Empirical research on food industrial security of China

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Abstract. The paper studies the industrial chain and the food security of China. It constructs an index system for estimating the food security of China during the period of 2006-2015. The empirical result indicates that during that time the condition of China's food industry develops from basic security to insecurity. After 2009, the security degree gradually exacerbated year by year. The industrial competition and industrial development circumstance are the key elements that affecting food industry security. The key factors are mainly the proportion of the specialized middle school and above years of schooling population in rural family, average per person cultivated area, competitive advantage index, production concentration degree, industrial world market share, agricultural scientific research input and production concentration degree. Therefore, to ensure food industry security, the government policy should be based on these factors.

1 Introduction

The conception of the food security was put forward first time by United Nations' Food and Agricultural Organization in 1970s. Most definitions on food security vary around World Bank. However, Mr. Brown (1997), an American scholar, won a strong influence about the food security by putting forward the theory "Who will feed China?" Overall, a bulk of the scholar thought food reserve as a kind of important strategic material of the state in the past time. A Chinese scholar Peng Gong (2011) pointed out that Mr. Brown overestimated the food gap of China and China needs no foreign help to feed itself. He put forward that even though food output quadrupled from 1950 to 2010, China still faced many challenges. But he is optimistic about food security of China and he believed that it is not a matter of whether China can feed itself, it is a matter of whether the Chinese people will choose to do so.

From the perspective of research method, Junichi Ito, Jing Ni (2013) researched the effects on China's food security that food production and land use policy have using a separate Cobb–Douglas (SCD) production function. It indicates that the attainment of a 95% self-sufficiency rate would be quite challenging for China, unless the terms of trade in agriculture improve substantially in favour of producers. Food security is a high priority issue on the Chinese political agenda. China's food security is challenged by several economical, socio-political, resource factors, including: population growth, urbanization and industrialization, land use changes, water scarcity, income growth and change of international food markets.

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Many scholars defined the food security from an angle of a balance between supply and demand, and emphasized the state's supply capability of food, the individual obtainable capability of food and the security of individual nutrition as the most important factors. These articles argue that the basic and precondition for eliminating the risk of family and individual's food insecurity are to relieve the risk of macroscopic food insecurity and enhance the states' obtainable of food. Therefore, the key factors to food security are shifted to the producing and circulating of food, so that food industry which covers food production and circulating should be contained in the scope of the food security research. While a systematic model for estimate and evaluate food industry security is still absence.

2 An index system for estimating food industry security

In order to measure the food industry security, we need to quantify the quantification index of industry operation which represents the security situation. Considering the complexity of food security, it is inaccuracy to measure the food industrial security only by one equation. So we try to synthetically take various factors into the measurement of the industry security. There are both internal and external causes which affect the situation of the industrial security. The internal causes contain international industrial competition and industrial development circumstance. The external causes are the factors that affect industry security in foreign trade. These factors interact with each other simultaneity to determine the situation of food industry security.

According to systematization, relevance, measurability and controllability principle, the paper constructs an index system for estimating the food industry security by synthetically referencing the research findings of the estimation index of food industry security we already have. (As shown in table 1)

Table 1. An index system for estimating the food industry security and an explanation the index

Estimation subject	Name of index	Meaning of the index
industrial development circumstance	Capital cost	Reflects collection and use capital price
	The proportion of the specialized middle school and above years of schooling population in rural family	Reflects the quality of agricultural labor
	Average per person hourly pay of agricultural labor	Reflects the cost of agricultural labor
	Average per person cultivated area	reflects land element condition
	Effective irrigated area in the unit cultivated area	Reflects the level of farmland irrigation
	Food demand rate of increment	Reflects the promoting effect to production owing to food demand
	Food commodity rate	Reflects the food marketability degree
	Food reserves rate	Reflects the ability of resisting the food supply and demand unbalanced risk
industrial competition	Industrial world market share	Reflects the competition condition of the industry in the world market
	Industrial domestic market share	Reflects the competition condition of the industry in the domestic market
	Competitive advantage index	Reflects the competitive advantage of food industry
	Agricultural scientific research input	Reflects the agriculture science and technology input condition
	Labor productivity	Reflects the input-output benefits of

		the factors of labor force
	Land productivity	Reflects the input-output benefits of the factors of land
	Production concentration degree	Reflects the formalization degree of food production
Industrial foreign interdependence	Industrial import foreign interdependence	Reflects the influence size to the industry from transnational factors
	Industrial export foreign interdependence	Reflects the influence size to the industry from transnational factors
	Food degree of self-sufficiency	Reflected the ability that food production satisfies the domestic demand

