

Research on Diversified Selection of Soybean Import Sources from the Perspective of Import Risk Minimization

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Abstract. From the perspective of reducing import risks, this paper quantitatively analyzes the optimization path of China's soybean import structure in 2020. The research conclusion shows that compared with 2000, China's soybean import sources will gradually diversify in 2020, and the import risk will increase significantly. In order to minimize the risk of soybean imports, China needs to increase soybean imports from the United States, while appropriately reducing soybean dependence on Brazil and Argentina. In addition, other import source countries such as Canada and Russia still have great import potential, which helps to diversify the concentrated import risks.

Keywords: Soybean Import, Food Security, Diversification, Optimal Strategy.

1. Introduction

Soybeans are a major source of edible oil and feed ingredients. With the rapid development of China's economy and the steady growth of residents' consumption, the domestic market demand for soybeans has maintained a rapid growth trend. Restricted by the basic national conditions of more people, less land and water shortage, China's soybeans are highly dependent on imports. The import volume has increased from 10.42 million tons in 2000 to 100.33 million tons in 2020, with an average annual growth rate of 12.0%. So far, soybean imports have accounted for more than 70% of total grain imports (General Administration of Customs of China, 2021). According to the "China Agricultural Outlook Report (2020-2029)", the continuous growth of China's population in the next ten years will continue to increase the demand for soybeans, and the pattern of relying on large amounts of soybean imports will remain basically unchanged. Due to the scarcity of land resources, soybeans compete with corn, wheat and other grain crops for arable land. Therefore, the large-scale import of soybeans indirectly saves arable land for the production of other grain crops. According to research, China's annual imports of soybeans and soybean oil in recent years are equivalent to about 500 million mu of sown area [1]. Considering that the yield per unit of soybean is lower than that of corn, wheat and rice, soybean imports have made an important contribution to ensuring domestic food security [2].

However, with the continuous growth of the import scale, China's domestic soybean market is increasingly affected by the changes in the international market and the global political and economic and trade environment, and the risk of soybean import has attracted much attention. Among them, the problem of high concentration of China's soybean imports has become increasingly prominent. As shown in Table 1, China's soybeans are mainly imported from Brazil, the United States, and Argentina, and the cumulative proportion of the top three import sources has exceeded 95% over the years. The excessive concentration of import sources aggravates the impact of changes in the external environment on imports, and increases the impact of domestic market prices and supply fluctuations in a few countries, which is prone to the risk of supply interruption, and not conducive to the sustainable and stable development of imports. It easily leads to the lack of pricing power for importers, which directly affects import costs [3-4].

Table 1 China's soybean imports from 2000 to 2020 (10,000 tons、%)

Year	Import Volume	Top three importing countries	Market Share
2000	1041.9	USA, Argentina, Brazil	99.0
2005	2659.0	USA, Brazil, Argentina	99.3
2010	5479.8	USA, Brazil, Argentina	97.4
2015	8169.0	Brazil, USA, Argentina	95.4
2020	10032.7	Brazil, USA, Argentina	97.3
Average	5546.9	Brazil, USA, Argentina	97.8

Source: UN Comtrade

In response to the above situation, scholars proposed to diversify imports to diversify the risk of excessive concentration of trading partners and ensure national food security. They suggested that countries with high production potential, high yield stability, and low political risks should be the priority sources for increasing soybean imports [5-6]. On this basis, some experts have considered the impact of regional and seasonal differences in import sources, shipping costs and security, and national relations on the choice of import sources [7-8].

To sum up, there are many studies on the import risk of soybean and other agricultural products and the factors affecting the distribution of import sources in the existing literature, but few specific analyses on how to choose the import source path to reduce the import risk. Most of the research focuses on energy products such as crude oil, natural gas, and coal [9-11]. Therefore, this paper will analyze the choice of diversification of China's soybean import sources from the new perspective of import risk minimization, and formulate a quantitative optimal strategy for China's soybean import, in order to enrich and expand the research on the diversification of grain imports, and also for China In the "14th Five-Year Plan" period, the implementation of the import diversification strategy and the guarantee of domestic soybean supply and food security provide a reference basis.

