Economic Analysis on
Chinese Grain Prices from the Perspective of Globalization

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Economic Analysis on
Chinese Grain Prices from the Perspective of Globalization

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Economic Analysis on
Chinese Grain Prices from the Perspective of Globalization

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ABSTRACT

China has been motivated to find a way to face the grain price globalization during the recent years. China holds the greatest number of population in the world, and it will be a difficult challenge for the government in the country to feed its population, by not only the traditional grain for food, but also the increasing demand for eggs, milk and meats, all of which will bring increasing demand for feed grains. In addition, the co-relationship between grains for food/feeding and for bio-energy provides big challenges on the rapid growth Chinese economies.

The results of this entire study indicate that China's grain price reform has gone through a long process of exploration. On the other hand, we must consider that the government decisions have a lagged effect on the grain prices.

Also indicated was that investors such as middlemen and speculators showed risk aversion in wheat and corn before China's joining WTO. After China joined the WTO, however, they have been risk avert for wheat and indica rice, risk appreciate for soybean. After the agricultural promotion policy introduced in 2004, investors are risk avert for staple food such as wheat, japonica rice and indica rice. During the global high grain prices in 2008, soybeans, corn and japonica rice showed risk avert effects. While indica rice showed risk avert to middlemen and speculators in the recent era, corn showed risk appreciate, which may bring a challenge for corn in the next few years.

In addition, the effective but costly grains policy measures in China in 2008 cut off the relationship between the domestic and the international market, and stabilized the

domestic prices. Stabilization index for wheat in China is the largest, followed by japonica rice, indica rice, and corn, with soybeans located at the lowest.

Wheat prices in China have been keeping gradually increasing since 2007. Corn wholesale prices and soybean wholesale prices in China have been higher than US price during the recent years. However, the US corn price had surpassed the China's corn price during the international price spike in 2008. Soybean prices in China shifted in the same direction as the US soybeans prices. Yet the China soybean prices remained above the world market price.

Our result of ADF test for grain prices in China and the US indicated that co-integrations might exist between the same grain prices. The results of VECM models also indicated existence of causality among all grains at 1% significance level. Volatility for the US soybean prices may have caused the Chinese soybean prices to fluctuate. In impulse response functions, Chinese grain prices response immediately to their own standard deviation innovations and the impacts from the international markets are more significant for soybeans. Prices of US soybean and corn show significant effect to their own innovations.

Based on the results of this research, we recommend that Chinese government should take some policy measures to face the new challenges for grain globalization. Firstly, China will have to introduce some new the pricing systems to replace the old pricing mechanism. Secondly, China can forecast the grain price fluctuations and take effective policy measures. It is necessary to reduce the speculators hoarding of large numbers of grains, which may lead to insufficient domestic grain supply. Thirdly, the Chinese government should help the farmers increase production in the future by increasing the financial and technical supports. In long run, the Chinese government

needs to prepare to face the higher prices. Finally, it is imperative for the Chinese government to focus on CBOT agricultural futures markets and find out immediately any new symptoms of the CBOT prices so that any negative influence to the Chinese markets can be harnessed.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background

China has to find a way to face the coming grain globalization in the recently years. China has the greatest numbers of population in the world, and it will be a difficult challenge for China to feed its population, by not only the traditional grain for food, but also the increasing demands for eggs, milk and meat, all of which will bring increasing demand for feeding from grains. In addition, the co-relationship between grains and energy also provide big challenges also to the rapid growing Chinese economics.

China's grain price reform has gone through a long process of exploration. Every grain price reform decision is considered comprehensively and carefully with the overall state economy, the food situation, grain farmers and urban consumers, and many other factors. Different historical periods of grain price policy have played positive roles to achieve the desired objectives on the protection of the grain market supply and stabilize prices, improve people's livelihood.

Weekly Chinese wholesale grain prices showed a steady increase in the recent era, during which price fluctuations existed for individual grains. More particularly, frequent grain price fluctuation has an impact on the behaviors of both feed-companies and middlemen, thus these market participants pay attention to the wholesale grain prices and decide to add or release their stocks. In addition, government can implement effective market price stabilization policies to avoid risks, based on the characteristics of grain prices volatilities.

In 2008, global prices of agricultural products skyrocketing increased and reached a record, although the increasing levels of price were various among different agricultural commodities, including milled rice, wheat, corn and soybeans. However, main grain prices' increase in China was rather moderate as compared to the US market. That was because that China government had taken a series of measures and policies to ensure grain supply and price stability, such as financial subsidy to farmers, minimum rice procurement prices for northeast China's rice, minimum grain purchasing price plan, temporary grain storage plan, and trade policy. Those policies have reacted positively to domestic trade, safeguarded farmer's profits and ensure stable grain production. China had successfully deal with the challenges of international food security, and its domestic grain prices remained relatively stable, which had contributed to the development of national economy.

In addition, after joining WTO, Chinese agricultural commodities linked with the international markets to a certain extent. Therefore, fluctuations of international grain prices started influencing Chinese domestic grain markets, which indicated that the volatility of international grain prices brought new challenges to Chinese grains' price stabilization. Fluctuations of the two grain markets are also simultaneously, which suggest that there is consistency between the domestic grain prices in China and the US future grain prices. The reason for this was due to the CBOT prices played a decisive role in announcing price information, by which Chinese domestic grain prices were influenced, such as soybean prices in China had fluctuated in a rather similar style as the US soybean prices.

In sum, Chinese grain prices will meet great challenges in the near future because of the grain globalization. Chinese government should improve grain market order,

increase its domestic farmer's income, and get ready for the growing integration with the world grain prices.

1.2 Purpose of the study

The overall objective of this research is to study the Chinese grain prices in the coming grain globalization in the recently years. In specific, this study will discuss the following five aspects:

We will calculate the real grain price indices in China, by taking the grain procurement prices indices from 1978 to 2000, and the grain producers' price indices from 2001 to 2013. In addition, varieties of grains covered wheat, paddy, corn and soybeans in this study and their price indices were also calculated in the same way.

We will employ ARCH family models to study grain price volatility in China, which includes the models for ARCH, ARCH-M, TARCH and EGARCH for price volatility. We selected indica rice, japonica rice, wheat, corn and soybeans in China as the studied grains.

This research also attempts to analyze the price stabilization of rice, wheat, corn and soybeans in China during the high grain prices in 2008. This study attempt to find out to what extent the domestic grains' price correlated with the international market. We will calculate the correlation coefficients of the prices of japonica rice, indica rice, wheat, corn and soybeans between the China's and the US markets in recent era, and a comparison to the result will show the relationships between the two markets. Secondly, we aim to study the situation for other major grain trade counties to investigate how China stabilized its domestic grain prices at that time, as the movements of Chinese domestic prices of main grains quite differed from that of the world prices.

In addition, this research also explores whether the international grain prices have an impact on Chinese grain prices in recent years, using the latest weekly time series data and econometric analysis. We verify the causality of the domestic and international grain prices and check whether long-run equilibrium or short-run equilibrium relationship between the Chinese and international grain prices exist or not.

Based on the analyses, this study will provide some policy recommendations for China to face the coming grain globalization.

1.3 Justification of research

Chinese grain price must get prepared to face the coming grain globalization. This study mainly aims to evaluate the Chinese grain price system and provide some useful policy implications to this issue.

Many researchers have studied about the Chinese grain price. However, there are still some area not mentioned, which mentioned in our research. First, previous studies have showed an approximately trend for Chinese grain prices. However, there was less convincing evidence to support their descriptions. This study calculated the real grain price indices to reflect the development of Chinese grain prices, especially after China implemented the reform and open up policies in 1978. This will provide the development of Chinese grain policies and grain prices.

Secondly, there are some researchers on Chinese grain price fluctuation. However, there are only few qualitative analysis used on Chinese grain markets. Also, most of the researchers used monthly or annual data in price fluctuation, among which there are no studies using more detailed grain prices, such as the weekly grain prices. Besides, scholars have not made comparisons on the grain price fluctuation within the different

periods in China, such as before and after joining WTO， before and after the world grain prices hiked, and so on.

Thirdly, majority of those studies related to Chinese grain stabilization policies mainly based on the graphical and descriptive analyses. Studies with empirical analyses were quite limited. This study attempts to analyze a series of grain policy measures in China in 2007 and 2008. In addition, we are going to evaluate that to what extent the domestic grains' price correlated with the international market, and explain how China controlled its domestic grain prices in 2008.

Fourthly, we will systematically analyze the prices and trade situation of rice, wheat, corn and soybeans in the world in recent era, especially in 2008. This study will employ some graphics and tables to show grain prices movements and the trade volumes of rice, wheat, corn and soybeans in China and other major trade countries in recent years.

Finally, previous studies on grain prices transmission from international markets to Chinese domestic markets are quite limited. This study will use the latest weekly time series data and econometric analysis to verify the causality of the domestic and international grain prices.

1.4 Structure of the study

Seven chapters organize this study respectively. The first chapter introduces some backgrounds, addressing that the Chinese grain prices have to face the coming grain globalization. Moreover, China must get prepared to challenge the "grain- energy" correlation with its economic development. Its related grain policies indicate that China needs both macro direction and marketization to maintain a national high grain self-

sufficiency to feed the greatest population. At the same time, increasing the benefits for the poor people, including the poor farmers and the poor consumers, will be a great answer that more than economical area. However, to subsidize the grain producers in the recent years is a reprehensive policy measure to show China's desire not only on encouraging its domestic grain supply, but also keeps increasing farmers income. This also the requirement for China to accept or follow the world grain markets in the future.

The other chapters mainly discussed the following topics. We shall briefly study the overview of Chinese grain historical prices and the related policies, by which we attempt to analyze about the development and experience of the government's intention for the specific grain price policies in different period.

An analysis of price fluctuation in recent Chinese domestic grain markets will be arranged as the third chapter, in which we want to employ econometric models to study grain price volatilities. We will discuss in chapter four about how china controlled it's the domestic grain prices in 2008, during which China carried out some specific grain price stabilization policies to cut down the relationship between Chinese domestic grain markets and the world markets.

In addition, a further introduction to Chinese and US' price differences follows in chapter five, where we will report also about Chinese international trade during the food crisis and grain trades among the main importers and exports for rice, wheat, corn and soybeans. We will also discuss about the supply and demand in grains in China. Chapter six will particularly focus on the grain prices transmission from international markets to Chinese domestic markets from the perspective of grain globalization, in which we want to declare about the present communication between Chinese grain and

the CBOT grain markets. Based on the results of the analysis, we provide some conclusions and several policy implications.

CHAPTER 2

OVERVIEW OF CHINESE GRAIN PRICES AND THE RELATED POLICIES

2.1 Background and literature review

At the beginning of the Chinese government was founded in 1949, grain supply had to face many challenges, and the grain prices fluctuation was quite serious. The reason was because that many people stored their grains to search for the benefits. In order to stabilize the grain prices and support the national finance economic, the government decided to enhance the impact of the state-owned commerce department, together with the a relative loose free purchasing polices. As a result, the stated-owned grain polices not only helped to control the grain prices well, but also support greatly to the government finance income, which played a positive effect to the development of the Chinese national economic.

However, grain policies changed in 1953 when the whole society in China started enhancing its economic development. The grain crisis in 1953 offered an important opportunity to promulgate a policy for unified purchase and sale of grain. Grain policies in China turned to facing monopoly for procurement and market in order to meet the demand of the economic construction and people's daily consumption. During this period, the Chinese government carried out the planned unified national purchasing and supply. Grain farmer sold their surplus commodities to the government, but the procurement volumes, supply volumes, procurement prices and supply prices must be determined or approved by the central government.

After that, the Chinese government increased the grain procurement prices by 3.1%, 2.6%, 25.3% and 1.5% in 1958, 1960, 1961 and 1965, respectively, among which China faced natural serious disaster in 1960s. However, the national grain sale prices did not change until 1963 and 1965, after which the grain procurement prices increased again by 17.1% in 1966, and the soybean procurement prices raised by 9% and 23.4% in 1971 and 1978. Procurement prices for stable grains such as paddy and wheat did not change in 12 years, and the government aimed to support its industry development and guaranteed the consumer's daily life by taking into the price subsides to the consumers.

Scholars have divided commonly the Chinese grain prices by some specific years, during which important agricultural polices had great impact on the grain prices in China. Wei (2009) divided from 1949 to 2006 into 6 periods, such as free market price with significant disadvantages (1949 - 1952), unified purchase and sale prices with government pricing (1949 - 1984), dual grain pricing system that expanded the range of market regulation (1985 - 1989), released the market grain prices (1990 - 1993), grain market mechanism was improved (1994 - 2000), and market-oriented grain price (2001 - 2006). He found that the market-oriented reform in China has brought a series of relevant problems and challenges, but China's grain market mechanism trend is formed significantly in the recent years, which not only makes China's grain supply and demand stable, but also helps to implement food security strategies and to reduce the risk from the international food crisis.

Guo (2009) analyzed the significant fluctuations since 1949. He studied the correlations between the policy adjustments and fluctuations for grain prices in 7 periods, including 1949 – 1976, 1977 – 1984, 1985 – 1990, 1991 – 1996, 1997 – 2002, 2003 – 2005, and 2006 – 2009. Guo pointed out that grain not only with the same

properties as ordinary commodities that can circulate in the market, but also belonged to important resource that related to the national and social stability. The author evaluated Chinese grain historical prices in different policy backgrounds, and he suggested that Chinese grain prices should connect with the world grain market in the future, and financial supports to farmers need to be increased. He also recommended that a price warning system was needed in Chinese grain markets, which should be based on the effective local wholesale markets and the future grain prices.

Kang (2010) described the evolution of Chinese grain prices into 8 periods since 1949. She regarded the first period from 1949 to 1952 is conducive to the recovery of the national economy, during which the free trade together with the state-owned enterprises were the leading procurement and sale. The second stage that Kang considered started from 1953 to 1978, during which the unified procurement and sale prices by the Chinese government tried to meet the domestic demand. The third stage was from 1979 to 1984 and China increased the unified procurement prices. After that, China canceled the unified procurement for grains from 1985 to 1992. The fifth stage lasted 3 years since 1993, during which unified procurement and sale prices were completely terminated. Grain protective prices were set during 1996 to 2000 to protect the farmers' benefits in order to avoid the surplus grains reducing market prices. The seventh stage in Kang's study suggested that China improved the grain protective prices in both main sale areas and mail production areas. The last stage that begun from 2004 suggested that minimum procurement grain prices, temporary grain storage plan and the grain subsidy policies could encourage farmers.

Leng, *et al* (2003) reviewed grain price policies since China started the reform and opening up policy, which suggested a transformation from a planned way to a market-

oriented process. She also tried to find some problems for the current grain price policies. They divided the period from 1979 to 2003 into 4 stages, based on several grain polices. In the first stage, a basically unified purchase policy and an increased the purchase price were defined from 1979 to 1984. The second stage from 1985 to 1990 was regarded that the Chinese government cancelled the unified purchase prices but retained the unified selling prices for grains. The third stage from 1991 to 1997 reported that the unified selling prices were removed in this period. China started exploring the market system for grain prices in the fourth stage from 1998 to 2003.

Deng, *et al.* (2009) argued that agricultural price policy in the different stages reflected national plans, food production and market demands situations. They thought that from 1979 to 1984, the Chinese government adjusted prices of agricultural products, open up fair trade and introduced market mechanisms. China abolished grain's unified purchase prices, but kept the unified selling prices in phase two (1985 – 1991). After that, prices of agricultural reformed and China started to introduce comprehensive market mechanisms from 1992 to 1997, during which the unified selling prices were abolished. During the fourth stage since 1998, market price mechanism for agricultural products circulation system gradually formed under the government's macro adjustments. They pointed out that there were some problems in Chinese agricultural market, such as insufficient production, low profit, reduction of cultivated area, low competitiveness of agricultural products, and so on. In addition, they suggested that, China can prove the policy goals to make a long-term agricultural policy and should promote new rural construction of socialism.

Previous studies have showed an approximately trend for Chinese grain prices. However, there was less convincing evidence to support their descriptions. Therefore,

we calculated the real grain price indices to reflect the development of Chinese grain prices, especially after China implemented the reform and open up policies in 1978. In addition, we shall also summarize Chinese grain price policies systematically in this study.

2.2 Evolution of Chinese grain prices（1978-2013）

We calculated the real grain price indices in China, by taking the grain procurement prices indices from 1978 to 2000, and the grain producers' price indices from 2001 to 2013 (Fig 2.2.1). Grain price indices are deflated by Chinese anural CPI to compute the real grain prices indices, by which we tried to describe the real fluctuation in the grain prices.