3 The empirical analysis of food industry security

For the empirical analysis of food industry security, we make reference of the research methods of economics security and economics early warning system, and divide the whole index system into three parts: construction of the index, early warning system and synthesis estimation. For constructing an index, we first establish a set of monitor indicator system which is able to sensitively reflect the industry security status. The mainly use of early warning system is to determine the warning boundary of various indexes and divided security status by warning limits. Synthesis estimation mainly designates the data processing method and calculates both the running status of index and the corresponding security ranking. After establishing the index system for estimating, the following step is to determine the warning limits and the security ranking.

3.1 Establish the warning limits of indexes

The statistical data used in our warning system are from “China statistical yearbook” and “The Chinese rural statistical yearbook”. We calculate the security status warning scope according to various index data, including overseas index of correlation’s data and world average, further based on broad survey and expert grading, the results are shown in table 2.

Table 2. The warning limits of food industry index at different security states

Index	Security state			
	Safe	Almost safe	Unsafe	Crisis
Capital cost (%)	0～7	7～10	10～15	Above 15
The proportion of the specialized middle school and above years of schooling population in rural family (%)	Above 30	18～30	6～18	Following 6
Average per person hourly pay of agricultural labor (RMB/ person*hour)	Following 10	10～50	50～100	Above 100
Average per person cultivated area (hectare/person)	Above 0.8	0.5～0.8	0.2～0.5	Following 0.2
Effective irrigated area in the unit cultivated area (%)	Above 35	20～35	5～20	Following 5
Food demand rate of increment (%)	3～10	0～3 or 10～13	－3～0 or 13～16	Following-3 or above 16
Food commodity rate (%)	Above 60	30～60	10～30	Following 10
Food reserves rate (%)	16～25	10～16 or 25～40	4～10 or 40～55	Following 4 or above 55
Industrial world market share (%)	Above 15	10～15	5～10	0～5
Industrial domestic market share (%)	97～100	90～97	80～90	Following 80
Competitive advantage index	0.6～1.0	-0.2～0.6	-0.6～-0.2	-1.0～-0.6

Agricultural scientific research input (%)	Above 0.2	0.1～0.2	0.05～0.1	0～0.05
Labor productivity (RMB /per person*year)	Above 150000	50000～150000	10000～50000	Following 10000
Land productivity (kg/hectare)	Above 5000	3800～5000	2500～3800	Following 2500
Production concentration degree (hectare/household)	Above 20	10～20	5～10	Following 5
Industrial import foreign interdependence (%)	2～5	1～2 or 5～15	0.5～1 or 15～20	Following 0.5 or above 20
Industrial export foreign interdependence (%)	3～5	2～3 or 5～10	1～2 or 10～15	0～1 or 15～100
Food degree of self-sufficiency (%)	90～115	55～90 or 115～145	25～55 or 145～180	Following 25 or above 180

3.2 Synthesis estimation of food industry security

Using the estimation model which already has been established, we estimate China's food industry security condition between 2006 and 2015. Some models and methods, such as linear regression and gray forecast, are applied to forecast eighteen index data of food industry from 2006 to 2015. According to the estimation data of China's food industry security condition from 2006 to 2015, we make estimation to the degree of food industry security. The result is shown in table 3.

