

Feasibility Study on the Establishment of a Futures Market for Aquatic Products in China

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Abstract: A total of ten samples of seven listed futures products, two unlisted agricultural products and aquatic products are selected to compare aquatic products with other agricultural products using factor analysis. A comprehensive and objective analysis of the establishment of the Chinese aquatic products futures market is carried out. From the results of the analysis, the feasibility of listing Chinese aquatic products futures ranked 5th among the ten products. The majority of these ten products are listed futures products, and the rest are not listed products with high demand in actual daily life, indicating that aquatic products have the feasibility of listing. Although the feasibility of listing aquatic products futures in China, there are still many unfavourable factors hindering the listing of aquatic products futures, and this paper puts forward relevant policy recommendations for the relevant unfavourable factors in order to help promote the listing and trading of aquatic products futures.

Keywords: Aquatic Products; Futures; Feasibility; Factor Analysis

1. Introductory

China's total fish production has been the world's largest since 1989. In 2020, China's aquaculture species will reach more than 300, and the annual per capita availability of farmed aquatic products will be 37 kg, which is two times higher than the world's average level. About 1/4 of China's national consumption of animal protein is derived from farmed aquatic products, and continues to grow [1-2]. The total production of farmed aquatic products is expected to increase by 2020, with a total annual per capita availability of 37 kg^[3].

However, in recent years, the prices of some aquatic products have often fluctuated greatly, experiencing multiple cycles of ups and downs, and showing the phenomenon of ups and downs^[4]. For example, the lowest price of grass carp in Jiangsu Suzhou Nanhuan Market 2022 was 14.02 yuan/kg (week 3), while the highest price of the year was 23.78/kg (week 26), an increase of 69.61 per cent, followed by a fall of 39.36 per cent to 14.42 yuan/kg (week 52). Kunming Huachao Aquatic Products Wholesale Market data show that the price of grass carp from the year's lowest week 8 13.33 yuan / kg, to the highest price of 24.45 yuan / kg in the 21st week, an increase of up to 83.8%. To the last week the price fell to 17.00 yuan / kg, down 30.47%. According to Xiamen's main aquatic products price data yellowtail prices from the highest price in the 21st week of 40.00 yuan / kg, to the lowest price in the 25th week of 25.57 / kg, a drop of 36.08%. To the last week the price rose to 28.00 yuan / kg, an increase of 9.5%. Kunming Huachao Aquatic Products Wholesale Market data show that the price of yellow croaker from the year's lowest 37 weeks 43.57 yuan / kg, to the highest price of 51 weeks 69.29 yuan / kg, an increase of 59.03%. To the last week the price fell to 51.00 yuan / kg, down 26.4%. The price of aquatic products directly affects the fishermen's income and the willingness of residents to consume aquatic products, aquatic products prices frequently and drastically fluctuations will not only affect the smooth operation of the aquatic products market will also be a hindrance to the sustained and healthy development of the fisheries industry. How to reduce the price fluctuations of aquatic products to stabilise prices has become a crucial research issue.

It is well known that the price of spot market has the characteristics of lagging, easy to fluctuate and so on. Although the network information can make up for the impact of price fluctuations in a timely manner, but analysed from a national perspective, the price of aquatic products around there is still a large amount of information asymmetry phenomenon, hindering the healthy circulation of aquatic products trading, reducing the efficiency of resource allocation, affecting the development of the industry. Futures trading method is based on improving the efficiency of resource allocation, can effectively reduce price fluctuations.

The establishment of the aquatic products futures market mechanism is an inevitable requirement of market development, which is conducive to price discovery and hedging in the aquatic products market. The futures price is the expectation of supply and demand and price

trend for a certain time in the future, increasing the transparency of the market^[5]. Aquatic practitioners can also play a role in avoiding risks by hedging.

The significance of the establishment of aquatic products futures trading market mechanism is that it is conducive to aquatic practitioners through the futures price discovery function of production guidance; conducive to the control of costs and profits in aquatic production and operation; conducive to the use of futures trading hedging, risk avoidance; conducive to the scientific deployment of warehousing and logistics resources; conducive to the opening up of the aquatic industry investment channels, to adapt to a diversity of motives, trading motives and interests It is conducive to the development of aquatic products preservation technology; it is conducive to the promotion of the stability of the price system, including reducing the price risk of speculators and improving the liquidity of the market.

