t \right) \end{cases} \quad (1)$$

where: *CS*, *CL* – short and long positions in commercial holdings, respectively; *NCS*, *NCL* – short and long positions in non-commercial holdings, respectively.

ii) The speculative pressure index (NC_2) is an indicator that excludes scale factors and is used to measure the pressure exerted by speculative forces on prices. Its numerical value, whether positive or negative, reflects speculators' judgments on the future direction of prices and their impact on price movements (Sanders et al. 2004).

$$NC_2 = \frac{NCL_t - NCS_t}{NCL_t + NCS_t + 2NCSP_t} \quad (2)$$

where: *NCS*, *NCL* – short and long positions in non-commercial holdings, respectively; *NCSP* – speculative positions in non-commercial holdings.

iii) Speculative size indicator (NC_3). Sanders et al. (2004) used the speculative size indicator to measure long-term speculative activity in the futures market. Speculative size represents the proportion of total speculative positions in open interest and contracts.

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$$NC_3 = \frac{NCL_t + NCS_t + 2NCSP_t}{2 \times TOL_t} \quad (3)$$

where: *NCS*, *NCL* – short and long positions in non-commercial holdings, respectively; *NCSP* – speculative positions in non-commercial holdings; *TOL* – all outstanding futures contracts.

Since these three speculative indicators focus on different aspects of measurement, and different speculative actions have varying impacts on commodity price volatility (Lawson et al. 2021), using a single indicator alone may lead to biased judgments regarding the relationship between agricultural product financialisation and food security. Therefore, based on the calculation of the three speculative indicators, this study utilised the principal component analysis to construct a comprehensive speculation index to measure agricultural product financialisation. Due to space constraints, the introduction and calculation process of principal component analysis are not presented here.

Variable definition. The dependent variable in this study was food security, measured by the natural logarithm of the Food Price Index (2015 = 100) published by the Food and Agriculture Organization of the United Nations (Taghizadeh-Hesary et al. 2019). The core explanatory variable was agricultural product financialisation, measured using the comprehensive speculation index constructed earlier. The mediating variable was the natural logarithm of the Chicago Mercantile Exchange (CBOT) wheat futures prices. The moderating variables were the US dollar index, monetary policy, and food self-sufficiency rate, measured respectively by the natural logarithm of the US dollar index, the growth rate of broad money (*M*2), and the ratio of wheat production to consumption. Control variables included GDP growth rate, inflation rate, real exchange rate, international crude oil prices, and cultivated land area. Descriptive statistics for each variable are provided in Table 1.

Methodology

Basic model testing. In order to investigate the impact of agricultural financialisation on food security, this study constructed the following empirical model:

$$FPI_{i,t} = \alpha_i + \beta_0 + \beta_1 FAP_{i,t} + \beta_2 Control_{i,t} + \mu_{i,t} \quad (4)$$

where: $FPI_{i,t}$ – food security; $FAP_{i,t}$ – agricultural financialisation measured by the comprehensive speculation index; i –country; t – year, α_i – individual fixed effects, $Control_{i,t}$ – all control variables; $\mu_{i,t}$ – random error term.

Mediation effect analysis. To examine whether futures prices mediate the relationship between agricultural financialisation and food security, this study employed a three-step approach to construct the mediation effect test model. The mediation effect test model was as follows:

$$FP_{i,t} = \theta_0 + \theta_1 FAP_{it} + \theta_2 Control_{i.t} + \alpha_i + \mu_{i,t} \quad (5)$$

$$FPI_{i.t} = \Phi_0 + \Phi_1 FAP_{i,t} + \Phi_2 FP_{i.t} + \Phi_3 Control + \alpha_i + \mu_{i,t} \quad (6)$$

Table 1. Descriptive statistics of variables

Type	Variable	Symbol	Mean	SD	Min	Max
Explained variable	food price index	*FPI*	4.354	0.391	3.069	5.128
Explanatory variables	financialization of agricultural products	*FAP*	0.000	0.705	–0.970	1.400
Control variable	GDP growth rate	*GDP*	3.216	3.980	–15.136	14.231
	inflation rate	*IR*	4.646	5.411	–0.732	48.700
	real exchange rate	*ER*	12.386	19.753	0.683	74.100
	crude oil prices	*OP*	4.028	0.424	3.257	4.602
	cultivated area	*AR*	22.882	19.091	3.010	56.824
Mediator variable	futures prices	*FP*	6.182	0.331	5.552	6.648
Moderating variable	dollar index	*DI*	4.596	0.076	4.458	4.703
	monetary policy	*M2*	0.124	0.113	–0.170	0.610
	food self-sufficiency rate	*FSR*	1.733	1.011	0.175	4.475

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

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where: θ, Φ – influence coefficients.