In addition, varieties of grains covered wheat, paddy, corn and soybeans in this study and their price indices were also calculated in the same way. We set the base year as 100 in 1978. Grain price indices in 2013 were calculated by each necessary published average value in the first quarter, including the producers' monthly grain price indices monthly CPI.

As a result, we divided our data into 7 periods according to both our calculated results and Chinese prices revolution policies since 1978, from which China started its reform and opening-up policy. We concluded that Chinese historical grain prices fluctuated due to the specific policies, and the real grain prices increased significantly in the recent years.

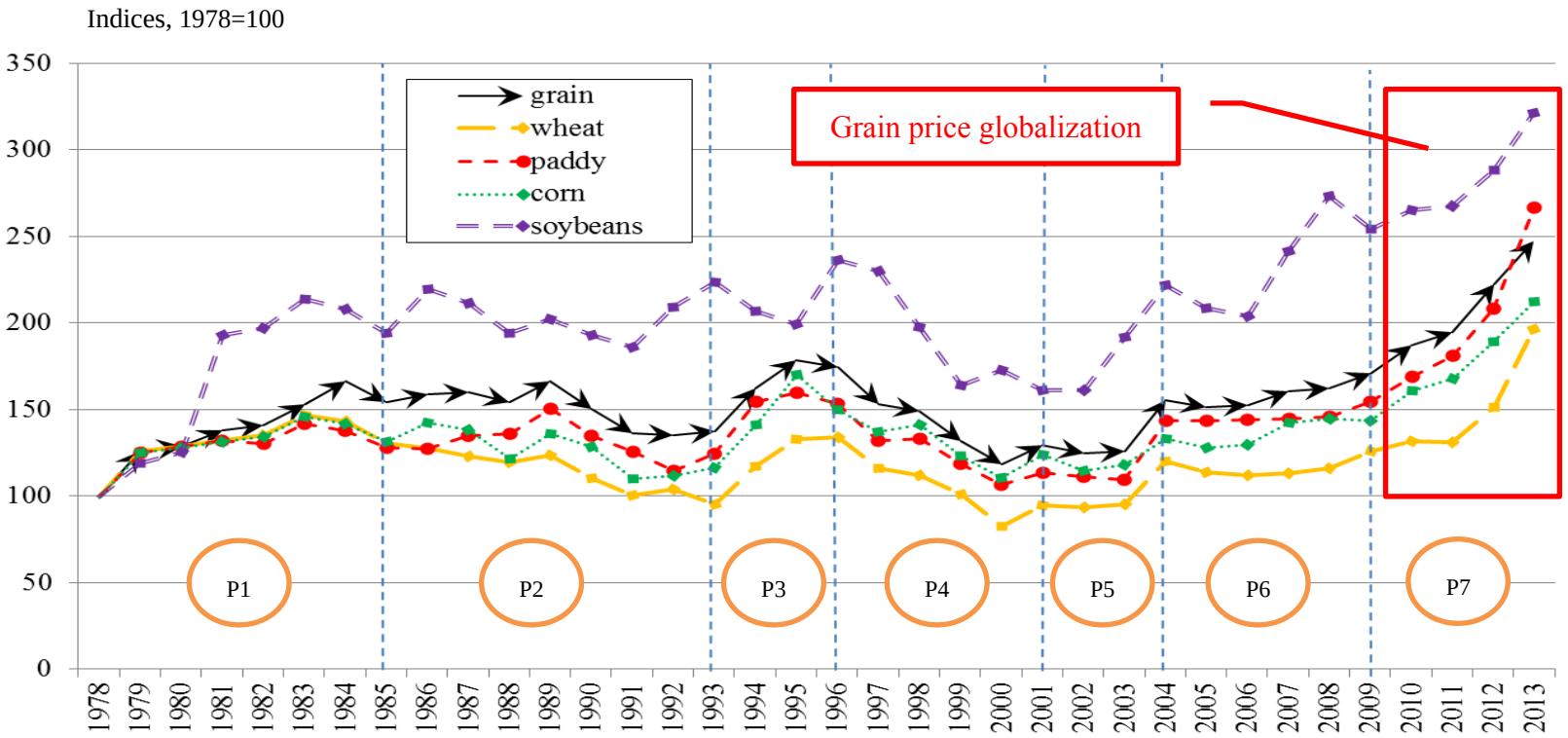

Fig. 2.2.1 Indices for real grain price in China from 1978 to 2013

Source: China Statistical Yearbook (1979 - 2012)

Note: 1. Base year: 1978=100; 2. Grain procurement prices indices (1978 - 2000), and grain producers' price indices (2001 - 2013); 3. Grain price indices in 2013 are calculated by the average value from January to April; 4. Calendar year based (January - December).

Period: P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.

Period 1: During 1978 and 1984, the Chinese grain procurement prices increased by 66.14%

In 1978, China carried out reform and opening up policies, and household-responsibility system was successfully introduced in 1981 to the Chinese farmers so as to increase their grain production. There was an about 20% increase in the grain procurement prices in 1979, followed by a significant 54.01% increase in the soybeans procurement prices in 1981 because that the Chinese government wanted to promote the soybeans production to meet the increasing consumption.

As a result, the domestic soybean production increased by 17.44%, which showed an effective impact to help the soybean farmers to promote their production. In this period, procurement prices for wheat, paddy, corn and soybeans increased by 43.50%, 37.57%, 41.45% and 107.65%, respectively. However, the Chinese government also had to spend huge amount of subsidies to the consumers due to the planned stabilized grain sale prices, which was less than the government procurement grain prices.

Period 2: During 1985 and 1992, China replaced the national procurement with the contract procurement.

The Chinese government abolished the national grain procurement policies since 1985. Instead, the government decided to make contract with the grain farmers with a procurement prices. This policy encouraged the farmers to sell their surplus grains to the market, which reduced significantly the government burden to buy all of the produced grains or to subsidize the consumers, then to reduce the situation that the purchasing prices exceeded the selling prices. In this period, the procurement grain prices maintained until they dropped by 12.50% since 1989, among which prices reduced by 20.42%, 10.26%, 14.90% and 4.19% for wheat, paddy, corn, and soybeans respectively. In addition, China also increased the selling prices in 1991 and 1992 in this period.

In order to reduce the gap between the procurement grain prices and its selling prices, the government implemented a series of policy measures, such as improved the

bargain systems in the contract, increased the procurement prices and the government selling prices, developed the grain wholesale markets, and also combined the grain procurement contract with the supplied fertilizer, diesel and the front money. This important grain price policy not only ensured that the government to master a certain number of grains to supply the needs of the market and the necessary reserves, but also helped to guide the grain producers in accordance with the needs of the market quantity, variety and quality of production. More importantly, this policy helped the government to reduce the heavy load for subsidize the farmers and the consumers. The invisible hand started to play an important role in the grain market, and the increasing market regulation was conducive to adjust the agricultural structure and promote the development of rural grain markets.

Period 3: During 1993 and 1995, China introduced the market regulation into the grain markets.

Chinese grain prices started to fluctuate gradually with its domestic markets since 1993 when the government carried out some important policies, including asked the farmers to sell their grains freely to the markets, removed the national edible oil procurement policy and the supply on edible oil rations. As a result, farmers begun to sell their grains actively to the market, and the grain producers' prices increased by 30.11%, among which wheat prices, paddy prices and corn prices significantly increased by 39.38%, 27.99%, and 46.67% during this period.

However, the soybean prices dropped by 10.82% because of the less benefits expected by the farmers. Meanwhile, the Chinese government also implemented the protective procurement pricing system and the grain risk fund to protect the farmers expected economic returns.

Period 4: During 1996 and 2000, oversupply pulled the grain prices to drop, thus China adjusted the area that adopted the protective procurement prices

As the grain farmers begun to arrange their cultivation activities and expected to get more benefit, grain production started to increase sharply since early 1990s. Anural ending stocks-to-use ratio in China suggested that oversupply pulled the grain prices to fall down in period 4, due to which grain price dropped by 32.12% from 1996 to 2000. Among that, producers' prices of wheat, paddy, corn and soybeans reduced by 38.58%, 30.54%, 26.23% and 26.89%, respectively.

At that time, the Chinese government set the protective procurement prices to improve the grain quality. For example, China reduced the protective procurement prices of inferior wheat in Northeast and South China and the poor-quality early indica paddy in South China in 1999, and removed their protective procurement prices in 2000.

Period 5: During 2001 and 2003, China released the protective prices in the main sales area.

China joined the World Trade Organization (WTO), and became one of its 143 members on December 11, 2001. The government decided to improve the grain markets to face the opportunities and challenges from the world grain markets. Chinese grain price index moved relatively stable during these three years, and dropped by 2.38%. Among that, price indices for wheat and soybean increased by 0.65% and 18.81%. But the price indices for paddy and corn fell down by 3.27% and 4.66%. Chinese soybean prices increased sharply was mainly due to that China started importing a great volume soybean, so the soybean prices begun correlating with the world market.

In addition, selling prices for grains in the main sales area was opened to the market prices in eight big cities in China, such as in Beijing, Shanghai, Tianjin, Zhejiang, Jiangsu, Fujian, Guangdong and Hainan provinces. Meanwhile, the grain procurement prices in the main grain production area was also decided by their local market in Anhui, Hunan, Hubei, Inner Mongolia and Xinjiang, which were five of the

main grain production areas in China. Meanwhile, the local government started being responsible for manage their provincial local market.

Period 6: During 2004 and 2008, China supported the agricultural development, and opened up both of the grain procurement and sale prices

The Chinese government encouraged the diversity of the grain market participants under the national macro-control and promoted the farmers benefits since 2004. China introduced a directly subsidy police to farmers, a minimum procurement grain price policy, and a temporary storage plan since 2004. All of these polices mobilized the enthusiasm of farmers to produce grains and helped to increase grain farmers' income, thus stabilized national food security and improved the grain price formation mechanism in China. Especially, the grain prices in the world market spiked during 2007 and 2008. However, the Chinese grain prices showed relatively stable during this period, but the government had to give up the opportunities for exporting grains for benefits due to the purpose of feeding its largest population and maintain its food security.

The real grain prices index from 2004 to 2008 increased slightly, with a 4.03% growth rate. Among that, real prices of paddy, corn and soybeans increased by 1.53%, 8.63% and 23.22%, respectively. However, the real prices indices for Chinese wheat dropped by 3.52% during this period. However, a objectively evaluation to the Chinese grain market was that its domestic grain markets started more and more to get influenced by the world grain market. For example, the bio-ethanol was becoming popular at that time, and grain prices were connected with the energy use, which was required by a huge world market. On the other hand, the future prices which contained the speculating activities also had begun making a decidable guidance to the local grain markets. So the Chinese domestic grain prices not only had to face the upward pressure from the world market, but also must consider about its domestic farmers' benefits.

Period 7: During 2009 and 2013, China enhanced supports to farmers' benefits.

In the recent years, China raised the level of minimum grain procurement prices and continued to increase the temporary storage volume. Meanwhile, the government also subsided to the grain farmers, the grain processors and the feed companies.

As a result, the producer prices index increased continuously. According to our estimation, real grain price index in China increased by 44.49% from 2009 to 2013, among which price indices for stable grains such as wheat and paddy increased by 55.77% and 72.89%, respectively. In addition, price indices for corn and soybeans also rose by 48.33% and 26.53% respectively.

2.3 Chinese grain price policies （1949-2013）

In this part, we will describe historically the main grain price policies from 1949 through 2013. We collected the Chinese government documents that influenced the domestic grain prices. We divided our total period into 9 parts and the entire lists of documents were shown in Appendix.

Table 2.3.1 indicates a time table for grain price policies in China. We shall analyze characteristics of Chinese grain price policies, growth the rates of the price movements, back ground for each policy and our evaluations in 9 periods from 1949 to 2013.

1949-1952

The early days of China faced serious inflation, and it's the economy was in recovery period. Free trade occupied the grain market, and the private grain-based business was the main factor in the grain trade. During that time, an obvious contradiction between food supply and demand came out, and some unscrupulous traders took the opportunity to hoard grains, which drove up grain prices and led serious grain price volatilities.

Table 2.3.1 Time table for grain price policies in China

Period	Characteristics of Chinese grain price policies	P change (%)	Background	Evaluation
1949-1952	Support state-owned grain enterprises; strengthen market management, formulate grain prices via free market.	-	Short of grains, some unscrupulous traders' hoarding drove up grain prices.	Safeguarded grain price stabilization, but the monopolized grain enterprises exacerbated inequality.
1953-1978	National purchase and sale, with prices are decided by the government. Non private grain dealers.	G (57.5)	Production was hard to meet the demand, leading a shortage for more than 4 billion kg.	Controlled private grain merchant. But the highly centralized management also constrained grain production.
1978-1984	Increase grain retail prices. Implemented multi-channel management. Market mechanism started in prices in grain market.	G(66.1); W(43.5); P(37.6);C(41.5); S(107.7)	Low grain production at the beginning of reform and opening up since 1978.	Purchase and sale prices still occupy a dominant position. There were still difficulties on selling and storing grains.
1985-1992	Change monopolized grain purchase to contract ordering, and allowed free purchase and sale to surplus grains.	G(-12.5); W(-20.4); P(-10.3);C(-14.9); S(7.6)	Nationwide farmers' to sell grains due to the grain oversupply,	State mandatory pricing system was broken, market-oriented reforms performed. It added financial burden.
1993-1995	Abolish the monopolized grain sale policy. Improve farmers' enthusiasm for growing grain. Increased ordering and sales prices.	G(30.1); W(39.4); P(28.0);C(46.7); S(-10.8)	Panic buying grains in 1993 because of the serious nationwide fluctuations in grain prices.	Cancellation in 1993 failed because of inflation. High order prices in 1994 and brought financial burden for inventory.
1996-2000	Implement protective grain prices. Separate responsibilities for government and enterprises. Improve grain price mechanism.	G(-32.1); W(-38.6); P(-30.5);C(-26.2); S(-26.9)	Oversupply forced grain prices to continue slumping.	Over grain production pulled down the grain prices.
2001-2003	Accelerate market-oriented reform for grains. Allow private grain enterprises to enter the market for grains' acquisition.	G(-2.4); W(0.7); P(-3.3);C(-4.7); S(18.8)	Protective prices did not be completely carried out.	Grain markets and the real market price were officially formed.
2004-2008	Liberalize grain market. Implement grain subsidies and reformed rural taxes. Ensure the domestic price stabilization.	G(4.3); W(-3.5); P(1.5);C(8.6); S(23.2)	Floods led a production cut in 2003. Tight global supply influenced the pricing system.	As gradually integrated into the WTO system, global grain market intensified. China reduced this effect.
2009-2013	Increase grain purchase and sale prices. Ensure supply. Protect farmers' benefits.	G(44.5); W(55.8); P(72.9);C(48.3); S(26.5)	Demand for grains was increasing. China wanted to improve the farmers' income.	Farmers' income and production increased. But the influence from the global competition is coming.

Source: China Statistical Yearbook, China Agricultural Statistics Yearbook, China Development and Reform Commission, Ministry of Agriculture of China.

Note: Grain prices, G-gains, W-wheat; P-paddy; G-corn; S-soybeans. "-" indicates no data. "P change" indicates procurement prices (1978-2000), and producers' prices (2001-2013).

The Chinese government supported state-owned grain enterprises, strengthened market management, and formulated grain prices via the free market. As a result, China safeguarded the food markets and grain price stability. But the problems came that state-owned grain enterprises relied on monopolized government support and help, exacerbated the other channels and the main channel between the purchase and sale of other ingredients, then increased the interests of inequality.

1953-1978

In this period, grain production was difficult to meet the demand, and there had been a shortage of grain supplies for more than four billion kilograms. So Chinese government implemented a series of grain price polices such as national purchase and sale policy, grain prices are decided by the government and non-private grain dealers operated freely.

A national purchase and sale policy indicated that China planned to acquainted and sell grain by the government throughout the country. Provisions of grain production, acquisition, storage, processing and marketing were entirely operated by the state regulation, and the grain prices were also formulated by the State. Rural households were required to leave enough food rations, seeds, feed and pay the agricultural tax, then the government would acquire substantially all of their surplus grain. On the other hand, China asked urban residents and farmers to carry out purchase and sale, and non-food private grain dealers were allowed to operate freely. As a result, Chinese real grain price indices in this period increased by 57%.

