

Study on the Impact of Import Source Diversification on China's Wheat Import Risk from a Correlation Perspective

Sen Wu*, Dayan Lin

School of Economics and Management, Nanjing University of Science and Technology, Nanjing, China

*Corresponding author: 1353883726@qq.com

Abstract

Food security is an important foundation for economic development, social stability and national prosperity, and General Secretary Xi Jinping has emphasized that "guaranteeing national food security is an eternal issue that cannot be relaxed at any time". China's food in the import scale continues to expand at the same time, food imports from the layout of the high concentration of the problem is also becoming more and more prominent, the food import risk is rapidly rising, is not conducive to food security. Therefore, this paper empirically examines the impact of diversification of wheat import sources on China's wheat import risk from the perspective of diversification of wheat import sources, taking the minimization of import risk of importing countries as a starting point, and using China's monthly wheat import data from 2015 to 2021. It is found that: the increase in the level of diversification of China's wheat import sources helps to reduce the volatility of China's wheat import risk, the increase in the level of domestic residents' consumption can reduce the volatility of China's wheat import risk to a certain extent, and the fluctuation of domestic wheat production does not have a significant impact on China's wheat import risk.

Keywords

Correlation Perspective; Diversification of Import Sources; Import Risk; Wheat.

1. Introduction

When the granaries are full, the world is at peace. Ensuring an adequate and stable supply of grain and important agricultural products has always been a top priority in governing the country. With the continuous upgrading of the dietary structure of urban and rural residents and the continuous emergence of agricultural structural problems, China's food security has gradually shifted its focus to food security, requiring the establishment of a "big food concept" and requiring "while ensuring the supply of grain, ensuring the effective supply of various types of food such as meat, vegetables, and fruits, and none of them can be missing" (Liu Changquan et al., 2023). At the same time, although my country's grain production has increased for many consecutive years since the 21st century and its comprehensive grain production capacity has continued to improve, under the hard constraints of domestic resources and the high level of agricultural opening, the scale of food imports has expanded rapidly. While better supplementing domestic food supply, meeting food consumption needs, and alleviating resource and environmental pressures, it has also made the stable operation of the domestic food market and people's daily life more deeply affected by food import risks. Under the conditions of high openness, facing the increasingly complex and changing international economic and trade environment, in order to ensure my country's food security, we must not only make full use of international markets and international resources, but also effectively prevent and control food import risks.

In addition to measures such as improving agricultural comprehensive production capacity, the diversification of agricultural product import sources has also received much attention. Diversification of import sources usually means that a country has more source options when importing, which can reduce dependence on a single import source, thus helping to reduce the overall risk of food imports. When there is a risk in one source, the importing country can increase imports from other sources to compensate, thereby ensuring sufficient and stable imports. For example, increase wheat imports from low political risk countries such as Australia and Brazil, while reducing imports from Ukraine, Russia and other countries to avoid political risks (Zhu Jing et al., 2023). On the contrary, if imports are highly dependent on a few import sources, it is not only easy for a few import sources to form a seller's market power, but also will be deeply affected by sudden situations such as food embargoes, natural disasters, and political changes in the exporting country (Zhu Jing et al., 2021). Based on this, scholars generally believe that diversification of import sources can effectively reduce the risk of food imports and widely call for measures to diversify import sources (Wang Xinhua et al., 2023; Han Yang, 2022; Chen Xiangyun et al., 2020). In terms of policy, diversification of import sources has also been highly valued. Since the Central Document No. 1 in 2013 first clearly proposed "promoting the diversification of import sources", the Central Document No. 1 in 2016 again clearly required "promoting the diversification of import sources", and the Central Document No. 1 in 2019 proposed "expanding diversified import channels". Starting from 2021, import diversification has been elevated to a strategic level. The Central Document No. 1 in 2021 requires "implementing the diversification strategy of agricultural product imports", and the Central Document No. 1 in 2023 further requires "deepening the implementation of the diversification strategy of agricultural product imports".