In the first step, it aligned with the baseline model. In the second step, formula (5) was utilised to examine whether futures prices significantly influence the agricultural product financialisation. In the third step, employing formula (6), the agricultural product financialisation and futures prices were included in the same model to assess their impact on food security.

Moderating effect test. To examine the moderating effects of the US dollar index, monetary policy, and food self-sufficiency rate on the impact of agricultural product financialisation on food security, we introduced interaction terms based on Equation (8) to construct the moderation effect model. The specific model construction was as follows:

$$FPI_{i,t} = \beta_0 + \beta_1 FAP_{i,t} + \beta_2 DI_{i,t} + \beta_3 FAP_{i,t} \times DI_{i,t} + \\ + \beta_4 Control_{i.t} + \alpha_i + \mu_{i,t} \quad (7)$$

$$FPI_{i,t} = \eta_0 + \eta_1 FAP_{i,t} + \eta_2 M2_{i,t} + \eta_3 FAP_{i,t} \times M2_{i,t} + \\ + \eta_4 Control_{i.t} + \alpha_i + \mu_{i,t} \quad (8)$$

$$FPI_{i,t} = \delta_0 + \delta_1 FAP_{i,t} + \delta_2 FSR_{i,t} + \eta_3 FAP_{i,t} \times FSR_{i,t} + \\ + \delta_4 Control_{i.t} + \alpha_i + \mu_{i,t} \quad (9)$$

where: $DI_{i,t}$ – US dollar index; $M2_{i,t}$ – monetary policy; $FSR_{i,t}$ – food self-sufficiency rate; β, η, δ – influence coefficients.

RESULTS AND DISCUSSION

Baseline regression results. The study first conducted a stationarity test on the variables using the inflation factor, and the results showed that the inflation factors for all variables were below 10, indicating that empirical analysis could be conducted. The baseline regression results are presented in Table 2, where Model (1) represents the regression without control variables, and Model (2) includes control variables. The coefficient of agricultural product financialisation is 0.180, which is significant at the 1% level, indicating that for every one-unit increase in agricultural product financialisation, the food price index rises by 0.180 percentage points. This suggests that with a higher degree of agricultural product financialisation, agricultural prices are more susceptible to fluctuations driven by market investors' expectations and sentiments, thereby increasing food security risks.

Table 2. Impact of agricultural financialization on food security

Variable	Model (1)	Model (2)
FAP	0.352*** (0.075)	0.180*** (0.037)
GDP	–	–0.020*** (0.004)
IR	–	–0.008** (0.003)
ER	–	0.026*** (0.002)
OP	–	0.297*** (0.054)
AR	–	0.096 (0.077)
Constant	4.354*** (0.000)	0.729 (1.853)
Individual	yes	yes
N	220	220
Adjusted R^2	0.482	0.836

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *FAP* – financialization of agricultural products; *GDP* – GDP growth rate; *IR* – inflation rate; *ER* – real exchange rate; *OP* – crude oil prices; *AR* – cultivated area

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

Heterogeneity analysis. Table 3 reports the results of heterogeneity tests for the pre and post-financial crisis periods and for economies with different levels of development. From Models (1) and (2), it can be observed that compared to the period before the 2008 financial crisis, the impact of agricultural product financialisation on the food price index was significantly positive at the 1% level after the crisis. This may be attributed to governments worldwide opting for quantitative easing monetary policies to stimulate economic recovery post-crisis, leading to an influx of financial capital into agricultural futures markets and exacerbating food price volatility. Additionally, this study used the Human Development Index (*HDI*), calculated by the United Nations Development Programme, as a criterion for classifying economies into developed and developing countries, with an *HDI* of 0.85 used as the threshold. The sample is divided into five developing countries and five developed countries based on this criterion. From Models (3) and (4), it was observed that the coefficient of agricultural product financialisation on food security was 0.135 in developed countries and 0.259 in developing countries. This may be due to the increasing dependency of developing countries on food imports amidst the backdrop of a globally concentrated food and agriculture system, making them more vulnerable to food price shocks. Moreover, due to the underdevelopment of futures markets in developing countries compared to developed ones, coupled