The national purchase and sale policy combated the private grain merchants manipulating the grain market, stabilized prices and promote the development of food production, food security, but grain prices were highly centralized management constraints to the development of grain production.

1978-1984

China introduced reform and opening up policy in 1978, but grain production was quite low at the beginning of the reform. In order to meet the domestic demand, China increased grain retail prices, implemented multi-channel management and market mechanism started in prices in grain market.

During this period, China increased grain retail prices through the restoration of grain fair trade, and the implementation of multi-channel management. China also adjusted by increasing grain imports to make up for the domestic grain varieties and national food shortage. Household-responsibility system was successfully introduced and sales price increased by 20% over the share price increased by 80%. As a result, Chinese grain prices increased by 66.1%, and a 43.5%, 37.6%, 41.5% and 107.7% increase to wheat, paddy, corn and soybeans, respectively.

Though those police measures, purchase and sale prices were still occupied a dominant position, the grain distribution was still not active enough, and there had been a difficult and in selling grains and grain storage.

1985-1992

China's total grain output of about 9,000 billion kilograms in 1990, which met another new record in history. But population control policy made slow population

growth. During the middle of 1980s, urban consumers purchase food tickets, so their demand was inelastic, then to lead a grain oversupply. Finally, there has been a nationwide problem for farmers to sell their grains.

Under this pressure, China changed monopolized grain purchase to contract ordering, and allowed free purchase and sale to surplus grains. Procurement price and bargain purchase price of the "dual track" mechanism. Contract the ordered food, national pressed proportional valuation into the original purchase price of the acquisition. It also provides that if the market price is lower than the share price of national unity, a national procurement all by purchasing peasants unified purchase all the grains. More substantial increased in the purchase price since 1991 and the state grain monopoly purchase and cancel further removed on the basis of grain marketing in the price, quantity ordered to put the implementation of grain prices. Grain prices increased by 50% in 1992 procurement price increased by 20%, while sales prices of the city further increased by 50%, basically realized the purchase and sale of the same price, while the consumer price subsidies complemented changes. The state-owned grain enterprises cancelled the corresponding price subsidies, fiscal subsidies only operating expenses. Grain procurement achieved the same price, based on price liberalization, liberalization of the pilot operation and success. At the end of 1993, more than 95% of China liberalized grain prices, completed the pricing and market pricing from a planned coexistence of "dual track" to market regulation monorail system changes, grain supply and consumption were completely, and the market regulation that mechanism determined by was basically formed.

In this period, Chinese grain prices decreased by 12.5%, and a 20.4%, 10.3%, and 14.9% drop to wheat, paddy and corn, respectively. But the prices for soybeans increased by 7.6%.

We regarded that grain price polices in this period that after China changed into the contract ordering, the actual price level decreased, and the rapid decline of food production, prices rebounded quickly. State mandatory pricing situation was broken and the scope of market regulation got further expanded. Market-oriented reforms in grain prices increased obviously. By the end of 1992, most areas of the country outside the county adopted a procurement liberalization reforms. Grains had been greatly restored, the role of market allocation of food resources significantly enhanced. But the purchasing and selling prices and increased the number of two inverted the burden on the state, which was not conducive to the development of market mechanisms.

1993-1995

Panic buying grains in 1993 because of the serious nationwide fluctuations in grain prices. 1994 State developed a "stable grain size, stabilize grain production, stabilize grain inventory to ensure national food balance and the total amount of regional balance. In response to grain production, China improved farmers' enthusiasm for growing grain twice. In 1994, a dramatically increased in grain ordering and sales prices, and in October 1994 China established the China agricultural Development Bank funds for grain acquisition management. China also proposed a grain provincial governor responsibility system in 1995, and the provisions of the province provincial policies must food production, distribution and

sales take full responsibility, which become central to solve China's grain total balance and regional balance taken a crucial reform measures.

By those grain price policies, Chinese grain prices increased by 30.1%, and a 39.4%, 28.0%, and 46.7% to wheat, paddy and corn, respectively. But the prices for soybeans decreased by 10.8%.

As southern rice production caused large fluctuations in grain prices nationwide in 1993, a large number of migrant workers in cities, greatly increases the urban demand for agricultural products. In addition, China conducted the devaluation of the RMB exchange reform in in 1994, and 57% are of foreign trade and the southern provinces to domestic purchase, so there was panic buying of grain in autumn 1993. Chinese grain price polices had a limited effect in stabilized grain prices.

1996-2000

Because of the continuous China's grain production in this period, grain surplus in the form of grain market oversupply made grain prices continued to slumping. Therefore, China started to implemented protective grain prices formulated grain price protection and separated responsibilities for government and enterprises. China also improved grain price mechanism and deepened the grain circulation system.

Grain prices resumed track system for heat, corn and other grain for national implementation of prices formulated grain price protection. From 1995 to 1997, China adopted a national purchasing peasants' surplus grain at protective prices as the core of macro-control measures. In addition, China has implemented separating, reserves and operating separately central and local responsibilities separate financial

accounts. Grain price mechanism as the basic principle in order to further deepened the grain circulation system.

As a result, Chinese grain prices decreased by 32.1%, and a 38.6%, 30.5%, 26.2% and 26.9% to wheat, paddy, corn and soybeans, respectively. Those grain price polices led an over grain production and pulled down the grain prices in this period.

2001-2003

In this period, some local areas places did not completely us the protective prices to open purchase surplus grain for farmers, and some varieties of grain had selling difficulties. Grain provincial governor responsibility system was not fully implemented and some areas of the grain risk fund could not be filled. In addition, the reform of state-owned grain enterprises lagged and national grain size, structure and management methods were not fully adapted to the needs of national macro-control.

Because of this back ground, China accelerated market-oriented reform for grains and allowed private grain enterprises to enter the market for grains' acquisition. China started to protected areas and the governor in charge to strengthen regulation reform policy. It was significantly to accelerate the pace of market-oriented reform of grains. To play the regional advantages of agricultural resources, China fully liberalized of the market sales areas and gradually opened up the main producing areas of the acquisition market, the central decision in Zhejiang, Beijing, Shanghai, Tianjin, Jiangsu, Guangdong, Fujian and Hainan eight main grain sales areas released grain market. The state allows private grain enterprises owned grain enterprises to enter the market along with the acquisition of grains.

During this period, real Chinese grain producer prices decreased by 2.4%, and a 3.3% and 4.7% for paddy and corn, respectively. But the prices for wheat and soybeans increased by 0.7% and 18.8%, due to China joined WTO and the globalization started to become a factor to influence the Chinese domestic grain prices.

Those grain prices in China established a new type of relationship between food production and marketing. Grain market system construction from a single subject to multiple subjects started. What's more, grain markets and the real market price were officially formed.

2004-2008

Grain production cut by the end of 2003, and the market became fluctuated. China suffered from natural disasters in main grain producing areas resulting in a substantial cut in food production. In addition, the industrial concept influenced agricultural market since 2006. Tight global supply and demand of agricultural products brought economic concepts deep into the grain pricing system. China's economy has maintained rapid growth, demand for grains in consumer increased.

Therefore, China carried out a series of grain polices to stabilize its domestic grain prices. The state grain purchase and sale of fully liberalized market in 2004, and the comprehensive buying and selling grain market was also introduced. In addition, China took grain direct subsidies, reformed rural taxes and provinces and cities to implement a minimum purchase price policy. Since 2006, grain prices fluctuate significantly, but the state controlled of industrial use of grain to and increased the volume and grain-market imports.

By implementing those grain policies, China real Chinese grain producer prices increased by 4.3%, and a 1.5%, 8.6% and 23.2% increase for paddy and corn, and soybeans, respectively. But the prices for wheat decreased by 3.5%, because of great production.

Grain price polices in this period led farmers to grow grain increase, although China's grain output increased year by year. But as the agricultural market gradually integrated into the WTO system, the impact of the global agricultural market intensified. With the purchase and sale released, the state had entered a market-based phase of the market price. In order to meet new socialist countryside construction and protect the interests of farmers, China reduced the globalization effects in grains.

2009-2013

As demand for grains increasing in recent years and the unexpected global food insecurity, China aimed to improve the farmers' income and to increase the domestic grain production. Therefore, China increased grain purchase and sale prices and ensure the effective supply of grain. Many polices aimed to protect farmers' benefits and increase their income.

According to our estimation, real grain producer prices in China increased greatly by 45.5%, and a 55.8%, 72.9%, 48.3% and 26.5% increase for wheat, paddy, corn and soybeans, respectively.

By those policy measures, farmers' income increased and they were encouraged to increase their production. But the influence from the global competition is coming, China faces great challenge from the grain globalization at present.

2.4 Summary of the Chinese grain prices and its related policies

Reviewing the historical evolution of food to support policy, we can conclude that China's grain price reform has gone through a long process of exploration. Every grain price reform are considered when the overall state economy, the food situation, grain farmers and urban consumers, and many other factors make comprehensive decisions carefully. Different historical periods of grain price policy has played a positive role to achieve the desired objectives on the protection of the grain market supply and stabilize prices, improve people's livelihood.

Different periods of grain price policies smooth convergence to achieve from the strict grain supply management and price controls to the use of economic, legal and other means to regulate the grain market changes, initially established price supports, subsidies support and industry support such as the combination of grain prices policy system.

On the other hand, we must consider that the government decisions have a lagged effect on the grain policies. Chinese food pricing mechanism is a mandatory change of institutional change, the government's choice of pricing mechanism has a dominant position. In general, the first government chose pricing mechanism can better achieve the appropriate food policy objectives. However, with the macro-economic environment, food supply capacity and other factors change, the existing pricing mechanism gradually adapt to the new situation, the requirements of food policy objectives, the performance of the system costs, system efficiency. To a certain critical point, the government will have to adjust the pricing mechanism, with a new pricing mechanism to replace the old pricing mechanism, in order to better achieve the appropriate food policy objectives.

However, China has to find a way on facing the coming grain globalization in the recently years. China has the greatest number of population in the world, and it will be a difficult challenge for China to feed its population, by not only the traditional grain for food, but also the increasing demand for eggs, milk and meat, all of which will bring increasing demand for feeding from grains. In addition, the co-relationship between grains and energy provide big challenges also on the rapid grow in Chinese economics.

CHAPTER 3

ANALYSIS OF PRICE FLUCTUATION IN RECENT CHINESE GRAIN MARKETS

3.1 Background and literature review

Weekly Chinese wholesale grain prices showed a steady increase in the recent era, during which price fluctuations existed for individual grains (Fig 3.1.1). It is important and practical for agricultural producers, feed-companies and investors to understand the characteristics of grain price volatility. Farmers can sell their commodities on their expected prices, and grain price fluctuations also influence their cultivation activities. More particularly, frequent grain price fluctuation has an impact on the behaviors of both feed-companies and middlemen, thus these market participants pay attention to the wholesale grain prices and decide to add or release their stocks. In addition, government can implement effective market price stabilization policies to avoid risks, based on the characteristics of grain prices volatilities.

Researchers studied the characteristics of fluctuations in Chinese grain prices by using a variety of methods. For example, Luo, *et al.* (2010) found that there was no significant heteroscedasticity effect on prices of indica rice, japonica rice and soybeans, but wheat and corn showed significant clustering and high-risk high-return characteristics.

Feng (2008) showed that grain price volatility had clustering effects and obvious non-symmetry. However, there are not so many studies that use econometric analysis

on Chinese grain price volatility. Scholars have not made comparisons on how the Chinese grain prices fluctuated in those five important issues, such as China joining WTO, China promoting farmers' income in 2004, and the spike in world grain prices in 2008.

In addition, many scholars have studied the Chinese price policies to reduce the grain fluctuations in the recent years. For example, Chen (2008) used GTAP model to identify that the imports of grain and oil should be reasonable adjusted too slow down the rapid expansion of oil imports, and increase grain imports can reduce the impact of Chinese Cereals and Oils on world markets.

Ma (2009) analyzed that in 2008 China's agricultural imports and exports have both increased. However, import growth is much greater than export growth in China.

Chen, *et al.* (2009) argued that although China holds adequate food stocks, and not influenced by the international food crisis, there is still a potential of China's food security crisis, so we should strengthen the protection of arable land resources and build water conservancy facilities.

Chen (2009) illustrated his point of view that moderate grain import and export policies not only can be consistent with the principle of comparative advantage, which improves the efficiency of resource allocation, but also can regulate species, reach balance, improve the ecological environment, and effectively guarantee food security.

Carter (2009) studied China’s Role in the 2007–2008 global food price boom and bust, and he found that contrary to some claims, income, demand and trade growth in China cannot be blamed for the increase in global food prices in 2007–2008. In the rural areas, per capita meat consumption has also stabilized in the last five years. China did not overreact to the 2007–2008 food price booms and one could even argue

that strong government intervention in China's grain sector was a stabilizing factor in the world grain markets over the last two years.

Hansen (2009) studied the impact of China's agriculture policies on domestic and world commodity markets and investigates potential implications of recent agriculture policies applied in China, and quantitatively analyzes their impacts on domestic and international commodity markets. Results indicated that the effects on international markets are likely to be small with world price impacts of less than one percent. The set of policies partially offset each other in the international market. Results indicate increased returns to farmers and lowering domestic prices to consumers. China's producers increase production slightly because of increased input subsidies. Exports are reduced because of applied export tax and decrease in value added tax rebate. Domestic consumer prices would likely decrease by 2 to 4.5 percent in real terms. The lower prices benefits lower income and rural households, and benefit expanding beef, pork, and poultry production in China.

Huang, *et al.* (2008) analyzed the nation has used two policy mechanisms to ease the price of food. Firstly, China's leaders chose to release grain from grain stocks, even though there was no supply shock. Secondly, export controls have at least temporarily relieved pressure on prices. But rising agricultural prices will be able to play a major role. Higher prices on a sustained basis will help raise the overall income of farmers. Because almost all rural households, especially those that are poor, have access to land, higher prices will play a key role in the war on poverty. The increase of food prices also will help narrow the gap between urban and rural incomes, which has been stated will be an important part of building a harmonious society.

In addition, our research is important because that grain price volatility is quite influential. First of all, farmers can sell at their accepting prices, cultivation activities. Secondly, feed-companies and middlemen: decide to add or release their stocks. Thirdly, government: implement effective market price stabilization policies to avoid risks.

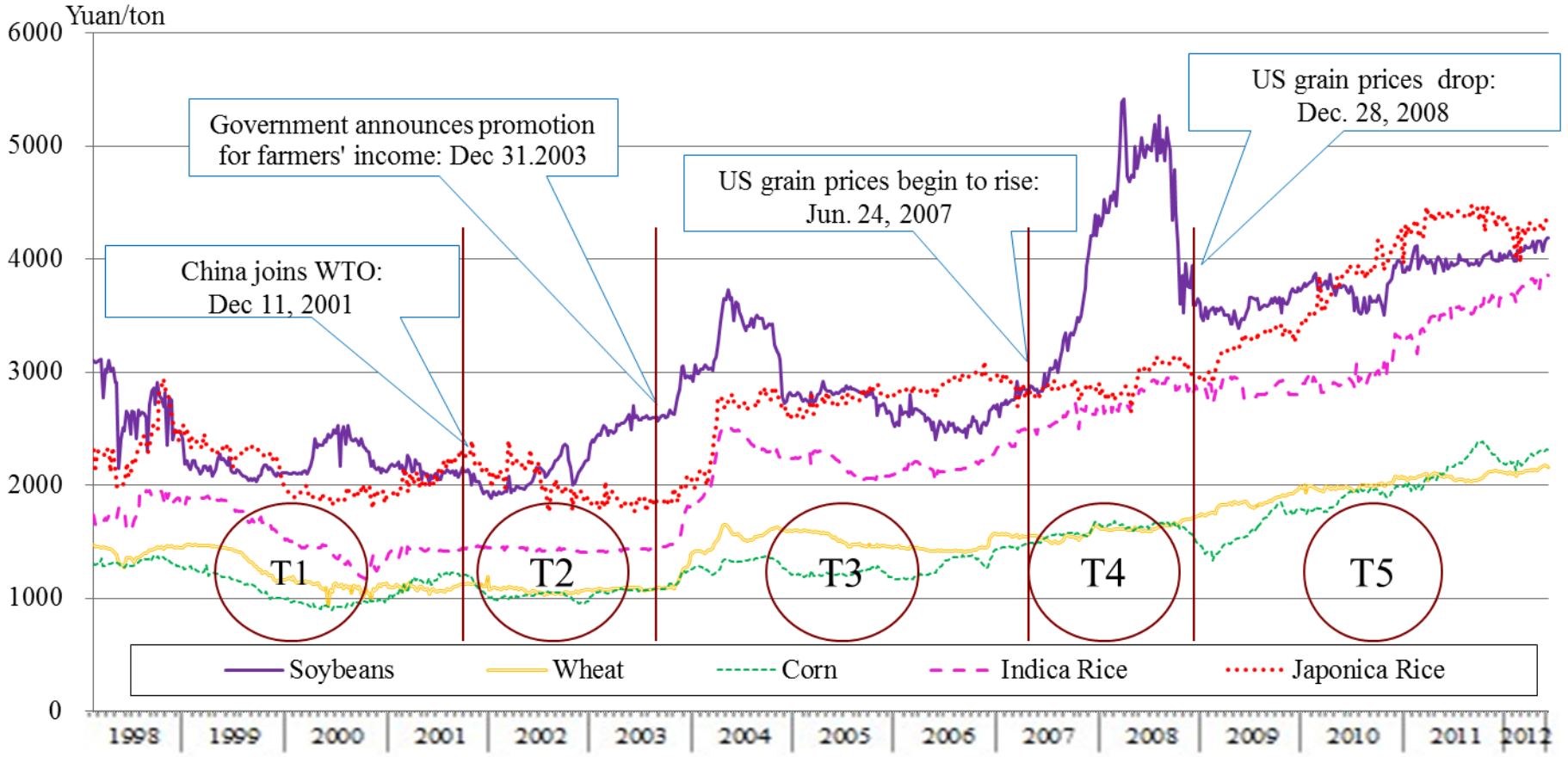

Fig. 3.1.1 Weekly wholesale grain prices in China

Source：Chinese grain and oil wholesale market prices network system (http:// datacenter.cngrain.com)

Data period: January 11, 1998 – May 27, 2012

3.2 Methodology and data

We employed ARCH (autoregressive of conditional heteroskedasticity) family models to study grain price volatility in China, which includes the models, ARCH, ARCH-M, TARCH and EGARCH for price volatility. Indica rice, japonica rice, wheat, corn and soybeans in China are selected in this study.