2. Research methodology and data sources

2.1 Factor Analysis

Factor analysis was initially used by the British psychologist C.E. Spearman in 1904 for the statistical analysis of intelligence test scores. Factor analysis is now widely used in psychology, medicine, meteorology, geology, economics and other fields, greatly broadening the field of application and contributing to the improvement and development of many subject areas. The principle of factor analysis is to extract multiple variables into a small number of composite indicators named by factors in a complex data system, to keep the loss of information to a minimum, thus greatly reducing the computational load, and the factors can be named and interpreted through the analysis. The naming and interpretation of factors helps to further explain and evaluate the results of factor analysis and give meaningful results for practical problems.

The core idea is to reflect most of the information of the original variables by extracting the factors by commonality, as shown in the following formula, set a total of n variables as X1, X2, X3, ..., Xn, and there is a strong correlation information between the variables, and the basic factor model can then be expressed as:

$$\begin{cases} X_1 = \alpha_{11} f_1 + \alpha_{12} f_2 + \alpha_{13} f_3 + \dots + \alpha_{1m} f_m + \varepsilon_1 \\ X_2 = \alpha_{21} f_1 + \alpha_{22} f_2 + \alpha_{23} f_3 + \dots + \alpha_{2m} f_m + \varepsilon_2 \\ X_3 = \alpha_{31} f_1 + \alpha_{32} f_2 + \alpha_{33} f_3 + \dots + \alpha_{3m} f_m + \varepsilon_3 \\ \dots \\ X_n = \alpha_{n1} f_1 + \alpha_{n2} f_2 + \alpha_{n3} f_3 + \dots + \alpha_{nm} f_m + \varepsilon_n \end{cases} \quad \text{Formulas(1)}$$

where $f_1, f_2, f_3, \dots, f_m$ are common factors and $m > n$, and A is the loading matrix of the factors. α_{ij} is the factor loadings where ($i = 1, 2, 3, \dots, n; j = 1, 2, 3, \dots, m$), interpreted as the loadings of the i th original variable on the j th factor. ε is the special factor, which indicates the unexplained part of the variable, and its mean value is 0, which is equivalent to the residual in linear regression^[6].

2.2 Factor Selection and Data Sources

This paper is mainly based on the new varieties of futures listing conditions to the selection of relevant indicators, as follows:

1. Large market supply and demand. The spot market is the foundation of the futures market, and a large spot market is an important factor for the establishment of the futures market. Therefore, this paper selects the total amount of agricultural products, aquatic products and per capita consumption to measure the level of supply and demand in the spot market.

2. Large price fluctuations. When a commodity price fluctuations are large and more frequent, if the commodity has been listed and traded in the futures market, then the production of practitioners can be hedged through the futures market to reduce the market risk and thus protect their rights and interests, this paper selects the standard deviation of price fluctuations in agricultural products, aquatic products during the period of investigation and aquatic products and agricultural products and the consumer price index of the residents of the index to measure.

3. Easy grading and standardisation. New futures varieties listed on the basis of the underlying material is easy to classify and standardise, no standardised contracts will lead to physical delivery in the futures trading process can not be completed successfully. Due to grad-

ing and standardisation is not very good quantitative, so this paper selects the production process unit mechanisation costs for grading and standardisation of measurement.

4. Easy to store and transport. The underlying futures contracts are easy to store and transport is to maintain the quality of futures products, to protect the rights and interests of buyers and sellers in futures trading, so as to achieve the smooth progress of physical delivery of the guarantee. In this paper, the capacity of delivery warehouse is chosen to measure it.

In this paper, 6 variables are selected from the 4 conditions of the new futures market, and then with the help of factor analysis, aquatic products are compared with other 9 kinds of agricultural products, and finally the feasibility of the establishment of China's aquatic products futures market is evaluated objectively and comprehensively. The feasibility variables are shown in Table 1:

Table 1 Feasibility Analysis Variables

Variables	Variable Meaning	Properties of Variables
X^1	Price standard deviation	Positivity indicators
X^2	Production	Positivity Indicators
X^3	Per capita consumption	Positivity Indicators
X^4	Delivery warehouse capacity	Positivity indicators
X^5	Consumption index	Positivity Indicators
X^6	Machinery operating costs	Positivity Indicators