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Table 3. Heterogeneity test results

Variable	Model (1) Before 2008	Model (2) After 2008	Model (3) Developed countries	Model (4) Developing countries
FAP	–0.0262 (0.0213)	0.0876*** (0.0231)	0.135*** (0.014)	0.259*** (0.054)
Controls	yes	yes	yes	yes
Constant	2.986 (1.785)	2.662 (2.506)	5.098*** (0.860)	–2.688 (2.384)
Individual	yes	yes	yes	yes
N	80	140	110	110
Adjusted R^2	0.633	0.759	0.773	0.902

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *FAP* – financialization of agricultural products

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

Table 4. Endogeneity test results

Variable	Coefficient	Corrected standard error	*Z*-statistic
L.FPI	0.9204***	0.0282	32.67
FAP	0.0768**	0.0351	2.19
Controls	yes	yes	yes
AR(1)		0.038	
AR(2)		0.346	
Hansen		0.996	

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *L* – first-order lagged term; *FPI* – food price index; *FAP* – financialization of agricultural products; AR(1) – first-order autoregression; AR(2) – second-order autoregression.

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

with fragile financial systems and inadequate regulatory frameworks for futures markets, there is an influx of more speculators into agricultural futures markets, leading to higher agricultural price bubbles and threatening food security.

Endogeneity test. To address potential endogeneity issues arising from reverse causality and omitted variable bias in the regression model, this study employed the generalised method of moments (GMM) proposed by Blundell and Bond (1998) to conduct endogeneity tests on the model. Table 4 reports the regression results estimated using GMM. Specifically, the values of $AR(1)$ and $AR(2)$ were 0.038 (less than 0.05) and 0.346 (greater than 0.05), respectively, which aligned with the prior assumption of no serial correlation in the GMM estimation. Moreover, the *P*-value of the Hansen test was 0.996, exceeding 0.1, indicating the inability to reject the null hypothesis that all instrumental variables are valid, thereby demonstrating the validity of the estimation. The coefficient of agricultural product financialisation in the dynamic panel data model was positive and significant at the 1% level, consistent with the baseline regression results, suggesting the robustness of the findings.

Robustness test. To ensure the robustness of the empirical results, this study conducted robustness tests using two methods: replacing the explanatory variables and employing double-sided trimming. Firstly, the core explanatory variables were replaced with Working's *T* index and speculative scale indicators for re-examination. Secondly, the variables were subjected to double-sided trimming at the 1st percentile, followed by a re-examination. The results of these tests were consistent with the baseline regression results, demonstrating the robustness of the core findings. Due to space limitations, specific test results are not presented here.

Mediation effect of futures prices. The results of the mediation effects test are presented in Table 5. In Model (1), the effect of agricultural financialisation on food security was significantly positive. In Model (2), the coefficient of agricultural financialisation on futures prices was significantly positive, indicating that agricultural financialisation promoted the increase in wheat futures prices. In Model (3), the coefficient of futures prices was 0.376, which is significant at the 1% level, while the coefficient of agricultural financiali-

Table 5. Results of mediation effect testing on futures prices

Variable	Model (1) *FPI*	Model (2) *FP*	Model (3) *FPI*
FAP	0.180*** (0.037)	0.023* (0.012)	0.171*** (0.036)
FP	–	–	0.376*** (0.071)
Controls	yes	yes	yes
Constant	0.729 (1.853)	4.575*** (0.822)	–0.993 (1.987)
Individual	yes	yes	yes
N	220	220	220
Adjusted R^2	0.836	0.775	0.863

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *FPI* – food price index; *FAP* – financialization of agricultural products; *FP* – futures prices

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

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sation was 0.171, which is lower than the coefficient of agricultural financialisation in Model (1). This suggests that agricultural financialisation influenced food security through its impact on futures prices. Therefore, the transmission channel of agricultural financialisation–futures prices–food security was effective.

Moderating effects of US dollar index and monetary policy. Table 6 reports the results of the moderation effects regression for the US dollar index and monetary policy. Models (1) and (2) showed that the coefficients of the interaction terms between the US dollar index, monetary policy, and agricultural financialisation were both significantly positive. This could be because the rise in the US dollar index and quantitative easing monetary policy led to increased liquidity in the agricultural futures market and a large influx of money, stimulating speculators to invest heavily in agricultural futures markets. This resulted in price fluctuations in agricultural products, exacerbating food security risks.