ARCH family models mainly issues heteroskedasticity, which means that variances in a random series are different. In this study, we focus on grain price volatility. If we find heteroskedasticity, we say that the ARCH effect exists. We can test the risk of the grain price volatility by using this method. Clustering effects means that heteroskedasticity effects may gather during a specific period. When a small fluctuation causes another smaller fluctuation, we say that the clustering shrinks. However, when a big fluctuation causes another greater fluctuation, we say that the clustering expands. High-risk-high-return effect refers to investors who hunt for high benefits during their investment but they also face high risk at the same time. In Chinese grain markets, these investors include middlemen who can decide to buy grains from farmers or sell their stocks to the grain demanders and speculators who invest their funds in future grain markets.

The ARCH model proposed by Engle (1982) is consists of two equations:

$$R_t = X'\gamma_0 + \varepsilon$$

$$h_t = a_0 + \sum_{i=1}^{q} a_i \, \varepsilon_{t-1}^2$$

where, R_t is grain price volatility in this study, X' is the lag of R_t, and h_t is the conditional variance of ε at time t, and it is defined as the sum of the residual lag weighted square. The first equation is the mean equation and the second one is

defined as a variance equation. $\sum_{i=1}^{q} a_i \varepsilon_{t-i}^2$ is called an ARCH item. If it shows high significance, grain price volatility shows a significant clustering effect. Furthermore, when the estimated value of a_i is greater than 1, we say the fluctuation will expand; otherwise we say the fluctuation shrinks.

The ARCH-M (ARCH-in-mean) model is proposed by Engle, *et al.* (1987). They added ht in the mean equation of ARCH models, which can be shown as:

$$R_t = X'\gamma_0 + \lambda h_t + \varepsilon$$

where, λ verifies whether the grain markets have high-risk-high-return effects or not. A positive λ means investors appreciate risk, while negative value suggests risk aversion.

The TARCH (Threshold ARCH) model was established by Rabemananjara, *et al.* (1993), whose conditional variance equation is:

$$h_t = a_0 + a_1\varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \varphi d_{t-1}\varepsilon_{t-1}^2$$

In this model, we will focus on φ that if φ> 0, which means that fluctuations caused by price decline is greater than by price increases. But if φ <0, fluctuations caused by price decline is less than by price increases.

The EGARCH (Exponential Generalized Autoregressive of Conditional Heteroskedasticity) model proposed by Nelson (1991) is modified in the conditional variance equation:

$$Lnh_t = a_0 + \beta_1 Lnh_{t-1} + a\left|\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}\right| + \gamma\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}$$

When γ is positive, fluctuations caused by price decline is less than by price increases, while a negative γ means that fluctuation caused by price decline is larger than by price increases.

Weekly Chinese wholesale prices for indica rice, japonica rice, wheat, corn and soybeans from January 11, 1998 to May 27, 2012 were collected from the Chinese grain and oil wholesale market prices network system, where authoritative average wholesale grain prices are published every week. Grain prices volatilities are calculated by using the adjacent week's grain prices, that is, $R_t = Lnp_t - Lnp_{t-1}$. We examined our data in 5 periods, before China joined WTO, after China joined WTO, after China promoted farmers' income in 2004, within the high world grain prices and in the recent era.

3.3 Results and discussion

Descriptive statistics showed that price volatility has sharp peaks and fat tails in all of the 5 selected periods. We used an augmented dickey-fuller test and found that grain price volatilities for all grains were stable at the 1% significance level among all of the 5 periods.

We implemented an ARCH-LM test to examine whether the heteroskedasticity effect exists or not (Table 3.3.1). Our estimated result shows that price volatility for wheat and corn had ARCH effects before China joined WTO. After which, price volatilities of wheat, indica rice and soybeans showed ARCH effects.

Since China promoted farmers' incomes in 2004, ARCH impacts exist for wheat, japonica rice and indica rice. But during the high world grain prices in 2008, price volatilities of soybeans, japonica rice and corn were proved to have ARCH effects. In addition, price volatilities of corn and indica rice suggests the ARCH effect in recent years.

Table 3.3.1 Results of ARCH-LM test on Chinese grain price volatilities

Grains	ARCH-LM	Before China joins WTO Jan. 11, 1998 - Dec. 11, 2001	After China joins WTO Dec. 11, 2001- Dec. 31, 2003	After promoting farmer's income Dec. 31, 2003 - Jun. 24, 2007	During high world grain prices Jun. 24, 2007 - Dec. 28, 2008	After high world grain prices Dec. 28, 2008 - May 27, 2012
Soybeans	N*R-squared	0.163	6.61	3.95	14.5	3.35
	Prob. Chi-Square	0.687	0.0101	0.0469	0.00600	0.0671
Wheat	N*R-squared	9.33	17.1	9.73	3.35	2.45
	Prob. Chi-Square	0.0023	0.000	0.00180	0.0671	0.118
Indica rice	N*R-squared	0.907	9.20	33.4	2.15	16.9
	Prob. Chi-Square	0.341	0.0024	0.000	0.143	0.0007
Japonica rice	N*R-squared	11.7	1.61	13.9	22.9	5.09
	Prob. Chi-Square	0.0397	0.205	0.000	0.000	0.0241
Corn	N*R-squared	14.9	0.0775	4.52	8.62	13.7
	Prob. Chi-Square	0.000	0.781	0.0336	0.0033	0.000
Results ARCH effects		wheat, corn	wheat, indica rice, soybeans	wheat, indica rice, japonica rice	soybeans, japonica rice, corn	corn, indica rice,

Source: Authors' calculation.

Then, we employed ARCH family models in different periods. Table 3.3.2 tells us the results for before China joined WTO. For wheat, the ARCH statistic is significant at 1% level, indicating that a significant price fluctuation clustering effect exists.

Furthermore, its value is significantly greater than one, indicating that the clustering impact will expand. The results also suggest that a 1% increase in the past volatility leads to a 0.232% decrease in the current volatility. We also find that λ is negative and significant, meaning that the risk aversion effect exists.

Results from the TGARCH and the EGARCH models show that φ is negative and γ is positive at the 1% significance level, so wheat price volatility is asymmetric and information for increasing prices is more influential. Our results suggest a significant clustering effect for corn, but this impact will gradually disappear.

In addition, a 1% increase in the past volatility leads to a 0.30% decrease in the current volatility. Negative λ shows that there is the risk aversion effect exists. The TGARCH and EGARCH models report that information for increasing prices is more influential than the information for decreasing prices.

Table 3.3.2 Results of ARCH-type models before China joined WTO in 2001

Grains	Parameter	ARCH		GARCH-M		TGARCH		EGARCH		Results
	λ			-0.165***	(-4.10)					
	R_{t-1}	-0.232***	(-8.22)	-0.195***	(-4.89)	-0.23***	(-6.11)	-0.33***	(-7.09)	
	a_0	0.000129***	(8.67)	0.000112***	(7.68)	0.000124***	(7.84)	-8.73***	(-60.6)	Cluster and expand
wheat	a_1	2.115***	(11.3)	1.91***	(9.18)	3.79***	(7.05)			Risk aversion;.
	φ					-2.71***	(-4.40)			III
	a							0.675***	(8.09)	
	γ							1.57***	(7.03)	
	λ			-0.119	(-1.43)					
	R_{t-1}	-0.304***	(-2.86)	-0.309***	(-2.84)	-0.306***	(-2.86)	-0.265*	(-2.51)	
	a_0	0.000163***	(8.41)	0.000162***	(7.85)	0.000***	(8.45)	-8.94***	(-76.0)	Cluster and shrink
corn	a_1	0.332**	(2.27)	0.331**	(2.21)	0.319	(1.73)			Without HH;.
	φ					-0.025*	(-0.106)			III
	a							-0.0401	(-0.350)	
	γ							0.662***	(4.03)	

Source: Authors' calculation.

Note 1: HH: high-risk high-return effect; III: information for increasing prices is more influenced

Note 2: Values in parentheses is z-statistics; * indicates a significant level of 10%, ** significant level of 5%, *** level of 1%, respectively.

After China joined WTO, there is a significant clustering effect for soybeans, but the impact gradually disappears (Table 3.3.3). In addition, the past volatility has no significant influence on the current volatility. A significant positive λ shows a high-risk high-return effect. Results of the TGARCH and EGARCH models suggest that information for increasing prices is more influential. Results for wheat and indica rice are similar to soybeans, except that there is no high-risk high-return effect for wheat and corn, the clustering impact for wheat shrinks, the clustering impact for indica rice shows expands, and a 1% increase in the past volatility for indica rice significantly leads to a 0.310% decrease in the current volatility.

China started promoting farmers' income in 2004 and our result in Table 3.3.4 shows a significant clustering effect but without a high-risk high-return effect for wheat in this period. In addition, the shrink clustering impact exists and information for increasing prices is more influential. Results of indica rice and japonica rice are similar to that of wheat.

Our findings in Table 3.3.5 suggest that during the high world grain prices in 2008, none of the price volatilities of domestic soybeans, corn and japonica rice showed high-risk high-return effects. In addition, information for increasing prices is more influential more than information for decreasing prices. Particularly, the results from the mean equations show that the 1% increases in the past volatility can significantly cause the decreases in the current volatility at 0.302%, 0.353% and 0.266%for soybeans, corn and japonica rice, respectively. In addition, there is a significant shrink clustering impact for corn at the 10% significance level.

Table 3.3.3 Results of ARCH-type models after China joined WTO in 2001

Grains	Parameter	ARCH		GARCH-M		TGARCH		EGARCH		Results
soybeans	λ			0.243**	(2.21)					Cluster and shrink HH III
	R_{t-1}	-0.147	(-0.958)	-0.167	(-1.11)	-0.121	(-0.823)	-0.101	(-0.690)	
	a_0	0.000342***	(8.81)	0.000***	(8.64)	0.000***	(8.57)	-7.92***	(-62.0)	
	a_1	0.458***	(2.50)	0.378***	(2.49)	0.283	(1.6)			
	φ					-0.415	(1.01)			
	a							-0.0938	(-0.723)	
	γ							0.490**	(2.50)	
wheat	λ			0.139	(1.42)					Cluster and shrink Without HH III
	R_{t-1}	-0.117	(-0.97)	-0.132	(-1.15)	-0.112	(-0.927)	0.0746	(0.755)	
	a_0	0.0000537***	(6.42)	0.000***	(7.58)	0.000***	(6.33)	-10.0***	(-56.1)	
	a_1	0.599***	(3.03)	0.595***	(3.12)	0.586***	(3.02)			
	φ					-0.0580	(0.101)			
	a							-0.196	(-1.18)	
	γ							1.01***	(4.36)	
indica rice	λ			0.055	(0.862)					Cluster and expand Without HH III
	R_{t-1}	-0.31***	(-4.37)	-0.321***	(-4.16)	-0.275***	(-3.36)	-0.0325	(-0.356)	
	a_0	0.0000195***	(4.44)	0.000***	(4.39)	0.000***	(5.17)	-10.8***	(-65.3)	
	a_1	1.152***	(5.36)	1.177***	(5.16)	1.71***	(4.34)			
	φ					-1.49***	(-3.51)			
	a							0.431***	(3.41)	
	γ							1.16***	(10.1)	

Source: Authors' calculation.

Note 1: HH: high-risk high-return effect; III: information for increasing prices is more influenced.

Note 2: Values in parentheses is z-statistics; * indicates a significant level of 10%, ** significant level of 5%, *** level of 1%, respectively.

Table 3.3.4 Results of ARCH-type models from 2004 to 2007

Grains	Parameter	ARCH		GARCH-M		TGARCH		EGARCH		Results
wheat	λ			-0.129**	(-2.08)					Cluster and shrink Risk aversion III
	R_{t-1}	-0.0314	(-0.369)	-0.0876	(-1.04)	0.0400	(0.457)	0.122***	(1.34)	
	a_0	0.0000341***	(7.00)	0.000***	(6.94)	0.000***	(7.09)	-10.2	(-80.3)	
	a_1	0.624***	(5.31)	0.687***	(5.20)	0.942***	(4.05)			
	φ					-0.764***	(-2.82)			
	a							0.282**	(2.56)	
	γ							0.557***	(3.82)	
indica rice	λ			0.0470	(0.688)					Cluster and shrink Without HH III
	R_{t-1}	-0.050	(-0.490)	-0.0614	(-0.575)	-0.0639	(-0.591)	0.032	(0.34)	
	a_0	0.0000983***	(19.0)	0.000***	(17.7)	0.000***	(19.2)	-9.32***	(-166)	
	a_1	0.442***	(3.56)	0.457***	(3.27)	0.536***	(3.38)			
	φ					-0.250	(-0.908)			
	a							0.0765	(0.652)	
	γ							0.722***	(4.7)	
japonica rice	λ			-0.00754	(-0.097)					Cluster and shrink Without HH III
	R_{t-1}	-0.207***	(-2.81)	-0.207***	(-2.79)	-0.228***	(-3.37)	-0.212***	(-2.46)	
	a_0	0.000245***	(12.3)	0.000***	(12.3)	0.000***	(12.6)	-8.20***	(-82.0)	
	a_1	0.356***	(4.10)	0.357***	(4.03)	0.520***	(3.26)			
	φ					-0.514***	(-3.07)			
	a							0.363***	(4.39)	
	γ							0.260***	(1.98)	

Source: Authors' calculation.

Note1: HH: high-risk high-return effect; III: information for increasing prices is more influenced

Note2：Values in parentheses is z-statistics; * indicates a significant level of 10%, ** significant level of 5%, *** level of 1%, respectively.