The standard deviation of price fluctuations in the feasibility analysis variables is the annual standard deviation of prices from 2013-2022, and the data were obtained from the official website of the National Bureau of Statistics of China and the China Agricultural Products Price Survey Yearbook. The data on production were obtained from the China Agricultural and Fishery Statistics Yearbook, the official website of the Ministry of Agriculture and Rural Development, and the official website of the National Bureau of Statistics. For listed futures products, the capacity of delivery warehouses in the futures market is adopted, and the data are obtained from the official websites of Zhengzhou Commodity Exchange (ZCE) and Dalian Commodity Exchange (DME); Those that are not listed are quantified by the cold storage warehouses for farmed agricultural products, with data from the official website of the Ministry of Commerce and the China Cold Chain Logistics Development Report. The consumer price index and per capita consumption are from the official website of the National Bureau of Statistics of China. Mechanical operation costs are expressed in terms of mechanical operation costs per mu of production for planted agricultural products, and in terms of fuel and power costs and feed processing costs per unit of production for farmed products, and in terms of fuel and power costs and feed processing costs per unit of production for eggs during the egg-laying process, with data from the official website of the Ministry of Agriculture and Rural Development of China and from the China Agricultural Product Costs and Benefits Information Compendium.

3. Process of factor analysis

3.1 Data preprocessing

Since different indicators have different scales and are not comparable, the raw data need to be table transformed and processed to eliminate the effect of scales before factor analysis. The standardised processing formula is as follows:

$$Z_i = \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad \text{Formulas(2)}$$

Where X_i raw data and Z_i is normalised data.

3.2 Adaptation analysis

Before conducting the factor analysis, Bartlett's test of sphericity was performed on the variables to determine the Sig and KOM values, and the results are shown in Table 2.

Table 2 KMO and Bartlett's test

Sampling sufficient Kaiser-Meyer-Olkin metrics		0.605
Bartlett's test of sphericity	approximate chi-square	50.373
	df	15
	Sig.	0.000

As can be seen from Table 2, the KMO value is 0.605, which is greater than the critical value of 0.6, suitable for factor analysis; Bartlett's test of sphericity shows that the P-value is less than 0.05, which indicates that the indicators selected in this paper are suitable for factor analysis.

3.3 Common divisor extraction

In this paper, the factors are extracted using principal component analysis and the eigenvalues greater than 1 are selected. Table 3 shows the initial solution of factor analysis, the first column shows the commonality of the variables under the initial solution of factor analysis, which are the eigenroots extracted by principal component method for the original six variables, and the commonality of the original variables under the initial solution is 1. The second column shows the commonality when extracting the eigenroots under the eigenroots greater than 1. The commonality of each original variable is higher, the loss of information of each variable is less, and the overall effect of factor extraction is better.

The number of common factors is generally determined according to the cumulative variance contribution rate of the factors, and the number of eigenroots when the cumulative variance contribution rate is greater than 85% is selected as the number of factors. As can be seen from Table 4, the first two common factors explain 87.752% of the total variance, indicating that the two extracted common factors can represent 87.752% of the original six indicators, which shows that there is less loss of information in the data, and it can explain the initial data better, so the two common factors Y1 and Y2 are extracted.

Table 3 Factor Analysis Initial Solutions

Variable	Starting (point)	Withdraw
Price standard deviation	1.000	0.926
Production	1.000	0.986
Per capita consumption	1.000	0.991
Delivery warehouse capacity	1.000	0.697
Consumption index	1.000	0.890
Machinery operating costs	1.000	0.776

Table 4 Total Variance Explained

Ingredient	Initial eigenvalue			Extract the sum of squares and load		
	Total	Variance%	Accumulate%	Total	Variance%	Accumulate%
1	3.834	63.903	63.903	3.834	63.903	63.903
2	1.431	23.850	87.752	1.431	23.850	87.752
3	0.515	8.576	96.328			
4	0.154	2.573	98.901			
5	0.054	0.898	99.799			
6	0.012	0.201	100.00			

3.4 Factor loading

The main purpose of factor analysis is to better explain the actual significance of each common factor, when the factor loading value is close to 0 or ± 1 , the explanation is better, but from Table 5, it can be seen that the distribution of factor loading is still not uniform, so it is necessary to carry out factor rotation.

Table 5 Factor Load Matrix

	Ingredient	
	1	2
Price standard deviation	0.935	0.224
Production	0.878	0.345
Per capita consumption	0.805	0.223
Delivery warehouse capacity	0.803	0.362
Consumption index	-0.651	0.750
Machinery operating costs	-0.687	0.720

In this study, the maximum variance method was used to perform orthogonal rotation of the factor loading matrices, and the rotation in the rotation has converged after three iterations. The results are shown in Tables 6 below.