2. Model and data

Referring to the research on the diversification of crude oil imports [11-12] and considering the influencing factors of soybean import risks at various stages, the import risk of soybeans is quantified as the import concentration index, the political risk index of the supplying country, the proportion of soybean imports to the soybean output of the import source country in the year, and the volatility of soybean import prices. By minimizing the soybean import risk index (Z), the optimal quantity plan of China's soybean import source structure is obtained. The model is as follows:

$$\min_{m_i} Z = \sum_i \left[\left(\frac{m_i}{M} \right)^2 \times r_i \times \left(\frac{m_i}{Me_i} \right) \times PV_i \right] \quad (1)$$

$$\text{s. t. } M + Q + BS - ES \geq D \quad (2)$$

$$0 \leq m_i \leq Me_i \quad (3)$$

m_i represents the quantity of soybeans imported by China from importing country i ; M represents the total amount of soybean imports and consumption in China; r_i represents the political risk index of soybean supplier country i ; Me_i represents the total soybean output of import source country i ; and PV_i represents the price volatility of soybean imported from country i ; Ne_i represents the total soybean export volume of country i . Q , BS , ES , and D represent China's total domestic soybean production, beginning inventory, ending inventory, and consumption, respectively.

In formula (1), $\sum_i (m_i/M)^2$ is used to measure the import concentration of soybeans, namely the Herfindahl-Hirschman index. r_i is measured according to the Political Risk Rating (Political Risk Rating) in the International Country Risk Assessment Index (ICRG) system issued by the PRS

(Political Risk Service) Group, and is converted in this model: $r_i = 100 - PR$. The smaller the converted r_i value, the smaller the political risk of a country. $\frac{m_i}{Me_i}$ represents the soybean export volume of soybean supplier i to China as a percentage of the country's soybean production in that year. $r_i \cdot \frac{m_i}{Me_i}$ stands for the Sustained Availability Index (SAI), and a smaller index indicates less supply risk to soybean exporting countries. PV_i represents the volatility of soybean export prices from countries to China, which is a measure of the country's price volatility risk. Equation (2) and Equation (3) are both constraints. The former indicates that the actual supply of soybeans should meet the domestic soybean demand and adapt to the current production capacity, while the latter means that China's soybean imports from import source country i do not exceed the total soybean exports from import source country i . In this paper, the GAMS software is used to solve the nonlinear programming model and carry out the optimization analysis.

Considering the timeliness and availability of data, this paper takes China's soybean imports in 2000 and 2020 as the research object. The relevant data of import source countries (m_i 、 M 、 PV_i 、 Me_i 、 Ne_i) come from FAO and UN Comtrade. China's soybean production (Q), consumption (D), beginning stocks (BS), and ending stocks (ES) are all from the Breck Agricultural Database.

3. Results

This paper uses the import data of China's soybeans in 2000 and 2020 to analyze China's soybean import strategy and import risks. It can be seen from Table 2 and Table 3 that over the past 20 years, China's soybean imports have expanded rapidly, from 10.419 million tons in 2000 to 100.305 million tons in 2020. The actual import risk has increased significantly, and the actual import risk in 2020 is about 12.6 times that of 2000. If soybeans are imported according to the calculated optimization strategy, the optimal import volume in 2001 and 2020 can be lower than the actual import volume, and the actual import risk value can be reduced by 26.7% and 33.3% respectively. It can be seen that in the case of meeting the demand for soybeans in my country, the import quantity of soybeans should be appropriately reduced to reduce the import risk.

In terms of different countries, China's soybean import sources have gradually shown a trend of diversification, and the number of major import source countries has increased from 5 in 2000 to 8 in 2020. China's soybean import risks mainly come from the United States, Brazil and Argentina. Among them, Argentina has limited import potential, and the optimal import volume in 2000 and 2020 is lower than the actual import volume. The actual import volume of the United States ranked first in 2000, but it has been overtaken by Brazil in 2020, and the gap between the actual import volume between the two countries continues to widen. Based on the optimization results, it can be seen that in 2000, the United States was the preferred country in China's optimal soybean import structure, and its import potential should not be underestimated. In 2020, although the optimal import volume of the United States is lower than that of Brazil, it is higher than its actual import volume, and the optimal import volume of Brazil is lower than the actual import volume. This means that despite political factors such as Sino-US trade frictions in recent years, China has turned its attention to Brazil in order to reduce its dependence on US soybean imports. However, the imbalance in the distribution of import quantities to the United States and Brazil has led to a rapid increase in the risk of my country's soybean imports. Based on a comprehensive review of various import risks, the United States still has import potential, and should moderately release the space for importing soybeans from the United States, and reduce the import volume of soybeans from Brazil accordingly. Except for the United States, Brazil, and Argentina, from 2001 to 2020, other import source countries have a large space for import expansion. Among them, Canada and Russia are particularly significant. The optimal import volumes of the two countries have risen from 481,000 tons and 46,000 tons in 2000 to 4.434 million tons and 1.196 million tons in 2020, with an average annual growth rate of 11.7%, 17.7%. In addition, new import source countries such as Ukraine and Uruguay can also diversify soybean import risks to a certain extent.