However, diversification of import sources does not necessarily reduce the risk of food imports. Although diversification of import sources provides more source options, it also means the input of more exogenous risks in the international food market, which may also increase the risk of food imports. In the situation where global agricultural product production and exports are still dominated by Western countries and the multilateral trade framework system is facing challenges, a series of non-market factors such as ideology and geopolitics may seriously disrupt the world food market and trade order, and increase the risk and uncertainty of using global food resources through imports (Zhu Jing et al., 2021). The current international geopolitical situation is unstable, trade protectionism is on the rise, and the COVID-19 and other viral epidemics are spreading widely. The global food market is extremely volatile and the international food supply chain is facing the risk of interruption (Cheng Guoqiang and Zhu Mande, 2020; Chen Zhigang et al., 2020; Zhang Lu and Luo Biliang, 2020). In addition to conventional factors such as climate change and population growth, non-traditional factors such as oil prices, biomass energy development, and financial speculative capital have increasingly significant impacts on the international food market, which has also exacerbated the volatility and instability of the international market (Zhu Jing et al., 2021). According to the neoclassical free trade theory, international trade will lead to price convergence in different countries (Ohlin, 1935). This means that the larger the scale of imports and the higher the degree of market openness, the stronger the impact of international market risks on the domestic market of the importing country, and the higher the risk of the above risks on a country's food supply through imports (Zheng Xuyun and Zhuang Lijuan, 2022; Seekell et al., 2017; Damour et al., 2016). Taking soybeans as an example, studies have shown that in the short term, expanding the source of soybean imports will incur high additional costs, and in the long term, expanding the source of soybean imports will be affected by the ecological environment and trade policies of potential import source countries, and the risks are also high (Song Haiying and Jiang Changyun, 2021). In 2022, affected by the conflict between Russia and Ukraine, the prices of corn, wheat, soybeans and food substitutes in the international market

continued to rise, and the prices of meat such as beef were pushed up through animal feed, resulting in an overall increase in the risk of food imports in African countries (Zhang Mengying, 2022). In fact, whether the diversification of import sources can effectively reduce import risks depends to a large extent on the correlation between different sources, in addition to the risks of a single import source itself. Due to differences in resource endowments, political situations, transportation conditions, and export conditions, even in the face of the same external shocks such as natural disasters and trade policy adjustments, the impact on a country's imports will be different. If different food sources are negatively correlated, and there are large differences or even opposites in resource endowment, political situation, transportation conditions, export conditions, etc., then in the face of external shocks, the direction of import changes is likely to be opposite, thereby playing a role in hedging the adverse effects of external shocks on overall food imports, and ultimately making the diversification of food import sources can effectively reduce food import risks. However, if different food sources are positively correlated, then in the face of external shocks, the direction of import changes is likely to be the same, and diversified food import sources will increase food import risks. It can be seen that the correlation between different sources is crucial to the effectiveness of diversified import sources in reducing import risks.

Although existing literature has increasingly attached importance to the role of diversified import sources in reducing import risks, most of them are simply mentioned in countermeasures and suggestions. The theoretical basis, mechanism of action, prerequisites and implementation effects of diversified import sources in reducing import risks have not been systematically explained, and the important role of the correlation between different import sources in the impact of diversified import risks has not yet attracted enough attention. The implementation effect of diversified import sources in reducing China's food import risks also needs to be tested. Therefore, this paper will: ① In view of the changes in the diversified pattern of China's food import sources, draw on the portfolio theory in uncertain economics, and based on the perspective of correlation, deeply examine the impact of import diversification on China's wheat import risks from the source dimension, revealing the theoretical basis, mechanism, prerequisites and implementation effects of the impact of import source diversification on China's wheat import risks; ② Systematically calculate wheat import risks, construct and analyze nonlinear programming models based on the import risk minimization goal, and construct an effective diversification implementation plan for wheat import sources; ③ Based on the analysis results, put forward policy recommendations for my country to effectively implement the agricultural product import diversification strategy, build and adjust an open food security guarantee system to reduce food import risks.

The research of this paper has important academic value. This paper introduces the characteristics of food imports into the portfolio theory framework, constructs a theoretical analysis framework and empirical model of the impact of diversification on import risks through the mean-variance model, and reveals the theoretical basis, mechanism, prerequisites and implementation effects of import source diversification to effectively reduce food import risks. The research will enrich the theoretical basis, research perspective and research content in the field of import risk and import source diversification, and provide a theoretical basis for the agricultural product import diversification strategy. Although existing studies unanimously agree on the role of import diversification in reducing import risks, and also potentially realize that the correlation between different sources plays an important role in effectively reducing import risks through import diversification, its mechanism, conditions and effects have not yet been systematically demonstrated.

The research in this paper also has important practical significance. With the focus of food security gradually shifting to food security, the rapid growth of food imports and the increasingly complex and changing international economic and trade environment, it is urgent

to prevent food import risks, and the strategy of agricultural product import diversification has therefore received high attention. This project answers the theoretical basis, mechanism of action, prerequisites and implementation effects of diversifying import sources to reduce wheat import risks, and finally proposes an implementation plan for diversifying wheat import sources, which can provide a scientific reference for the effective implementation of the agricultural product import diversification strategy, the construction and adjustment of the food security guarantee system of an open country, and is of great significance for preventing food import risks and effectively ensuring food safety under open conditions.