Table 3. Estimation score of food industry security index from year 2006 to 2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Capital cost	18.1	18.1	18.1	18.1	18.1	23.0	23.0	23.0	23.0	23.0
The proportion of the specialized middle school and above years of schooling population in rural family	89.1	88.5	87.9	87.3	86.7	86.1	85.5	84.9	84.3	83.7
Average per person hourly pay of agricultural labor	8.4	9.0	9.4	9.8	10.2	10.8	11.2	11.6	12.0	12.6
Average per person cultivated area	90.0	90.0	90.0	90.0	91.0	91.0	91.0	91.0	91.0	91.0
Effective irrigated area in the unit cultivated area	17.4	17.3	17.1	17.0	16.7	16.6	16.5	16.3	16.2	16.1
Food demand rate of increment	42.0	42.0	42.1	42.2	42.0	42.1	42.4	43.2	43.3	43.4
Food commodity rate	63.2	62.3	61.4	60.5	59.6	58.7	57.8	56.9	56.0	55.1
Food reserves rate	44.4	44.4	36.2	36.2	36.2	25.8	25.8	25.8	14.7	14.7
Industrial world market share	87.2	86.8	86.3	85.8	85.3	84.8	84.2	83.7	83.1	82.5
Industrial domestic market share	29.9	31.2	32.5	33.9	35.4	37.0	38.7	40.4	42.3	44.3
Competitive advantage index	75.0	76.7	78.3	79.9	80.9	81.9	82.8	83.7	84.6	85.4
Agricultural scientific research input	82.4	81.6	80.8	80.0	79.4	78.2	77.0	75.8	74.6	73.4
Labor productivity	78.6	78.1	77.7	77.2	76.8	76.3	75.9	75.4	75.0	74.5
Land productivity	29.4	28.4	27.4	26.4	25.4	24.4	23.5	22.5	21.5	20.5
Production concentration degree	98.4	98.4	98.4	98.5	98.5	98.5	98.5	98.6	98.6	98.6
Industrial import foreign interdependence	21.9	22.9	24.0	25.2	26.5	27.8	29.2	30.7	32.3	34.0
Industrial export foreign interdependence	14.3	11.2	7.9	4.5	0.9	2.9	6.8	11.0	15.3	19.8
Food degree of self-sufficiency	12.8	13.7	14.6	15.5	16.5	17.4	18.2	19.0	19.7	20.2

According to the index weight, we can calculate the overall estimation score and obtain the results of security degree of Chinese food industry from year 2006 to 2015. As shown in table 4

Table 4. The results of security degree of Chinese food industry from year 2006 to 2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Score of the security degree	46.12	46.83	47.54	48.98	50.32	51.36	51.30	52.26	52.47	53.10
Security state	Almost safe	Almost safe	Almost safe	Almost safe	Unsafe	Unsafe	Unsafe	Unsafe	Unsafe	Unsafe
Security grade	B	B	B	B	C	C	C	C	C	C

The estimation result shown in table 4 indicates that during this period the condition of Chinese food industry develop from basic security to insecurity, and the score of security degree increases year by year. After 2009, the situation of China's food industry changes from almost safe to unsafe. In this period, the security degree of food industry continues to decrease but at a modest rate, showing no tendency to deteriorate.

The estimation result indicates that: First, there are two ingredients driving China's food industry security from security to insecurity status. One is the industrial competition, and the other is industrial development circumstance. Second, some index scores are below 20 points, under the security limit, such as industrial import foreign interdependence, industrial export foreign interdependence and food degree of self-sufficiency. So we conclude that China's food industry foreign interdependence is not high, and trade influence on food industry security is not much. This is mainly because China always places the development of food production as a country strategy and insists that we should solve the food problem by ourselves.

4 Conclusions

Proceeded from the conception of food industry security, this article constructs an index system for estimating the food industry security and evaluates the food industry security in China during the period of 2006-2015. The empirical result indicates that during that time the condition of China's food industry develops from basic security to insecurity. After 2009, the security degree gradually exacerbated year by year. The industrial competition and industrial development circumstance are the key elements that affecting food industry security. The key factors are mainly the proportion of the specialized middle school and above years of schooling population in rural family, average per person cultivated area, competitive advantage index, production concentration degree, industrial world market share, agricultural scientific research input and production concentration degree. On the contrary, China's food industry foreign interdependence is not high, and trade influence on food industry security is not much.

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