Table 6 Rotated Factor Loading Matrix

	Ingredient	
	1	2
Price standard deviation	0.931	-0.153
Production	0.919	-0.286
Per capita consumption	0.875	-0.100
Delivery warehouse capacity	0.805	-0.220
Consumption index	-0.176	0.977
Machinery operating costs	-0.222	0.970

3.5 Factor explanation

According to Table 6, the common factor 1 has a large loading on price standard deviation, production, per capita consumption and delivery warehouse capacity, the common point of the two indicators of production and delivery warehouse capacity is that they can represent the supply of the market to a certain extent, and the standard deviation of price and the standard deviation of price can represent the demand of the market, so the common factor 1 can be defined as a supply and demand factor. Common factor 2 has a larger load on residential consumption and machinery operating costs, these two indicators can represent the price level of the market to a certain extent, it can be grouped into a category, defined as the price factor.

3.6 Factor score

The factor score coefficient matrix was calculated and the results are shown in Table 7.

Table 7 Factor Score Coefficient Matrix

	Ingredient	
	1	2
Price standard deviation	0.290	0.010
Production	0.122	0.537
Per capita consumption	0.103	0.524
Delivery warehouse capacity	0.260	0.027
Consumption index	0.320	0.090
Machinery operating costs	0.309	0.110

Based on the matrix of factor score coefficients, a factor score function is established as follows:

$$Y_1 = 0.290X_1 + 0.122X_2 + 0.103X_3 + 0.260X_4 + 0.320X_5 + 0.309X_6 \quad \text{Formulas(3)}$$

$$Y_2 = 0.010X_1 + 0.537X_2 + 0.524X_3 + 0.027X_4 + 0.090X_5 + 0.110X_6 \quad \text{Formulas(4)}$$

The variable data for each of the 10 products are substituted into the above formula to calculate the scores of each factor for each prod-

uct, and the scores are shown in Table 8 below.

Table 8 Factor Score Coefficient Matrix

Varieties	Y1	Y1Rankings	Varieties	Y2	Y2Rankings
Cattle	1.99	1	Maize	2.5	1
Pig	1.19	2	Wheat	0.84	2
Sheep	0.72	3	Aquatic products	0.64	3
Aquatic products	-0.1	4	Swine	0.05	4
Maize	-0.2	5	Apples	-0.18	5
Wheat	-0.26	6	Cattle	-0.3	6
Cotton	-0.56	7	Eggs	-0.57	7
Soya	-0.67	8	Soya	-0.63	8
Apples	-1.01	9	Sheep	-0.65	9
Eggs	-1.1	10	Cotton	-0.84	10

3.7 Comprehensive Score and Ranking of Feasibility of Listing Fish Futures

In order to accurately analyse the possibility of listing aquatic products futures, this paper adopts the variance contribution rate of the two main factors as the weights to establish the factor weighting equation, so as to obtain the formula for calculating the composite score, as shown below.

$$Y = \frac{0.63903}{0.87752} Y_1 + \frac{0.23850}{0.87752} Y_2 \quad \text{Formulas (5)}$$

Table 9 Composite Score and Ranking

Varieties	Aggregate Score	Overall Ranking
Cattle	1.37	1
Pig	0.88	2
Corn	0.53	3
Sheep	0.35	4
Aquatic products	0.1	5
Wheat	0.04	6
Cotton	-0.64	7
Soya	-0.66	8
Apples	-0.78	9
Eggs	-0.96	10

3.8 Analysis of empirical results

From the comprehensive score of China's aquatic products futures listing feasibility in the 10 agricultural products ranked 5th, of which the supply and demand factor ranked 4th, the market factor ranked 3rd. ranked first cattle, hogs as a listed futures products, in real life demand and price fluctuations are also larger, in this paper analyses the total comprehensive rankings in the 2nd, is in line with the objective situation. The two public factors are specifically analysed as follows:

From the Y1 supply and demand factor, ranked in front of aquatic products are pigs, cattle and sheep, in daily life, the price fluctuations of these three products as well as per capita consumption are relatively large, and each other as substitutes. From the Y2 point of view, aquatic products ranked third, the top two corn and wheat as a traditional food crops, and more extensive use, and a higher degree of scale so from the rankings of the more advanced.

4. Conclusions and recommendations

4.1 Conclusion

In the comparative analysis of listed aquatic products futures using factor analysis, the feasibility of listing Chinese aquatic products futures ranked 5th among the ten products selected in this paper according to the final comprehensive ranking. The other nine agricultural products selected for comparison, the vast majority of listed futures products, the rest are not listed in the actual daily life of products with high demand. Therefore, through the above research, this paper believes that aquatic products futures have the feasibility of listing. Although this paper through the study that China's aquatic products futures listed with the feasibility, but in the process of reality there are still many unfavourable factors will hinder the smooth listing of aquatic products futures, including the current Chinese futures market related legal system has not yet been perfected as well as new species of futures listed on the mechanism to be reformed; there are also aquatic products in the spot market is not too perfect, the lack of futures listed in the guidance of the production operators to enter the futures market for trading. There are also problems such as the spot market for aquatic products is not perfect and there is a lack of professional fishery organisations that can guide producers and operators to enter the futures market for trading after futures are listed. If these problems can be successfully solved, it will be a great help to the listing and trading of Chinese fishery products futures.