Table 2 Optimization results of China's soybean imports in 2000

Country	Actual Import Volume (10,000 tons)	Optimal Import Volume (10,000 tons)	Difference (10,000 tons)	Actual Value at Risk	Optimal Value at Risk
U.S.A	541.38	629.14	87.76	0.00624122	0.00979515
Argentina	278.43	223.14	-55.30	0.00674958	0.00347401
Brazil	211.95	129.16	-82.80	0.00888692	0.00201084
Canada	5.72	48.12	42.40	0.00000126	0.00074919
Russia	4.37	4.58	0.21	0.00000241	0.00000278
Total	1041.86	1034.14	-7.72	0.02188140	0.01603197

Table 3 Optimization results of China's soybean imports in 2020

Country	Actual Import Volume (10,000 tons)	Optimal Import Volume (10,000 tons)	Difference (10,000 tons)	Actual Value at Risk	Optimal Value at Risk
Brazil	6427.76	4667.63	-1760.13	0.24936801	0.09548843
U.S.A	2588.76	3724.50	1135.74	0.02558550	0.07619430
Argentina	745.57	635.98	-109.59	0.00136383	0.00084650
Uruguay	165.66	215.23	49.57	0.00030248	0.00066337
Russia	69.32	119.59	50.27	0.00002640	0.00013554
Canada	24.53	443.40	418.87	0.00000126	0.00745998
Ukraine	6.51	177.06	170.55	0.00000018	0.00362231
Ethiopia	2.43	6.62	4.19	0.00000001	0.00000018
Total	10030.53	9990.00	-40.53	0.27664766	0.18441061

Note: Difference = Optimal Import Volume - Actual Import Volume.

4. Conclusions

According to the above analysis results, there is a lot of room for optimization in the layout of China's soybean import sources. According to the actual demand for soybeans in China and the comprehensive import risks of each import source country, a scientific and reasonable diversification import plan should be formulated; On the basis of the import volume of soybeans in Brazil, it is necessary to moderately explore the market potential of soybeans in Argentina, and take Canada, Russia, Uruguay and other countries as soybean importing partners that focus on in the future, so as to optimize the soybean import market structure and minimize import risks to provide effective solution and solid support for maintaining a stable supply of soybeans and ensuring the safety of soybean imports.

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References

- [1] Ma Xiaohe, Huang Bei. How much of the world's agricultural resources is being utilized by my country today [J]. Issues in Agricultural Economics, 2012, 33(12): 4-10+110.
- [2] Lin Dayan, Zhu Jing, Wu Guosong. Does Seasonal Factors Affect my country's Soybean Import Market Pattern——Theoretical Analysis and Empirical Test Based on Extended H-O Model[J]. International Trade Issues, 2014(03): 44-51
- [3] Bian Jing. Main risks and countermeasures facing China's food security in the next 15 years [J]. Economics, 2019(05): 119-128.
- [4] Wei Hao, Zhang Wenqian. Multidimensional Imports and China's Regional Economic Growth [J]. Economics and Management Research, 2020, 41(09): 29-46.
- [5] Li Guoxiang. The impact of Sino-US economic and trade friction on China's agriculture [J]. Dongyue Lun Cong, 2020, 41(04): 17-25.
- [6] Zhou Shudong, Zhao Mingzheng, Chen Kang, Xiao Xiao. Analysis of the Grain Production Potential of the World's Major Grain Exporting Countries[J]. Agricultural Economic Issues, 2015, 36(06): 91-104+112.
- [7] Lin Dayan, Zhu Jing, Zhang Shu, Wu Guosong. An Empirical Analysis of the Reasons for the Fluctuation and Decline of China's Soybean Imports from the Perspective of Origin Layout[J]. International Trade Issues, 2015(03): 108-117.
- [8] Sun Hongxia, Zhao Yuxin. Research on the Optimization of my country's Transnational Grain Supply Chain Based on Crisis Response [J]. The Economist, 2020 (12): 107-115.
- [9] Xiucheng Dong, Zhaoyang Kong. The impact of China's natural gas import risks on the national economy [J]. Journal of Natural Gas Science and Engineering, 2016, 36.
- [10] Zhang Huiqing. Quantitative Assessment of China's Iron Ore Import Risk——Also on the Effectiveness of Import Diversification Strategy [J]. International Economic and Trade Exploration, 2014, 30(01): 44-56.
- [11] Qi Ming, Marco Opazo Basaez, Fan Shuqi. A Diversified Analysis of China's Future Crude Oil Imports [J]. Resource Science, 2014, 36(03): 512-519.
- [12] Qi Ming, Guo Haitao, Zhao Jing. Research on the diversification path of crude oil import considering price factors[J]. Technical Economy, 2020, 39(01): 74-81+88.