Table 3.3.5 Results of ARCH-type models during high world prices 2007-2008

Grains	Parameter	ARCH		GARCH-M		TGARCH		EGARCH		Results
soybeans	λ			0.148	(1.20)					No cluster Without HH III
	R_{t-1}	-0.302 **	(-2.11)	-0.406 ***	(-4.00)	-0.419 ***	(-4.47)	-0.439 ***	(-3.98)	
	a_0	0.000412	(0.904)	0.000670 *	(1.76)	0.000707 **	(2.15)	-6.19 ***	(-3.62)	
	a_1	0.364	(1.36)	0.711 **	(2.19)	0.501	(1.56)			
	φ					-0.926*	(1.67)			
	a							-0.314	(-1.50)	
	γ							1.06 ***	(3.16)	
corn	λ			0.131	(1.18)					Cluster and shrink Without HH III
	R_{t-1}	-0.353 ***	(-3.13)	-0.364 **	(-3.15)	-0.356 ***	(-2.69)	-0.368 ***	(-3.23)	
	a_0	0.000164 ***	(5.06)	0.000 ***	(5.16)	0.000 ***	(4.72)	-8.83 ***	(-42.9)	
	a_1	0.311 *	(1.83)	0.32 *	(1.74)	0.117	(0.588)			
	φ					-0.308	(0.692)			
	a							-0.111	(-0.655)	
	γ							0.582 **	(2.51)	
japonica rice	λ			-0.0321	(-0.22)					No cluster Without HH III
	R_{t-1}	-0.266 *	(-1.78)	-0.266 *	(-1.78)	-0.270*	(-1.77)	-0.143	(-1.30)	
	a_0	0.000196 ***	(7.85)	0.000 ***	(7.08)	0.000 ***	(7.81)	-8.62 ***	(-61.4)	
	a_1	0.233	(1.10)	0.230	(1.10)	0.250	(0.851)			
	φ					-0.0369	(-0.11)			
	a							-0.0875	(-0.492)	
	γ							0.409*	(1.76)	

Source: Authors' calculation.

Note1: HH: high-risk high-return effect; III: information for increasing prices is more influenced.

Note2: Values in parentheses is z-statistics; * indicates a significant level of 10%, ** significant level of 5%, *** level of 1%, respectively.

Table 3.3.6 Results of ARCH-type models in the recent era 2008-2013

Grains	Parameter	ARCH		GARCH-M		TGARCH		EGARCH		Results
corn	λ			0.286***	(3.68)					No cluster HH III
	R_{t-1}	-0.112	(-1.54)	-0.171**	(-2.44)	-0.010	(-0.147)	-0.107	(-1.18)	
	a_0	0.0000290**	(2.05)	0.0000277**	(2.3)	0.0000403***	(3.48)	-12.5***	(-7.73)	
	a_1	0.056	(1.21)	0.0606	(1.37)	-0.0952	(-1.35)			
	φ					-0.303**	(2.19)			
	a							-0.0636	(-0.504)	
	γ							0.530**	(2.45)	
indica rice	λ			0.0554	(0.696)					Cluster and shrink Without HH III
	R_{t-1}	-0.311***	(-4.14)	-0.315***	(-3.72)	-0.323***	(-4.3)	-0.268***	(-3.51)	
	a_0	0.000165***	(6.29)	0.000***	(6.28)	0.000***	(6.55)	-8.810***	(-55.8)	
	a_1	0.742***	(3.85)	0.686***	(3.41)	1.020***	(4.50)			
	φ					-0.570**	(-2.15)			
	a							0.137	(1.48)	
	γ							0.866***	(4.66)	

Source: Authors' calculation.

Note1: HH: high-risk high-return effect; III: information for increasing prices is more influenced.

Note2: Values in parentheses is z-statistics; * indicates a significant level of 10%, ** significant level of 5%, *** level of 1%, respectively.

In this study, we find that significant high-risk high-return effects existed for corn in the recent era (Table 3.3.6). The ARCH statistic is 0.742 at the 1% significance level, indicating there is a shrinking clustering impact for indica rice. Our result also suggests that the 1% increases in the past volatility significantly leads to the 0.311% decreases in the current volatility. In addition, information for increasing prices is more influential for both corn and indica rice.

Table 3.3.7 Comparison with previous study

Grains	Characteristics	Time periods					Luo, *et al.* (2010)
		Before China joins WTO	After China joins WTO	After promoting farmer's income	Within high world grain prices	After high world grain prices	
		Jan. 11, 1998 - Dec. 11, 2001	Dec. 11, 2001- Dec. 31, 2003	Dec. 31, 2003 - Jun. 24, 2007	Jun. 24, 2007 - Dec. 28, 2008	Dec. 28, 2008 - May 27, 2012	Mar. 1997 - Dec.2007
soybeans	Heteroskedasticity effect cluster high-risk high-return no-symmetry	No ARCH	yes yes yes yes	No ARCH	yes no no yes	No ARCH	No ARCH
wheat	Heteroskedasticity effect cluster high-risk high-return no-symmetry	yes yes no yes	yes yes no yes	yes yes no yes	No ARCH	No ARCH	yes yes no yes
corn	Heteroskedasticity effect cluster high-risk high-return no-symmetry	yes yes no yes	No ARCH	No ARCH	yes yes no yes	yes yes yes yes	yes yes no no
indica rice	Heteroskedasticity effect cluster high-risk high-return no-symmetry	No ARCH	yes yes no yes	yes yes no yes	No ARCH	yes yes no yes	No ARCH
japonica rice	Heteroskedasticity effect cluster high-risk high-return no-symmetry	No ARCH	No ARCH	yes yes no yes	yes no no yes	No ARCH	No ARCH

Source: Authors' calculation, Luo, *et al.* (2010)

3.4 Conclusions

In this study, we employed ARCH family models to analyze Chinese grain price fluctuation. We found that before China joined WTO, wheat and corn show significant ARCH effects, but neither of them shows high-risk high-return effects. Soybeans, wheat and indica rice show clustering effects after China joined WTO, among which, soybeans are regarded as risk appetite. Since 2004, wheat and milled

rice have had significant ARCH effects. However, the clustering effect is barely found for corn during the skyrocketing world grain prices. Nowadays, the high-risk high-return effect exists for corn due to its insufficient supply.

A clustering effect suggests that a larger price fluctuation follows a previous large one, while a smaller price fluctuation follows a previous small one. Therefore, farmers should take the most beneficial selling price, and feed-companies can avoid wasting money when prices are rising, while investors can enlarge their investments to gain more benefits from the market sentiment.

Based on our analysis, we provide the following policy implications: Firstly, China needs to be aware that excessive grain price volatilities may cause negative effects, not only on farmers' enthusiasm in cultivation, but also on grain demanders' consumption power. Secondly, China can forecast the grain price fluctuations and take effective policy measures. Finally, it is necessary to reduce the speculators hoarding of large numbers of grains, which may lead to insufficient domestic grain supply.

Investors such as middlemen and speculators showed risk aversion in wheat and corn before China joined WTO. After China joined WTO, they are risk aversion in wheat and indica rice, but they showed great interest in soybean, which suggested risk appreciate. After promoting farmers since 2004, investors are risk aversion in staple food such as wheat, japonica rice and indica rice. Within the high grain prices in the world in 2008, soybean, corn and japonica rice showed risk aversion effects. While in the recent era, indica rice showed risk aversion to middlemen and speculators, but corn showed risk appreciate, which may bring a challenge for corn in the next few years.

CHAPTER 4

EVALUATION OF GRAIN PRICE STABILIZATION POLICIES IN CHINA: HOW DID CHINA CONTROL THE DOMESTIC GRAIN PRICES IN 2008

4.1 Background and existing reports

In 2008, global prices of agricultural products skyrocketing increases and reached a record, although the increasing levels of price various among different agricultural products, including rice. The US rice prices shot up and reached its peak on April 27, 2008 at $874.49/ton, an increase of more than 100% as compared to the prices on May 6, 2007. The US wheat price took off and reached its peak on 16th, March in 2008, with the price of 546.76 $/ton, which is 2.41 times than the price on May 6, 2007. And the peak price of US corn appeared on 19th, July, 2008, up to 297.13 $/ton, which nearly doubled compared with the price in the middle of 2007. The US soybeans highest price was 761.92 $/ton, which was 2.26 times compared with May 6, 2007.

There are several reasons for the prices spiked. First of all, in 2008, the world cereal production decreased since the impact of climate disasters. Secondly, the growing world demand for cereals brings international food price crisis rapidly spreading, including part of the grain and oil have been used to produce fuel ethanol and bio-diesel. Also, some developing countries reduce domestic food production because of industrialization and urbanization. Food-exporting countries have

introduced food export policies to control the domestic grain price, while food-importing countries have to scramble for food in the international market.

As both the largest rice production and consumption country, China also plays an important role in world rice trade. However, China hasn't been influenced by the international food crisis due to adequate food stocks in 2008, and main domestic grain prices in China remained relatively stable. For example, the peak prices of japonica rice prices, indica rice, wheat, corn in China in 2008 had just increased 35%, 28%, 11% and 26%, respectively, comparing with the prices in the middle of 2007. However, soybeans prices in China increased 2.05 times compared with May 6, 2007, still less than the increase of international prices ratio at 2.26 times.

Main grain prices' increase in China was rather moderate as compared to the US market. That is because that China government had taken a series of measures and policies to ensure grain supply and price stability. In 2008, the Chinese government promulgated a series of policies on Chinese grain development, such as financial subsidy to farmers, minimum rice procurement prices for northeast China's rice, minimum grain purchasing price plan, temporary grain storage plan, and trade policy.

Chinese rice policies have reacted positively to domestic trade, safeguard farmer's profits and ensure stable grain production. China had successfully deal with the challenges of international food security, and the domestic grain prices remain relatively stable, which had made contribution to the development of national economy. However, the Chinese domestic grain prices remained more stable than the US prices. The characteristics of the Figure 4-1 show that global agricultural products prices rose dramatically in 2008, while domestic grain prices in China were rather moderate as compared to the US market. In 2008, global prices of agricultural

products rose dramatically due to skyrocketing increases in crude oil prices and greater demand for corn for bio-energy. However, main domestic grain prices in China remained relatively stable due to a variety of policy measures. Weekly grain prices from February 25, 2007 to March 27, 2011 in China and US were compared in this study (Fig. 4.1.1).

Peak prices of milled rice, wheat, corn and soybeans in the US markets in 2008 appeared on April 27, March 16, June 29 and July 6, respectively. Comparing with the prices on February 25, 2007, their growth rates are 128%, 141%, 98% and 126%, respectively. In contrast, peak prices of grains in China in 2008 delayed, except for soybeans. Growth rates of indica milled rice, japonica milled rice, wheat, corn and soybeans in China were also lower than in the US market, at 35%, 28%, 11%, 26% and 105%, respectively. Soybean prices in China fluctuated in a rather similar style as the US soybean.

The overall objective of this research is to study the price stabilization in China in 2008 in order to contribute to what extent the domestic grains' price correlated with the international market and the reasons why China can keep its rice price stable during the world rice prices skyrocketing. As the movements of domestic prices of main grains quite differ from that of the world prices, this study in specific will take rice as an example and investigate Chinese rice policies so as to discuss the following three aspects: Firstly, this study attempt to find out to what extent the domestic grains' price correlated with the international market. We will calculate the correlation coefficients of the prices of japonica rice prices, indica rice, wheat, corn and soybeans between the China's and the US markets in recent era, and a comparison to the result will show the relationships between the two markets. Secondly, this study aims to

answer the question of how did China control its domestic rice price in 2008. Fully analysis on various rice policies in 2008 in China will explain the effectiveness of China's policy control to stabilize the rice price in 2008. Thirdly, based on the analyses, this study will provide some policy recommendation because the relatively successful experience in China showed important implications for other countries.

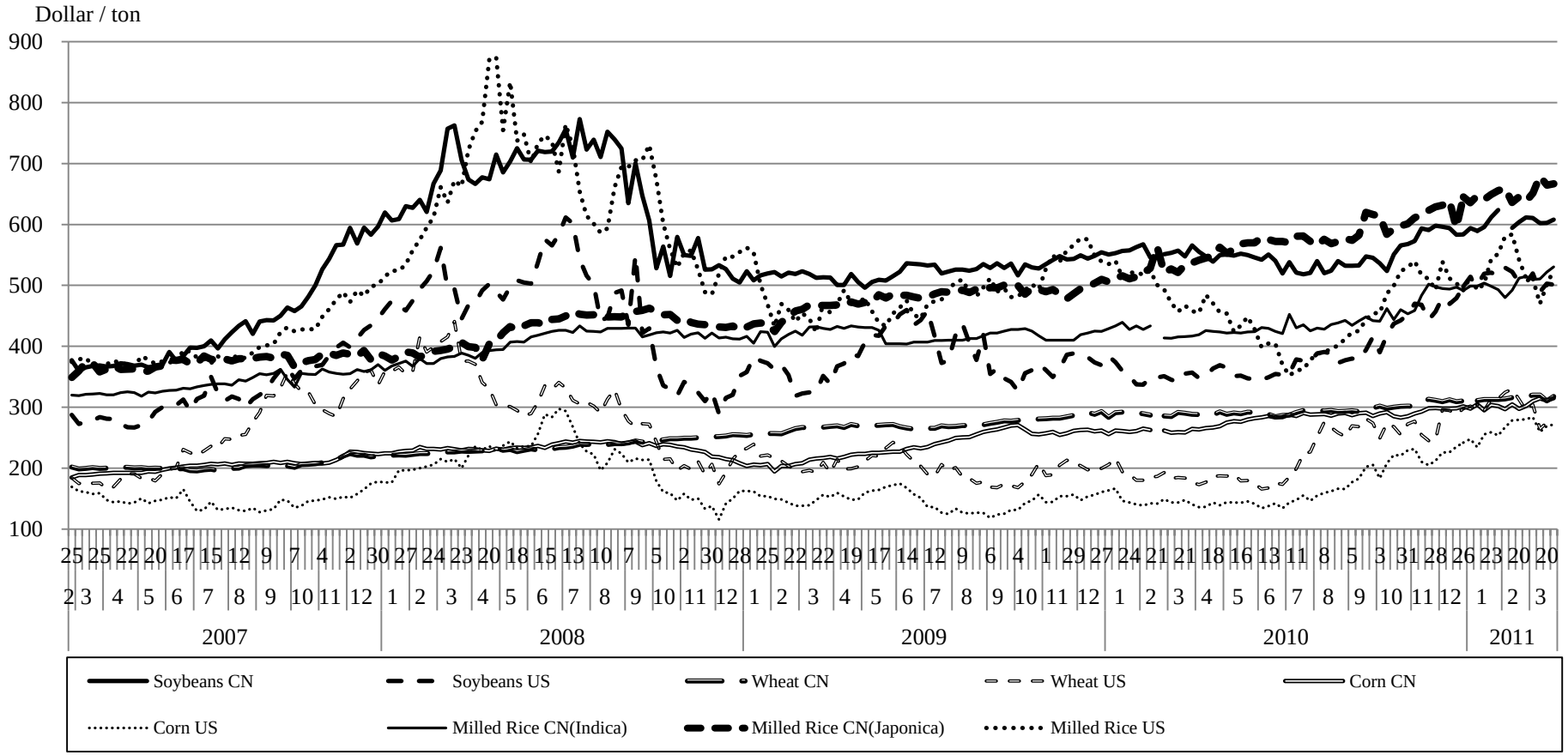

Fig. 4.1.1 Weekly grain prices in China and the US markets

Source: China Grain Data Center, http://datacenter.cngrain.com

The Central Parity of RMB, State Administration of Foreign Exchange, http://www.safe.gov.cn

World Grain Prices and Graphs, http://worldfood.apionet.or.jp/pricechart/chartE/No1-3.html

We studied literatures about price stabilization. There were several studies analyzing about price stabilization in academic studies. However, none of existing papers analyzed the reasons for China's stabilization of grain prices, especially rice, the main food in China, from the policy point of view. They studied the grain price stabilization in some Asia countries such as India and some countries in Eastern and Southern Africa.

Among those, Hanley, *et al.* (1993) studied price stabilization by using data between 1982 and 1987. He found that stabilization truncated the distribution of post-issue prices at a floor price, lowering the risk of adverse price moved and hence, in a competitive dealer market, reducing the bid-ask spread. He pointed that spreads narrow when the market price was close to the offer price and stabilization was most likely. Moreover, significant negative returns were documented after the hypothesized termination of stabilizing activities, suggesting that price stabilization affected market prices.

Herings (1997) gave a price adjustment process for an exchange economy to study that converges generically to Walrasian equilibrium. The assumptions made with respect to consumptions. Preferences and initial endowments were standard. No restrictions are made with respect to the starting price system. In this special case, the prices of commodities in excess demand or supply are strictly increasing or decreasing, and therefore the qualitative behavior of the process resembles the Walrasian process. Moreover, on every market the absolute value of the total excess demand was monotonically decreasing.