2. Empirical Analysis

2.1. Modeling

Based on the above logic, using the investment portfolio theory of uncertain economics, a mean-variance theoretical model of the impact of diversified import sources on wheat import risk is constructed.

The theoretical model of this paper is:

$$Ir_t = \beta_0 + \beta_1 Dic_t + \beta_2 Dic_t^2 + \beta_3 Div_t + \beta_4 Div_t^2 + \beta_5 Sr_t + \beta_6 Pdi_t + \beta_7 Z_t + \mu_t \quad (1)$$

In the above formula, Ir , Dic , Sr , Dr , and Er represent wheat import risk, diversification of wheat import sources, domestic wheat supply volatility risk, and domestic demand volatility risk, respectively; Z represents other factors affecting food import risk, t is the period, β is the coefficient to be estimated, and μ is the random disturbance term. Among them, food import risk can be calculated according to formula (7), and the diversification level of food import sources can be expressed by the diversification index of the import source combination, and can be calculated by referring to Lu Xiaodong and Li Linfeng (2018) to calculate the diversification index of the export market combination:

$$Dic_t = 1 - \frac{\sum_{m=1}^M \frac{q_{mt}^2}{(\sum_{m=1}^M q_{mt})^2}}{M} \quad (2)$$

In the above formula, it represents the amount of food imported from country j in period t , and M represents the number of import sources. In view of the availability of data, the sample period of this article is selected from January 2000 to December 2022 for measurement. The domestic supply volatility risk (Dr) is represented by the volatility of domestic food production. The domestic demand volatility risk (Sr) includes the volatility risk of direct use demand and demand for food derivatives. Both demands change with the changes in residents' consumption level. Therefore, they are represented by the volatility of residents' consumption level. Due to the lack of monthly data on domestic food production, it is calculated based on the annual wheat production and the monthly cumulative harvest rate.

2.2. Stationarity Test

Since the monthly data selected in this paper are time series data, in order to avoid the "pseudo-regression problem" that may occur in the estimation of time series data, this paper uses the ADF test to test the stationarity of the model variable data before estimation. This paper selects the variable data of one period lag ($d1ir$, $d1dic$, $d1dic2$, $d1dr$, $d1sr$) for testing. The test results show that the test statistics of all variables are less than the critical value of 1%, that is, the null

hypothesis of "the existence of unit root" is rejected at the 1% level. Therefore, all variables can be considered to be stationary.

Table 1. ADF test results of variables in China's wheat import risk model

variant	Z(t)	P-value	steady
d1ir	-14.746	0.000	Yes
d1dic	-15.325	0.000	Yes
d1dic2	-15.325	0.000	Yes
d1dr	-9.442	0.000	Yes
d1sr	-8.910	0.000	Yes

2.3. Model Estimation and Result Analysis

In import practice, due to the influence of various risk factors, importers in importing countries may choose import sources on their own to reduce import risks and price fluctuations, thus causing endogenous problems in the import source structure. Therefore, this paper selects the import source diversification index (L1.dic) with a lag of one period as an exogenous variable, and uses the Hausman test to determine whether the model has endogenous problems. The results show that the P value is greater than 0.05, that is, the model does not have endogenous problems. Therefore, this paper uses the ordinary least squares method (OLS) for estimation, and the estimation results are shown in the table below. According to the results in Table 2, the overall fitting effect of the model is good. The coefficient of the import source diversification index (dic) to be studied in this paper is significant at the statistical level of 1%, and the coefficient sign is negative. This result shows that the improvement of the diversification level of China's wheat import sources is helpful to reduce the volatility of China's wheat import risk.

Table 2. OLS Estimation of Risk Volatility of China's Wheat Import

variant	coefficient	Standard error	t-value	P-value
dic	-0.2014867	0.069317	-2.91	0.005
dic2	0.1010359	0.0347504	2.91	0.005
dr	-3.37e-10	2.36e-10	-1.43	0.158
sr	-1.17e-10	6.59e-11	-1.78	0.079
_cons	0.100453	0.0345667	2.91	0.005
hausman	Prob>chi2(2)			

The results in Table 2 also show that the improvement of domestic residents' consumption level can reduce the volatility of China's wheat import risk to a certain extent, while the fluctuation of domestic wheat production has no significant impact on China's wheat import risk. During the period of rapid economic growth in China, Chinese residents' income increased rapidly, and the domestic demand for wheat increased day by day. Therefore, changes in domestic demand have a significant impact on the volatility of wheat imports. Under the constraints of food security policies and low comparative returns, domestic wheat production has been weak, and the domestic demand for wheat growth mainly relies on imports to meet it. The impact of changes in domestic wheat supply on the volatility of wheat imports is not obvious.