Moderating effects of food self-sufficiency. Table 7 presents the results of the moderation effects regression for food self-sufficiency rate. Models (1) to (3) indicated that the interaction terms between agricultural financialisation and food self-sufficiency rate were significantly negative in the full sample and in developing countries, with a larger impact coefficient in developing countries, while not significant in developed countries. This could be due to the higher food self-sufficiency rate in developed countries, where overall food supply and demand were more balanced, agricultural financial markets were more mature, and government regulatory systems were more robust. As a result, the moderating effect of the food self-sufficiency rate on the impact of agricultural financialisation on food security was not significant in developed countries. In contrast, in developing countries, where the food self-sufficiency rate was lower and agricultural futures markets were less developed, with weaker government intervention in food market supply and demand, an increase in food self-sufficiency rate could effectively mitigate the adverse effects of agricultural financialisation on food security.

Table 6. Moderating effects of US dollar index and monetary policy

Variable	Model (1)	Model (2)
FAP	–3.548*** (0.884)	0.134** (0.0422)
DI	0.962** (0.335)	–
FAP × *DI*	0.800*** (0.195)	–
*M*2	–	–0.183 (0.199)
FAP × *M*2	–	0.530* (0.246)
Controls	yes	yes
Constant	–4.246 (3.151)	1.218 (2.108)
Individual	yes	yes
N	220	220
Adjusted R^2	0.855	0.846

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *FAP* – financialization of agricultural products; *DI* – dollar index; *M*2 – monetary policy

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

Table 7. Moderating effect of food self-sufficiency

Variable	Model (1) Full sample	Model (2) Developed countries	Model (3) Developing countries
FAP	0.331*** (0.054)	0.074 (0.047)	0.382*** (0.049)
FSR	–0.004 (0.018)	–0.021 (0.012)	0.021 (0.043)
FAP × *FSR*	–0.073*** (0.021)	0.025 (0.020)	–0.121** (0.035)
Controls	yes	yes	yes
Constant	0.144 (1.158)	4.996*** (1.028)	–3.096 (1.837)
Individual	yes	yes	yes
N	198	88	110
Adjusted R^2	0.873	0.791	0.909

*, **, *** $P < 0.1$, $P < 0.05$, and $P < 0.01$ respectively; *FAP* – financialization of agricultural products; *FSR* – food self-sufficiency rate

Source: Own calculations based on the FAO (2022), the World Bank (2022), and the Wind (2022) database

CONCLUSION

This study empirically examined the impact of agricultural financialisation on food security and its mechanisms from 2000 to 2021 across ten countries. The research findings are as follows: Firstly, agricultural financialisation exacerbated food price volatility, negatively impacting food security. This effect was more pronounced after the 2008 financial crisis, and it was more significant in developing countries compared to developed ones. Secondly, the results of the mediation effects model indicated that agricultural financialisation affects food security by intensifying futures price volatility. Thirdly, the results of the moderation effects model showed that an increase in the US dollar index and loose monetary policies exacerbated the impact of agricultural financialisa-

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tion on food security, but an improvement in the food self-sufficiency rate can effectively mitigate this impact.

The theoretical and practical significance of this study lies in the following aspects: Against the backdrop of the increasingly prominent global food security issues, governments worldwide should attach great importance to the crucial role of stable agricultural financial markets in ensuring food security. Stability in financial markets, particularly in agricultural futures markets, is essential for safeguarding both national and global food security. It is imperative, especially for developing countries, to strengthen regulatory frameworks for agricultural futures markets, fully utilise the price discovery and hedging functions of these markets, and curb excessive speculative activities. It is worth noting that the United States, as a global financial powerhouse, utilises the dominance of the US dollar worldwide and continuously adjusts the direction of its monetary policies, transmitting its domestic inflation pressures globally, thus exacerbating fluctuations in agricultural prices and posing significant challenges to global food security. Therefore, countries should enhance communication and coordination in international monetary policies to maintain monetary policy stability and mitigate risks of food price fluctuations. Continuously increasing domestic food self-sufficiency is a fundamental strategy for all countries, especially for developing ones, to ensure food security. Due to data limitations, the empirical section of the article only used wheat data from the Chicago Mercantile Exchange for ten countries. Future research could consider expanding the sample to include more agricultural products and countries. Additionally, measurements of agricultural financialisation and food security could be further enriched to ensure the rigour of research conclusions.

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