Sarris (2000) reviews the types of responses of low income food deficit country agents to food related shocks. He argued that the world cereal markets do not appear to have become more unstable despite recent liberalization and declines in world stocks. Then he proposes the institution of a fund aimed at providing option like contracts to the LIFDCs, to insure that they would not incur excessive food import costs in times of need. The premiums of such contract could be subsidized by developed countries, as part of their overall aid. While such a fund would not provide full insurance against excessive food import bills, it would go part of the way toward such a goal. Simulations of the proposal suggest that the cost to develop and developing countries alike would seem to be smaller than the cost of current arrangements, and the benefits would seem larger.

Srinivasan and Jra (2001) analyzed the effects of liberalizing food grain trade on domestic price stability using a multi-market equilibrium model in which the direction of trade is determined endogenously and world prices are sensitive to the amount traded by India. Simulation results demonstrated that contrary to popular belief, freeing of trade by India leads to greater domestic price stability even though world prices are more volatile. Freeing of trade by India also leads to higher world price stability. Under liberalized trade, variable levies subsidies are more effective in stabilizing domestic prices compared to buffer stocks. It is therefore in India's interest to argue for non-zero binding on import tariffs and export subsidies at the WTO negotiations.

Athanasius, *et al.* (2008) pointed out in his paper that the price stabilization was stated and solved for a nonlinear cobweb model with government stocks. It was shown that if the storage capacity for the commodity was sufficiently large then a

simple stabilization policy existed, called the 'keep supply at equilibrium (KSE)' policy, such that the equilibrium price is a global attractor for the corresponding closed-loop system. In addition, it is shown that if the government approximates the equilibrium supply with the average supply, stabilization is guaranteed.

Rashid and Cummings (2007) employed case studies from six Asian countries. He pointed in his paper that assesses the relevance of underlying rationales for public intervention in food grain markets, documents the existing policies and regulatory supports to grain marketing parastatals, examines benefits and costs of parastatals, and summarizes lessons from reforms and reduced interventions. The results suggest that commonly cited rationales for food market intervention are no longer convincing, the costs of parastatals- led price stabilization are staggering, and the price policies are being dictated by special interests. The evidences from the early reformers indicate that reduced intervention can promote competition, reduce subsidies, and release funds for development and anti-poverty programs—all without jeopardizing price stability.

Dawe (2001) said in his paper that although international trade agreements are pushing the world in the direction of free trade, price stabilization, remained important in developing Asia because of the large share of rice in economic output. A policy of pure price stabilization for rice, without consistent protection (either subsidization or taxation), can help to create the macroeconomic stability that is essential for sustained rapid economic growth by increasing the quantity and efficiency of investment throughout the economy. Pure price stabilization can also generate significant equity gains by protecting poor consumers and farmers from sharp fluctuations in prices. While domestic commodity price stabilization schemes

have a checkered history around the world, the experience of Asian countries in stabilizing rice prices offers more scope for optimism. Asian governments have been generally successful in stabilizing rice prices, and there are several instances where this has been accomplished without sustained protection of either consumers or farmers. However, there is room for improved stabilization mechanisms that would lower the costs of intervention.

Cummings, *et al*. (2006) proved his argument that governments in most Asian countries used grain price stabilization as a major policy instrument when they embarked on promoting the Green Revolution. The art of public policy-making is to know when to introduce government interventions and when to withdraw. The common mistake is to forget the withdrawal part, leading to unsustainably high costs – a dilemma that most Asian countries are confronted with today. Analyzing case studies of six Asian countries, which have tried to tackle the task in different ways with varying degrees of success, eight key lessons can be learned from the more than three decades of food price stabilization in Asia. Times have changed: policies and public agencies that may have been appropriate 30 years ago are not optimal today. Private institutions have strengthened significantly, or could be strengthened significantly, and should be entrusted for many of the functions that parastatals, or other government agencies, have traditionally performed. Holding on to old practices delays reaping the benefits that changing current policies have to offer.

Stephen (1979) considers several issues pertaining to the role of an efficient futures market for price stabilization. The main aspect which is emphasized is the provision of information by such a market. It provided efficient forecasts which facilitate both production and storage decisions. As a result of which the stability of

spot prices is generally increased. The allocation of the benefits from a futures market to the various groups in the economy is discussed and the present results related to those of the more traditional buffer stock literature. Finally, the degree of stability provided by a futures market is compared with that obtained by active market intervention by a stabilization authority.

Jha and Srinivasan (2001) explored the implications of private storage and subsidized distribution of food grain for price stabilization policies in India through simulation exercises. A multimarket equilibrium approach was used to incorporate the simultaneity in the determination of supply and demand for the three major cereals, namely, rice, wheat, and coarse cereals. The policy implications of the results obtained are relevant to the current debate on agricultural policy reforms in India.

Poulton, *et al.* (2006) discussed the desirability and options for the stabilization of staple food prices principally in Eastern and Southern Africa. It considers a number of options for price stabilization, assessing the strengths and weaknesses of each and suggesting situations in which each may be appropriate. These questions addressed the reason that stabilization of food (grain) prices desirable, and he also made some comments for technically feasible of price stabilization.

Ahmed (1988) reviewed the rationale of price stabilization, establishes the importance of price stabilization for food security, examines the nature and extent of fluctuations in rice prices, and develops an approach to stabilize rice prices in Bangladesh. The results showed that the extent of annual price variability has increased somewhat in the post-technology period compared to pre-technology period. Seasonal pattern of prices has also changed with sharper troughs in September and peak in May in the 1976-1984 periods. The paper argued that the theoretical positions

against price stabilization are not valid in the context of rice price in Bangladesh. A framework for stabilization of rice prices that integrates public procurement, import, rationing and open market operations is developed in order to contain annual and seasonal prices within desired price bands.

Benveniste, *et al.* (1998) said in his paper that the initial public openings that receive secondary market price support from their underwriters are characterized by severely attenuated selling by small-quantity, presumably retail, traders and more aggressive selling by large-quantity, presumably institutional, traders. The increase in institutional trading is concentrated in the first day of trading while the attenuation of retail trading persists. This pattern exists in spite of the likelihood that retail investors receive relatively large initial allocations of (fully priced) stabilized. Thus, the evidence is consistent with institutional investors being the primary benefit canaries of price stabilization exports and with the use of penalty bids to constrain retail selling activity.

Macbean and Nguyen (1987) found out that the rationale for intervention is that markets produce excessive price fluctuations causing micro and macroeconomic damage. Theoretical arguments for price stabilization are reviewed. The links with other objectives are discussed and reasons why ultimate objectives such as income stabilization may not be achieved are set out. The paper points out how actual agreements have been far from ideal because of political and practical problems. The sheer technical difficulties of operating a buffer stock are demonstrated by a simulation experiment which traces the reactions to exogenous shocks with and without the interventions of the buffer stock.

Focused on Chinese grain market, especially during the world price spike in 2008, there are not so many studies. Among previous studies, William, *et al.* (2010) employed Anderson's dataset to calculate the stabilization index.

Yang (2008) stressed in his article that how China is being affected by and is responding to the world food crisis. And the Chinese officials have responded to higher world prices by drawing down stocks and limiting exports of major grains. These policy instruments were not available for soybeans, so domestic prices of soy and other oilseeds have risen with international prices. Using a global CGE model, he showed that the initial world price rise was largely due to higher world oil prices and demand for bio-fuels as opposed to other factors, especially in maize and soybeans. China's response to this shock has kept domestic grain prices low relative to world grain markets and to domestic soybean prices. As grain stocks are depleted, however, demand growth will push domestic prices back into alignment. Anticipating this pressure on consumers and accelerating supply response through public investment will facilitate adjustment.

The previous literatures gave much idea to this study. However, majority of those studies were in the form of reports and notes written by researchers and analysts of local and international organizations. Only few of them were in the form of journal paper. Consequently, they analyzed and concluded mainly based on the graphical and descriptive analyses. Studies with empirical analyses were quite limited. So this study attempts to answer the questions mentioned above. Our study is very valuable because that Chinese experience for grain price stabilization during the world grain price spiked is not important to Chinese domestic policies, but also provides important experience to the other countries in the world.

4.2 Methodology and data

This study attempts to analyze the price stabilization of rice, wheat, corn and soybeans in China in recent year. Data applied in this study are shown in Table 4.2.1. We considered the US wheat, corn and soybeans prices as the world prices due to its great share in world grain trade market.

Table 4.2.1 Explanation for data resources used in this study

Data	Periods
Weekly grain prices in China	Feb. 25, 2007 to Mar. 27, 2011
Weekly grain prices in US	Feb. 25, 2007 to Mar. 27, 2011
Weekly exchange rates	Feb. 25, 2007 to Mar. 27, 2011
Monthly grains export volume in China	Jan. 2006 to Mar. 2011
Monthly grains export value in China	Jan. 2006 to Mar. 2011
Monthly import volume for soybeans	Jan. 2006 to Mar. 2011
Monthly grain prices in US	Jan. 2006 to Mar. 2011
Grain policies and market information	Feb. 2007 to Mar. 2011

Source: China Grain Datacenter, Chicago Board of Trade, Bank of China, Commerce Department of China, General Administration of Customs of China, China Grain Information Center, etc.

According the previous study by Ito (1991) and the survey in rice markets in US and Thailand, we found that the US and Thai rice exports prices are highly competiveness. So we used US rice as the world rice price in this study. We use 1 week lagged data because we assumed that the impacts of changing prices in the Chicago Board of Trade take 7 days or so to reach the Chinese due to adjustments in the Chinese local marketing system.

In addition, we compared the price by using the real price of rice, wheat, corn and soybeans. The weekly exchange rates between the Chinese yuan and the US dollar were calculated by taking data from the Bank of China. The units of price also conversed under the same calculation. Turning points of those grain price differences were selected, which we used to test the correlation coefficients between China's wholesale market and the US grain market.

We attempts to use a list of graphs and tables to describe the price differences between Chinese japonica rice, indica rice, wheat, corn and soybeans prices and the same crops' prices in US market. We will compare those grain prices based on the calculation of the weekly exchange rates between the Chinese yuan and the US dollar. And we change unites of different grains into the same style. All the above methods made the price in domestic China and abroad comparable.

Also, we are going to analyze correlation coefficients of japonica rice, indica rice, wheat, corn and soybeans prices in domestic and abroad. We assumed that the impacts of changing prices in the Chicago Board of Trade take 7 days or so to reach the Chinese due to adjustments in the Chinese local marketing system. So we use 1 week lagged data in this study. Turning points of those grain price differences were selected, based on which we attempts to test the correlation coefficients between China's wholesale market and the US grain market.

Correlation coefficient (typically denoted by r) was developed by Karl Pearson, and now have widely used in statistics as a measure of the strength of linear dependence between two variables. So the correlation coefficient is sometimes called "Pearson's r."

The formula of correlation coefficient can be defined as follows:

$$\gamma = \frac{1}{\mathrm{n}-1}\sum_{i=1}^{n}\left(\frac{X_i - \bar{X}}{s_X}\right)\left(\frac{Y_i - \bar{Y}}{Y_X}\right)$$

Where,

r stands for correlation coefficient

X and Y are two variables,

n stands for the number of sample

$\left(\frac{\mathrm{X_i}-\bar{\mathrm{X}}}{\mathrm{s_X}}\right)$, $\bar{X}$ and s_X are the standard score, sample mean, and sample standard deviation respectively. The meanings of variables related to Y are the same to X. This study calculates sample's correlation coefficient of the price of japonica rice, indica rice, wheat, corn and soybeans in Chinese domestic and abroad by the software of STATA.

In addition, Anderson's model is employed and developed in this study, which can be described as 5 equations:

$$\mathrm{NRA} = \frac{\mathrm{P_d}}{\mathrm{P_f}} - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\ln(\mathrm{P})_0 = \alpha + \beta_1 \mathrm{t} + \varepsilon \ldots\ldots\ldots\ldots (2)$$

$$\ln(\mathrm{P})_1 = \alpha + \beta_1 \mathrm{t} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

$$\widehat{\mathrm{P}} = \frac{\ln \mathrm{P}_0}{\ln \mathrm{P}_1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\mathrm{SI} = 100 - \frac{\mathrm{sd}(\widehat{\mathrm{P}_\mathrm{d}})}{\mathrm{sd}(\widehat{\mathrm{P}_\mathrm{f}})} * 100 \ldots\ldots (5)$$

Where, NRA is short for Nominal Rate of Assistance, and $\mathrm{P_d}$ represents domestic price in China for a given grain in a special week and $\mathrm{P_f}$ is the world prices. Ratio-detrending was used to remove the time trend on prices, by regressing observed prices $\ln \mathrm{P_0}$ on time t, and using the resulting predicted values $\ln \mathrm{P_1}$ defined generate

detrended prices ($\widehat{P}$) as the ratio of observed over predicted prices. We use the standard deviation (sd) of each price, in a ratio that we call the Stabilization Index (SI) for a specific grain in China. Descriptive analysis and Correlation coefficient analysis are both used in this study. By definition, if NRA is positive, producers are subsidized by taxpayer or consumers, and if NRA equals to 0, a competitive free trade regime is recommended, while a negative NRA implies that producers are taxed by trade policy, such as export restrictions. In addition, a positive SI shows policy stabilizes domestic prices, and if SI becomes to 0, policy does not influence the price stability, while negative SI indicates that policies may de-stabilize domestic prices.

4.3 Results

In order to study to what extent the domestic grain prices correlated with the US market, we estimated the correlation coefficients of main grain prices between China's and the US markets (Table 4.3.1).

Table 4.3.1 Correlation coefficient of grains prices between two markets

Grains	Observations	Correlation coefficient	Results
Indica rice	213	0.27***	Weak relationship
Japonica rice	214	- 0.03	No relationship
Wheat	213	-0.25***	Weak relationship
Corn	213	0.39***	Weak relationship
Soybeans	212	0.83***	Strong relationship

Source: China Grain Data Center, http://datacenter.cngrain.com

The Central Parity of RMB, State Administration of Foreign Exchange,

World Grain Prices and Graphs, http://worldfood.apionet.or.jp/pricechart/chartE/No1-3.html

Note 1: Time period (February 25, 2007 - March 27, 2011), weekly data

Note 2: Significance level shown at 99% (***), 95% (**), and 90% (*) levels, respectively.

The result shows that the soybean prices had a strong relationship, with a correlation coefficient of 0.83, while indica rice, wheat and corn show week relationship and japonica rice show no significant relationship. This indicates that Chinese domestic prices of rice, wheat and corn were insulated from the global price hike, while Chinese soybeans prices have strong relationship with the US market. Reason for the low correlation coefficients for wheat and milled rice between Chinese prices and the US prices was due to the sufficient domestic supply. And the government was able to put the sufficient stock to the market to stabilize the prices. As expansion for domestic corn demand in China, corn prices tend to correlated to the world corn prices.

Rice, wheat, corn and soybeans, as the main grains in the world, can substitute to each other for food consumption, however, their prices showed different relationships between Chinese domestic market and the US market. We tested NRA for milled rice, wheat, corn and soybeans. Figure 4.3.1 indicated that NAR of soybeans and corn were basically positive, but rice and wheat showed the negative sign in 2008. While the NRA of all grains drops since late October in 2007, among which the NRA of japonica rice and corn remarkably dropped, and that means the cost for tax increase or export quota were issued.