3. Conclusion and Policy Recommendations

In recent years, the scale of China's wheat imports has expanded rapidly, and the impact of import fluctuations on the domestic market has continued to deepen. This paper mainly analyzes the impact of wheat import risk fluctuations from the perspective of diversification of

import sources. It is found that in China's wheat imports, the sources are mainly concentrated in Australia, the United States, Kazakhstan and other regions. With the continuous advancement of my country's import diversification process, the import sources are becoming more and more diversified. Hungary, Lithuania and other countries are gradually occupying a place in my country's import sources, which has reduced the volatility of China's wheat import risks to a certain extent. In addition, this paper establishes an empirical model and uses the monthly data of China's wheat imports from 2015 to 2021 to conduct an empirical analysis of the impact of diversification of import sources on China's wheat import risks. The results show that the improvement of the diversification level of China's wheat import sources will help reduce the volatility of China's wheat import risks, the improvement of domestic residents' consumption level can reduce the volatility of China's wheat import risks to a certain extent, and the fluctuation of domestic wheat production has no significant impact on China's wheat import risks.

It is worth paying great attention to that simple source diversification does not necessarily effectively reduce import volatility. If the production season or export time of emerging import sources is the same as that of traditional import sources, or the production season or export time is opposite to that of import sources but the export volume to China is much higher than that of traditional import sources, the import volatility of the importing country will increase, which will increase the import risk. Therefore, when formulating the import source layout strategy, China should carefully select import sources, pay attention to the differences in production seasons and export time between emerging import sources and traditional import sources, focus on and cultivate countries with production potential that have great seasonal complementarity with existing import sources and have not yet been fully developed, and promote seasonal diversification of import sources, rather than simply increasing China's import source channels, in order to reduce the risk of import volatility.

References

- [1] CAROLE D., QIU H.G., HANSAKI N, et al. Denise Mauzerall, Ignacio Rodriguez-Iturbe, Balancing water resources conservation and food security in China[J]. Proceedings of the National Academy of Sciences (PNAS), 2015, 112(15): 4588~4593.
- [2] Charette, M. F., 1985. Determinants of export instability in the primary commodity trade of LDC's [J]. Journal of development economics, 18(1): 13-21
- [3] Chen, Z., and B. Yan, 2021, "The Impact of Trade Policy on Soybean Futures in China", Managerial And Decision Economics, (8): 1-12.
- [4] HUBBARD L J, HUBBARD C. Food security in the United Kingdom: External supply risks[J]. Food policy, 2013(43): 142-147.
- [5] Iizumi T, Luo J J, Challinor A J, et al. Impacts of El Nio Southern Oscillation on the global yields of major crops[J]. Nature Communications.
- [6] Jia, R., D. Wang, J. Tu, and S. Li, 2016, "Correlation between Agricultural Markets in Dynamic Perspective—Evidence from China and the US Futures Markets", Physica A: Statistical Mechanics and its Applications, 464: 83-92.
- [7] Kerr, W. A., 2020, "The COVID-19 Pandemic and Agriculture: Short- and Long-run Implications for International Trade Relations", Canadian Journal of Agricultural Economics, 68(2): 225-229.
- [8] KOPPENBERG M, BOAAOLA M, DALHAUS T, et al. Mapping potential implications of temporary COVID-19 export bans for the food supply in importing countries using precrisis trade flows[J]. Agribusiness, 2021, 37(1): 25-43.
- [9] LABORDE D, MARTIN W, SWINNEN J, et al. COVID-19 risks to global food security[J]. Science, 2020, 369(6503): 500-502.