4.2 Responses and recommendations

According to the research of this paper, combining the Chinese futures market with the status quo of the Chinese aquatic products spot market and related research, the following countermeasures are proposed to enhance the feasibility of the establishment of China's aquatic products futures market:

(1) Improve the aquatic products spot market. A perfect spot market is the basis for the successful establishment of the futures market. A perfect market can provide open, transparent and symmetrical market information for participants in futures trading to judge the market price trend. At the same time to provide a fair and non-monopolistic and non-manipulative market environment, which can ensure the fairness of trading participants in the futures trading process and the smooth progress of physical delivery. Improve the aquatic products spot market, in addition to the need to increase investment in all aspects of production for the supply of aquatic products and physical delivery to provide protection, but also need to speed up the establishment of a national or regional aquatic products wholesale market and the establishment of a national aquatic products market information dissemination platform, and actively build the information platform for the aquatic products market, for different varieties of choice to cover the price, production, circulation, processing and trade and other industries. The information platform covering price, production, circulation, processing and trade and other industrial links to provide fair and symmetrical price information to ensure the smooth operation of the futures trading market. Finally, China also needs to continue to improve the aquatic products logistics system, and constantly improve the service level of aquatic products logistics. Logistics points can be set up directly in the production of aquatic products, in order to improve the speed of its delivery; should also specialise in aquatic products logistics courier for professional training, so that it can master the aquatic products fresh and alive, packaging and transport expertise.

(2) Improve the scale of aquaculture. China in recent years, the total amount of aquatic products and exports are ranked first in the world, is a real aquaculture country. However, from the current scale of aquaculture in China, China's large-scale aquaculture production and management is relatively small, mainly fishermen as the basic unit of production and management, such a status quo to a certain extent on the listing of aquatic products futures to form an obstacle. Improve the scale of aquaculture, play a leading role in the moderate operation of agriculture, scientific planning of the scale of the industry, which in turn improves the operational efficiency of the entire supply chain of the aquaculture industry, and accelerates the pace of the listing of aquatic products futures.

(3) Accelerate the construction of fishery specialised cooperative organisations. The establishment of fishery co-operative organisations can play a positive role in the production and operation of aquatic products, disease prevention and control as well as circulation of fishermen as the basic production unit of production operators, not only to improve the scale of production, but also to effectively improve the produc-

er's market premium ability, improve the producer's disadvantaged position in the market, and to promote the benign development of aquatic industry. Not only that, after the listing of aquatic products futures, cooperative organisations can improve the enthusiasm of production operators to enter the futures market through effective publicity, which will help the producers to rationally adjust their production and operation through the use of the futures market function, so as to diversify a series of market risks brought about by price fluctuations. A series of documents and policies issued by the state are constantly strengthening the basic position of agriculture, and the efforts to support and benefit agriculture are also increasing, and agricultural insurance is one of the important components. The promotion and development of fishery insurance in China has been slow, resulting in a small coverage of fishery insurance. The government should accelerate the development of fishery insurance with insurance companies to ensure that producers can use fishery insurance to avoid the market, disasters and epidemics to bring risks, while fish futures listed producers can also choose the "insurance + futures" way to reduce risk. This will stabilise the market supply and provide protection for the physical delivery of aquatic products after the listing of aquatic products futures.

(4) Accelerate the development and improvement of China's futures market. According to the current situation of China's futures market, first of all, the futures exchanges should accelerate the optimisation of the structure of futures varieties, and increase the development of new varieties of futures, and accelerate the speed of the listing of products whose conditions are ripe for listing and trading. Secondly, they should strengthen the order of the futures market, accelerate the popularisation of the Futures Law and other relevant laws and regulations, and improve the market regulatory mechanism. Finally, since China's current mechanism for listing and trading new futures varieties is a time-consuming and inefficient approval system, which largely restricts China's ability to develop new futures varieties, it can learn from the relevant systems for listing new futures varieties in foreign countries, and combine them with China's actual situation to accelerate the reform of the mechanism for listing new varieties, delegate the initiative to the exchanges, and improve new varieties, so as to improve the efficiency of listing new futures varieties. The efficiency of listing new varieties of futures can be improved by delegating the initiative to the exchanges and improving the new varieties.

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