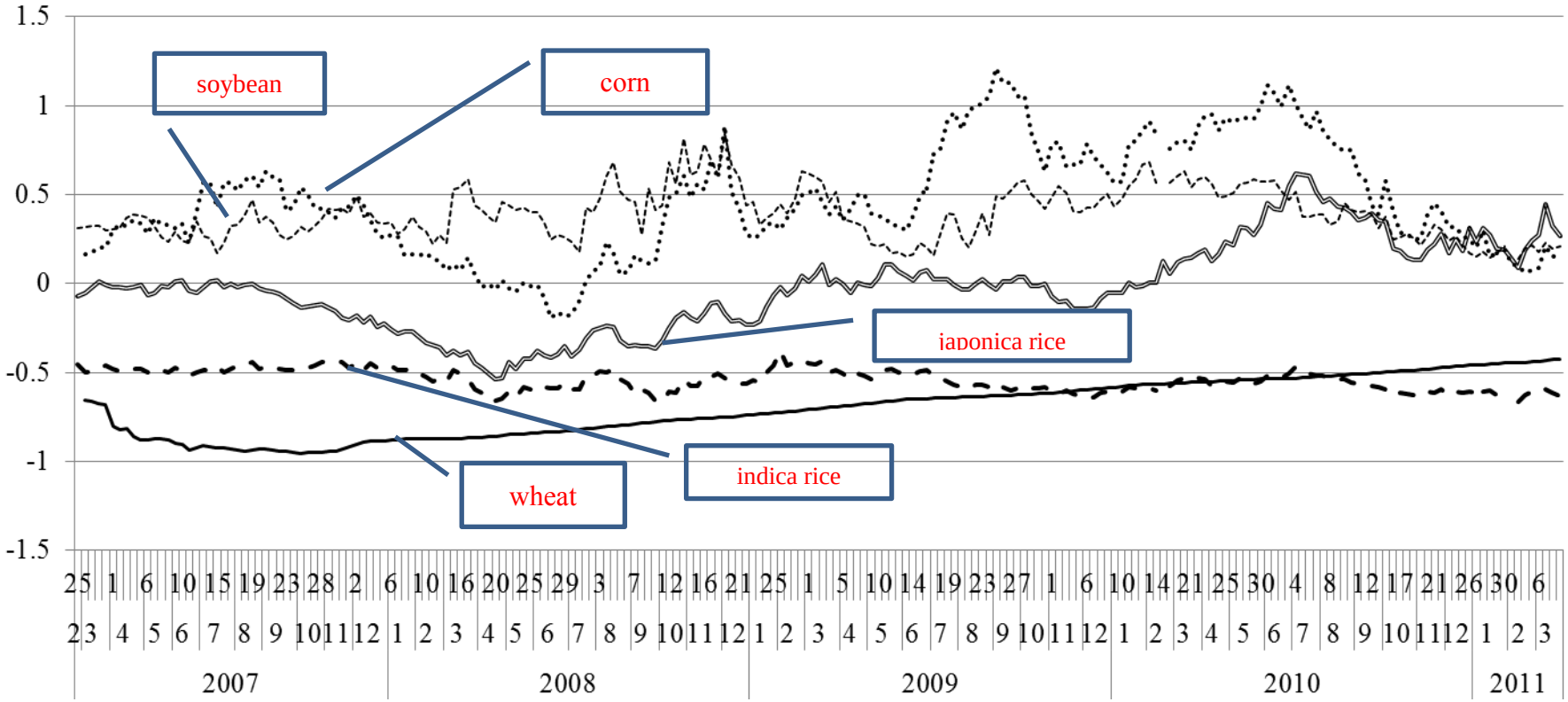

Fig. 4.3.1 Nominal Rate of Assistance (NRA) for Chinese grains

Source: China Grain Data Center, http://datacenter.cngrain.com

The Central Parity of RMB, State Administration of Foreign Exchange, http://www.safe.gov.cn

World Grain Prices and Graphs, http://worldfood.apionet.or.jp/pricechart/chartE/No1-3.html

Note: Time period (February 25, 2007 - March 27, 2011)

To explain the reasons for the characteristics of NRAs, we studied a series of response of policy measures in China since 2007 (Table 4.3.1). Chinese government tried to hold the enough domestic grain supply by temporary storage plan and encourage producers' and middlemen's benefit by raising the minimum procurement price and freight subsidy policy for milled rice in 2008. In addition, the Chinese government successfully released tariff and quotas by reducing the export licenses.

Table 4.3.1 A series of response of policy measures in China since 2007

Grains	Period	Policy measures
Rice	Dec. 2007 to Jan. 2008	Abolished export tax rebate for rice and rice flour
	From Jan. to Dec. 2008	A 5% tariff on rice and 10% tariff on rice flour
	Since Nov. 2008	Tariff level was reduced to 3% on rice and 8% on rice flour
	From Jan. to Jun. 2008	Freight subsidy to milled rice in 3 provinces in northeast China
	From Nov.2008 to Apr. 2009	Raised the level of freight subsidy in Heilongjiang province
	Feb. and Mar. 2008	Increased the minimum procurement prices for paddy twice
	Oct. and Dec. 2008	Implemented the temporary storage plan
Wheat	Dec. 2007 to Jan. 2008	Abolished export tax rebate for rice and rice flour
	From Jan. to Dec. 2008	A 20% tariff on wheat and 25% on wheat flour
	Since Jan. 2008	Set quota on wheat flour export
	Feb. and Mar. 2008	Increased minimum procurement price for wheat twice
	Since May 2008	Published new classification standard
Corn	Since Sep. 2007	Limited deep processing industry for corn
	Dec. 2007 to Jan. 2008	Abolished export tax rebate for corn and corn products
	From Jan. to Dec. 2008	A 5% tariff on corn and 10% on corn products
	Since Jan. 2008	Set quota on corn export
	Jan. , Mar. and Dec. 2008	Implemented the temporary storage plan
	Jul. 2008	Sold national corn storage
Soybeans	Since Oct.2007	Reduced import tariff from 3% to 1%
	Mar. 2008	Sold small pack oil from national storage to supermarkets
	From Apr. to Sep. 2008	Extent import tariff at the same level
	May-08	Implemented he law of examination and approval system for oil

Source: China Grain Information Center, http://www.grain.gov.cn

A further study found that foreign-funded enterprises reduced by about 87% of their rice export volume since April 2008. And the export volume of wheat dropped sharply from 206.76 thousand tons in December 2007 to 2.05 thousand tons in April

2008. The reason was that majority export quotas were obtained by the state-owned enterprises. Corn export quotas were shared by state-owned enterprises and private-run enterprises, but both of them significantly cut the export volume since September 2007. Soybeans' import volume jumped from 1.89 million in September to 2.85 million tons in October 2007, during which the government reduced the import tariff for soybeans.

We got a result that there were no relationship between Chinese domestic grain prices and the world grain prices except soybeans' price in 2008. In this chapter, we are going to take rice as the case of price stabilization in China during the skyrocketing prices to find out why China could keep its rice price stable in 2008. We can analyze rice price stabilization in 2008 in China based on the following parts (Fig. 4.3.2).

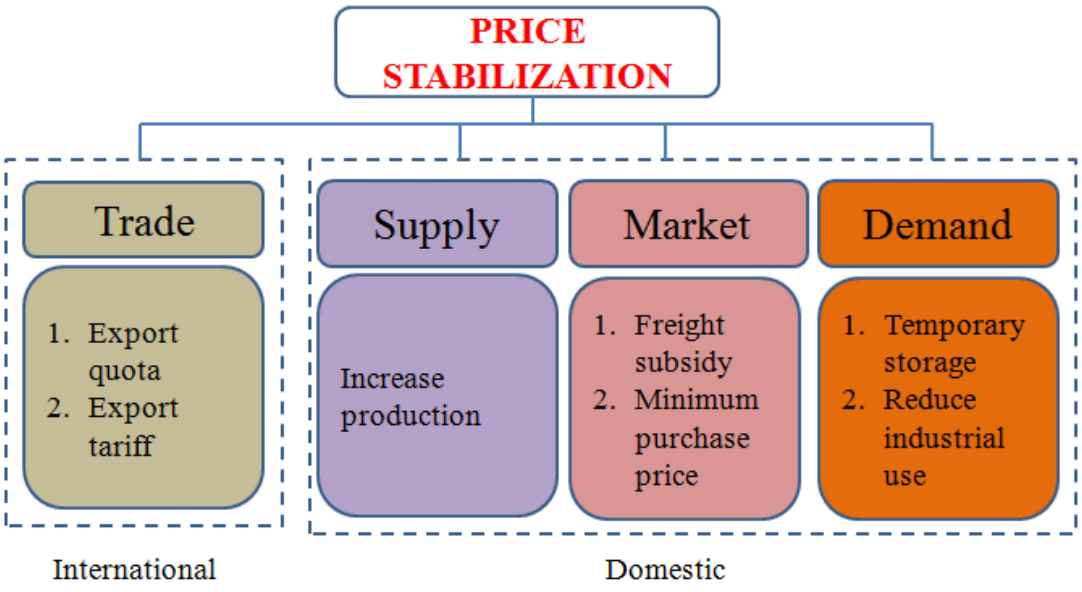

Fig. 4.3.1 Diagram of price stabilization in 2008 in China

In the international factors, we will study trade policies on rice in China in 2008, including rice export quota and rice export tariff. We will take milled rice as an example.

In the domestic factors, we are interested in three elements: on the supply side, rice production keeps increasing in the recent era in China. In the market side, freight for north east rice in China and MPP were taken into consideration.

While on the Demand side, temporary storage for rice and reduction for rice industrial use will be analyzed. All these factors above are key reasons for China to stabilize its grain prices in 2008, during which the world grain prices were seriously influenced by the energy. As a result, Chinese grain prices were isolated from the food crisis, and China had not brought its greatest number of people to the world grain markets. In addition, China stopped efficiently the speculations for export grains for gain benefits at that time.

Fig. 4.3.3 indicates that area harvested tends to reduce in recent years, and the reasons for this include: firstly, many land faces be abandoned; secondly, many rice land in south China can grow twice, but farmers only grow once a year. And the further reason is that the share of farming income getting lower and lower, so many farmers go to cities to look for job and become part time famers.

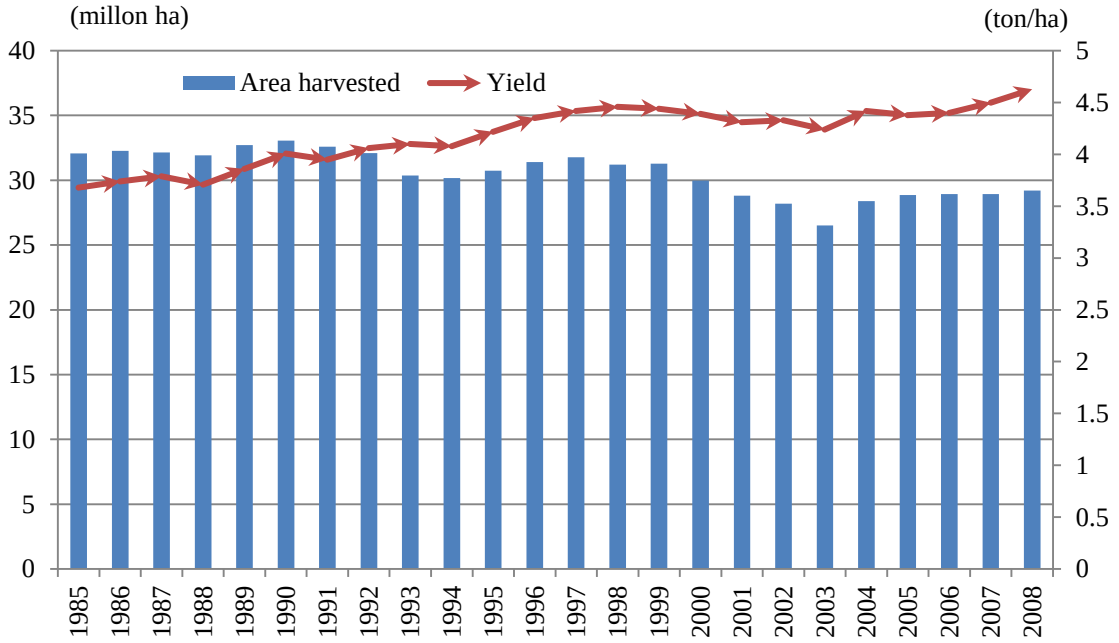

Fig. 4.3.2 Area harvested and yield for rice in China

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

But we are glad to see that rice yield increase as time goes. Technology brings a balance between rice area reduction and rice yield increase, as a result of which, rice production continuously rise recently. Rice supply in recent era in China make it possible for the government to adjust is amount in the rice market.

Rice production in China has been growing since 2004. In 2008, rice production increased by as much as 3.2%, over 2007. About 29.4 million hectares of rice were sown in 2008, and rice yield reaches 4.63 ton/ha. (Fig. 4.3.4)

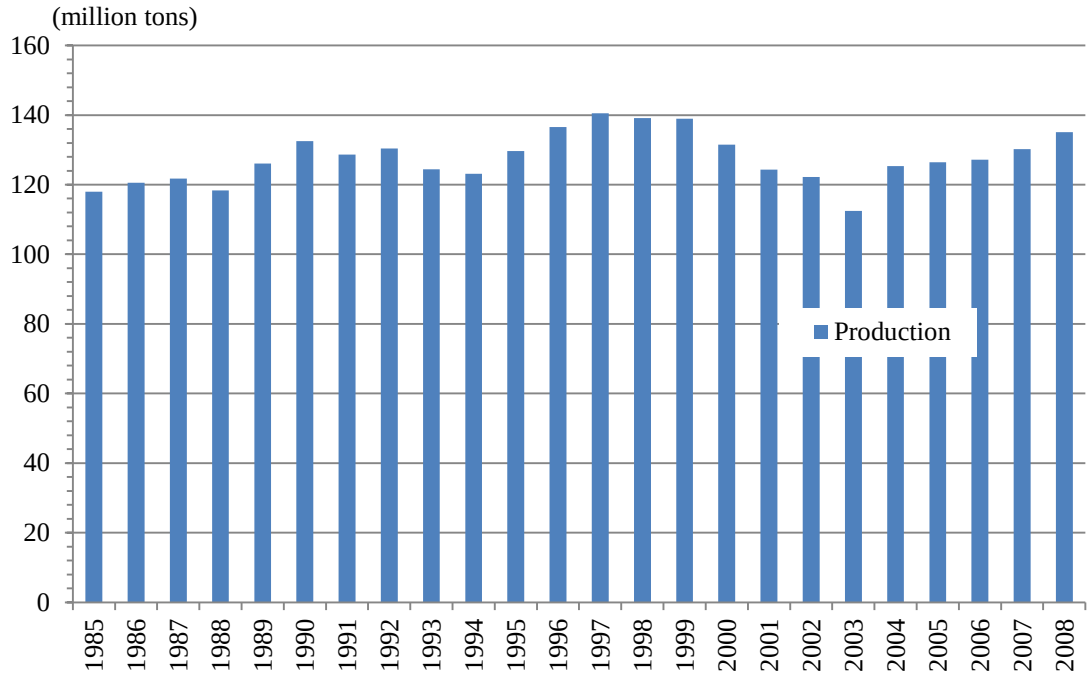

Fig. 4.3.3 Rice production in China since 1985

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Chinese government encouraged rice producers to increase rice total production by taking many measures. For example, financial support to agriculture in 2008 was significantly higher than the previous year. Chinese government take 562.5 billion Yuan as the ‘three rural' input, which increases 130.7 billion Yuan than in 2007, including increasing grain direct subsidies, increasing comprehensive direct subsidy to agricultural supplies, expanding the subsidies to improved varieties, increasing farm machinery purchase subsidy, improving the subsidy standards, and increasing the minimum price. Chinese government introduced 10 new policies supporting agriculture and benefiting farmers in 2008, including increasing directly subsidies to grain farmers, raising MPP of rice and wheat, increasing 2 billion Yuan as control and

drought and small-scale irrigation and water conservancy grant funds and Increasing 2 billion Yuan in agricultural infrastructure construction funds, and so on.

The use of rice is relatively homogeneous in China, mainly for food consumption and a small amount of processing and feed consumption. In China, there is a slight downward trend on domestic rice consumption in recent years. The reason for this is that the improvement of living standards in recent years, people has increase their income, by which they can consume more meat, eggs, milk and so on (Fig. 4.3.4).

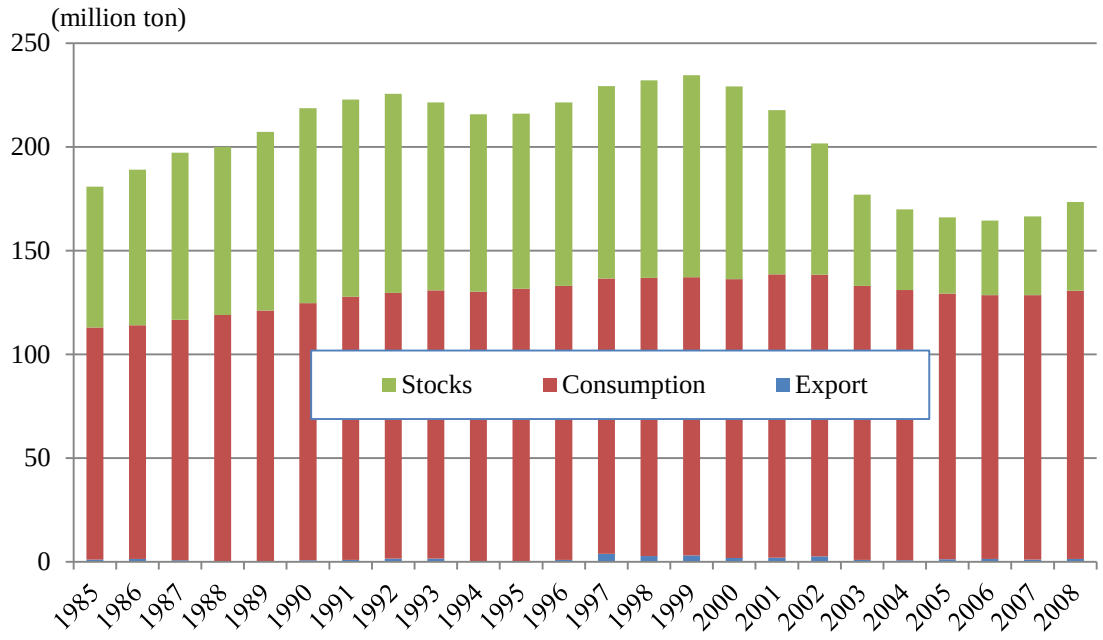

Fig. 4.3.4 Rice consumption in China since 1985

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

As the largest population country, China has slowed the speed of increasing population. Per capita rice consumption in China kept reduced since 1991, but in 2008, per capita rice consumption increased to 97.2 kg/capita. In 2008, meat price

increased, but domestic grain price didn't changed so much, so consumers preferred to grains, rice is one of the examples (Fig. 4.3.5).