- [10] Macbean, A. L., Nguyen, D. T., 1980. Commodity concentration and export earnings instability: A mathematical analysis[J]. *Economic Journal*, (90):354-362.
- [11] Matchard P, Carr J A, Dell' angelo J, et al. Reserves and trade jointly determine exposure to food supply shocks[J]. *Environmental research letters*, 2016, 11(9):1-11.
- [12] Rosenzweig, C., C. Mbow, L. G. Barioni, T. G. Benton, M. Herrero, M. Krishnapillai, ... and J. Portugal-Pereira, 2020, "Climate change responses benefit from a global food system approach", *Nature Food*, 1(2), 94-97
- [13] X F, WANG J M. Target setting of food self- sufficiency level in China: Literature review and policy enlightenment. *Journal of Natural Resources*, 2019, 34(11): 2257-2269.
- [14] YU X H. Meat consumption in China and its impact on international food security: Status quo, trends, and policies. *Journal of Integrative Agriculture*, 2015, 14(6): 989-994.
- [15] ZHANG H, WANG J, MARTIN W. Factors affecting households' meat purchase and future meat consumption changes in China: A demand system approach. *Journal of Ethnic Foods*, 2018, 5(1): 24-32.
- [16] Zhou, W., K. Guan, B. Peng, Z. Wang, R. Fu, B. Li, E. A. Ainsworth, E. DeLucia, L. Zhao, and Z. Chen, 2021, "A Generic Risk Assessment Framework to Evaluate Historical and Future Climate-induced Risk for Rainfed Corn and Soybean Yield in the U.S. Midwest", *Weather and Climate Extremes*, 33(9): 1-16.
- [17] Chen Zhigang, Zhan Yue, Zhang Yumei, Fan Shenggen Impact of the COVID-19 on global food security and countermeasures [J]. *China Rural Economy*, 2020 (05): 2-12.
- [18] Cheng Guoqiang, Zhu Mande COVID-19 impacts food security: trends, impacts and responses [J]. *China Rural Economy*, 2020 (05): 13-20.
- [19] Cheng Guoqiang, Zhu Mande Path selection and policy framework for implementing global strategies in Chinese agriculture [J]. *Reform*, 2014 (01): 109-123.
- [20] Ding Cunzhen, Xu Xuanguo Research on Security Risks and Responses of International Food Supply Chain [J]. *Economist*, 2022 (06): 109-118.
- [21] Du Zhixiong, Gao Ming, Han Lei Research on the Impact of Supply Side Import Changes on China's Food Security [J]. *China Rural Economy*, 2021 (01): 15-30.
- [22] Lin Dayan Research on the Impact of Soybean Import Price Fluctuations in China: Empirical Analysis Based on Seasonal Complementary Import Source Diversification [J]. *International Business (Journal of the University of International Business and Economics)*, 2019 (02): 1-12.
- [23] Lin Dayan, Zhu Jing, Zhang Shu, Wu Guosong Empirical analysis of the reasons for the fluctuation and decline in China's soybean import quantity from the perspective of source layout [J]. *International Trade Issues*, 2015 (03): 108-117.
- [24] Li Dongmei, Li Qinghai Exploring the Path of Ensuring Food Security with the "Big Food Concept" [J]. *People's Forum*, 2022 (13): 63-65.
- [25] Liu Changquan, Han Lei, Li Tingting, Wang Shukun, Luo Qianfeng Research on the Safety of Feed and Grain Supply in China under the Perspective of Big Food [J/OL]. *China Rural Economy*, 2023 (01): 33-57.
- [26] Li Xiande, Sun Zhilu, Jia Wei Impact of the COVID-19 on the global agricultural product market and trade and countermeasures [J]. *Agricultural Economic Issues*, 2020 (8): 4-11.
- [27] Mao Xuefeng, Liu Dongmei, Liu Jing The current situation and future of large-scale grain imports in China [J]. *Chinese Soft Science*, 2016(1):59-71.
- [28] Mao Xuefeng, Liu Jing, Zhu Xinkai International Food Consumption Insights and Analysis of China's Food Gap: Based on Historical Data [J]. *Economic Theory and Management*, 2014(8):10~26.
- [29] Tan Linyuan, Li Xiande Research on China's Barley Supply Security Strategy - Risks and Countermeasures of China's Barley Import Dependence [J]. *Price Theory and Practice*, 2018 (11): 71-74.
- [30] Wang Shuai, Zhao Xiumei China's Grain Circulation and Food Security: Risk Identification of Key Nodes [J]. *Journal of Northwest A&F University (Social Sciences Edition)*, 2019, 19 (02): 124-132.

- [31] Zhong Yu, Cui Qifeng From food security to the concept of big food: dilemma and path selection [J]. Journal of Theoretical Studies, 2022 (06): 102-109.
- [32] Zhu Jing, Wang Rongbo, Cao Lijuan The fluctuation of world grain market and China's food security under the Russia-Ukraine conflict [J]. Social Sciences Series, 2023 (01): 158-168.
- [33] Zhu Jing Establishing a Big Food Concept and Building a Diversified Food Supply System [J]. Agricultural Economics and Management, 2022 (06): 11-14.