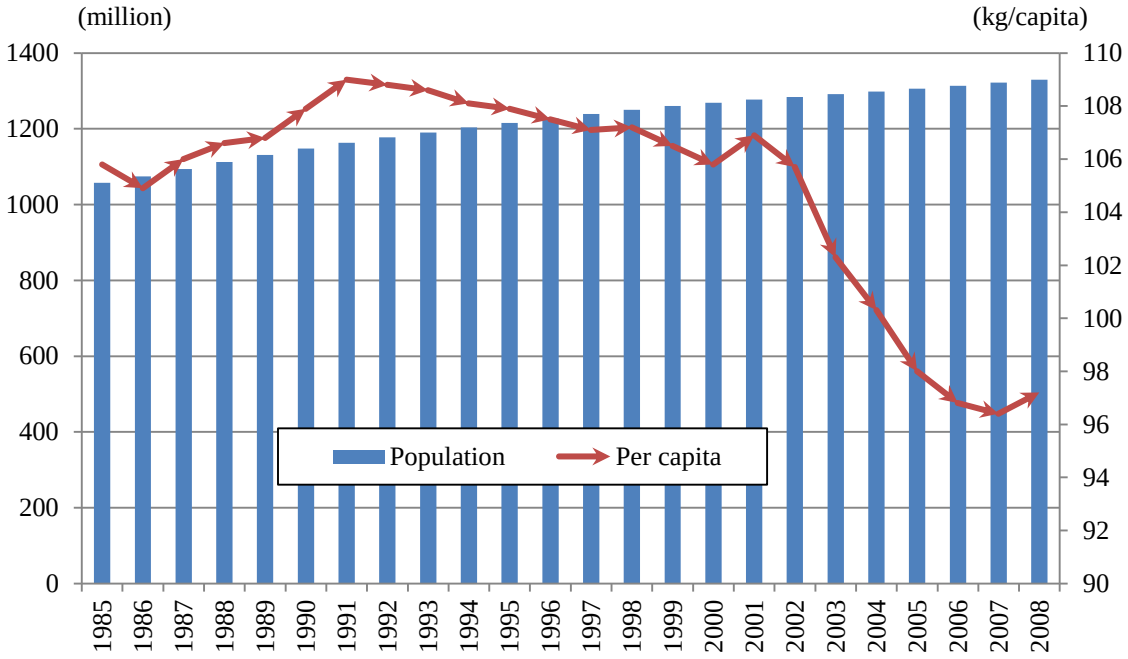

Fig. 4.3.5 Population and per capita rice consumption in China since 1985

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

We can conclude from Fig. 4.3.6 that ending stocks of rice in China have risen since 2006, with the ending stocks being 38.9 million tons in 2008, and reaching 41 million tons in 2009. Self-sufficiency rates of rice have exceeded 100% since 2005. Stock to use ratio had decreased year by year since 2001, but increased in 2007 and in 2008 because government increases stocks of grains. And since 2003, rice self-sufficiency had kept increasing, and in 2006 rice self-sufficiency raised up to 100%,

then in 2007 it kept increasing to 102.2%. And in 2008, rice self-sufficiency in China reached 104.5%.

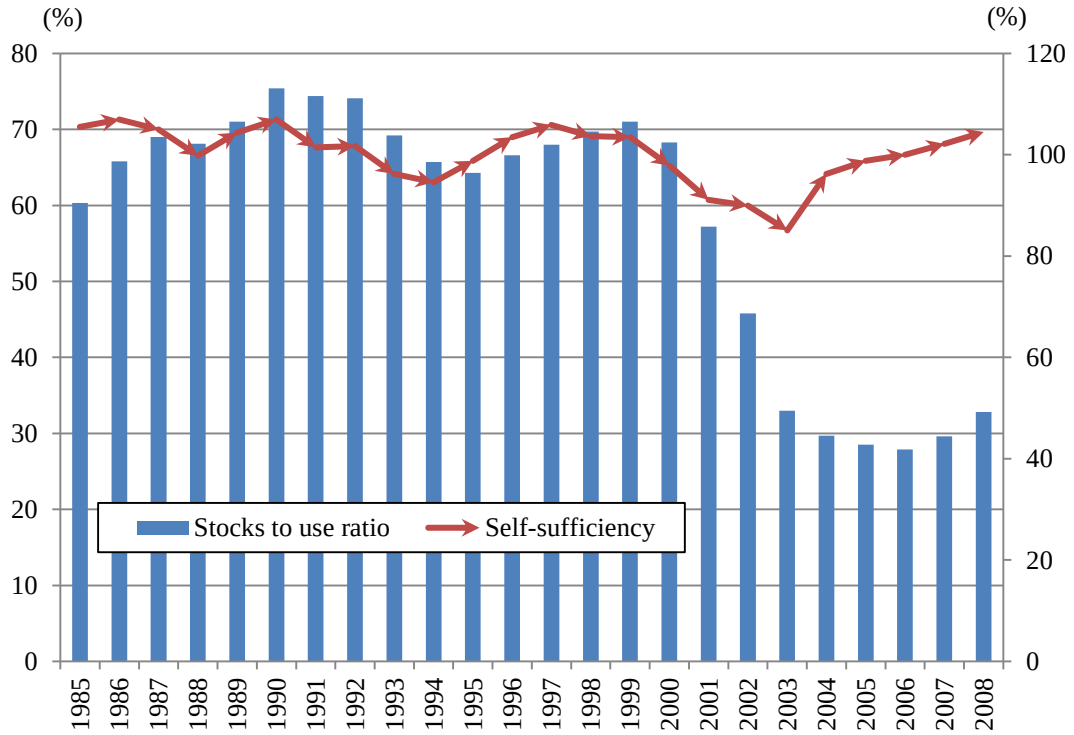

Fig. 4.3.6 Stock to use ratio and self-sufficiency for rice in China

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Note: Left axis: self-sufficiency; Right axis: stock to use ratio.

The Chinese government promulgated a temporary storage policy for the main grain of corn, rice, soybean, and rapeseed in 2008. And the government implemented the temporary storage plan for rice twice in 2008, namely in October and December (Table 4.3.2).

Table 4.3.2 Temporary storage volumes for milled rice in China in 2008

Date	Japonica (Million tons)	Indica (Million tons)
Oct. 08	4.0	6.0
Dec. 08	4.5	3.0
Total	8.5	9.0

Source: China Zhengzhou Grain Wholesale Market, http://www.czgm.com

In total, 8.5 million tons of japonica rice in Northeast China and 9 million tons of indica rice were kept in storage. In northeast China, where is the main japonica rice production area, 4 million ton japonica rice was brought into temporary storage plan in October, 2008, with purchasing price at 1.84 Yuan/kg.

In the second temporary storage plan in December, northeast China stored 4.5 million ton japonica rice also at 1.84 Yuan/kg. In south China, where belongs to main production area of indica rice, 6 million ton indica rice was brought into temporary storage plan in October at a purchasing price of 1.88 yuan/kg, while in December, an additional 3 million ton indica rice were stored at the same price.

In sum, the temporary storage plan proved important to stabilize the rice price in China in 2008 due to the fact that this policy made the government able to collect enough rice to control supply, then to stabilize the domestic rice prices. With that storage in hands, China has to pay great costs on keeping and managing. However, it is necessary to prepare enough stock for the emerge use, because of its large demand for food security.

In addition, Chinese government tried to curb the industrial use of rice. The domestic consumption of rice in China includes food, industrial use, feed and loss, and seed (Table 4.3.3).

Table 4.3.3 Domestic supply and demand for paddy in China (Million tons)

Items	2005/06	2006/07	2007/08	2008/09
Production	180.6	181.7	186.0	191.9
Import	1.0	0.7	0.5	0.6
Supply	181.6	182.4	186.6	192.5
Food	152.0	151.8	152.0	154.5
Feed +Losses	16.5	16.8	16.6	15.0
Industrial	7.9	10.0	11.0	10.5
Seed	1.2	1.2	1.2	1.2
Consumption	177.5	179.7	180.8	181.2
Export	1.4	1.7	1.8	1.5
Demand	179.0	181.5	182.6	182.7
Balance	2.7	1.0	3.9	9.8

Source: China Zhengzhou Grain Wholesale Market, http://www.czgm.com

By far, the greatest part of rice production is for human consumption. In 2008, industrial use of rice was decreased from 11 million tons to 10.5 million tons (paddy basis). Feed and losses also dropped from 16.6 million tons to 15 million tons. The use for seed remained unchanged, but export was reduced to 1.5 million tons. Total demand for rice remained fairly steady in 2008/2009.

On the other hand, rice production increased to 191.9 million tons and imports rose to 0.6 million tons. The absolute quantities of rice supply were greater than the demand, so the overall balance in stocks was positive and increased to 9.8 million

tons in 2008/2009, which was around 2.5 times higher than the previous year. The reduction in feed and industrial use in 2008/2009 made a positive contribution to rice price stabilization.

The Chinese government implemented another policy in 2008, i.e. the freight subsidy policy, which covered 3 main japonica rice producing provinces in northeast of China, namely Heilongjiang, Jilin and Liaoning provinces. The freight subsidy policy was established in two periods: from January 23 to June 30, 2008 (Fig. 4.3.7), and from November 1, 2008 to April 30, 2009 (Fig. 4.3.8).

Heilongjiang province received the highest freight subsidy level for transporting its japonica rice to southern China, followed by Jilin and Liaoning provinces from January 23 to June 30, 2008. This is due to the fact that Heilongjiang province is located the farthest from the southern Chinese markets, while it maintained the highest rice production among these three provinces.

With those subsidies, transportation costs by railway combined with ship were the highest, followed by trucks and then railway. The rate of subsidy for railway combined with ship was the largest. This is because it covers the farthest distances to deliver, including shift costs between train and ship. The freight subsidy standard did not change in Heilongjiang and Jilin provinces from November 1, 2008 to April 30, 2009. In Liaoning province, the subsidies increased, but the rate of subsidy was still lower than in the other two provinces.

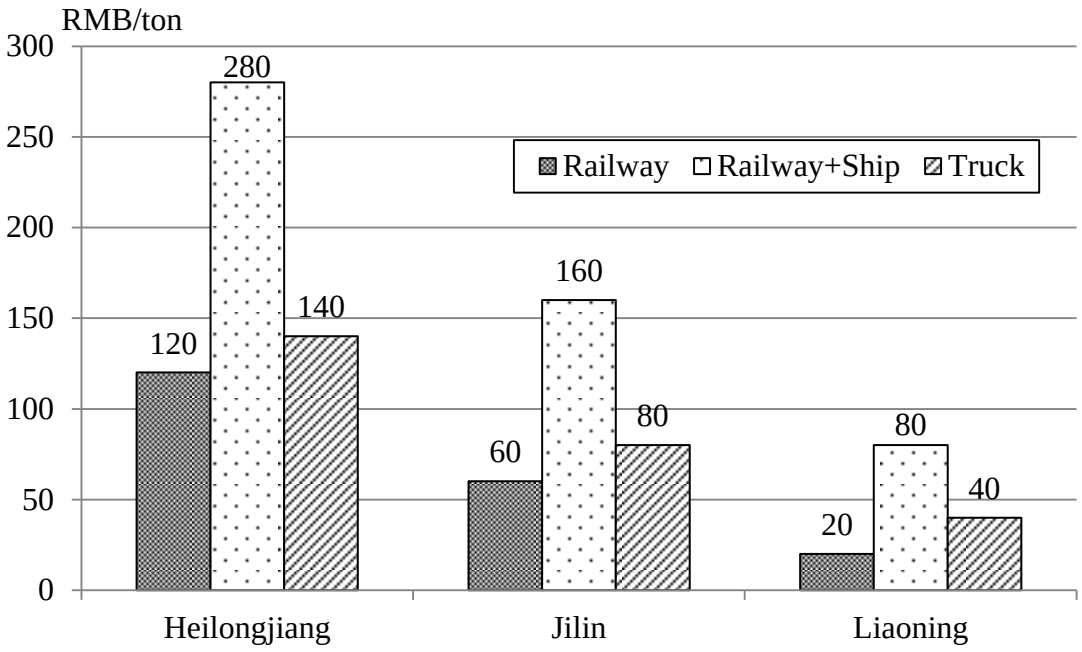

Fig. 4.3.7 Freight subsidy on northeast rice (Jan. 23, 2008 - Jun. 30. 2008)

Source: China Zhengzhou Grain Wholesale Market, http://www.czgm.com

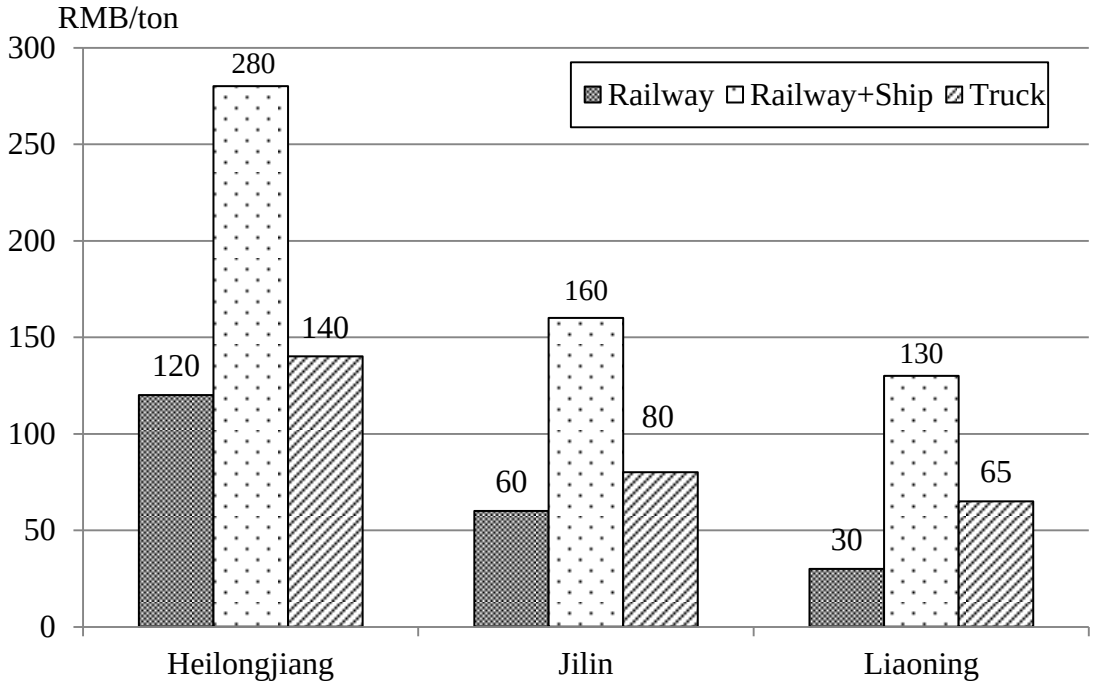

Fig. 4.3.8 Freight subsidy on northeast rice (Nov. 1, 2008 - Apr. 30, 2009)

Source: China Zhengzhou Grain Wholesale Market, http://www.czgm.com

Every year in the Chinese rice market the excess supply after harvest in the northern part of China becomes a problem as local market prices come under pressure. After harvest in northern part of China, the local rice prices tend to plunge due to the excess supply.

At the same time, the rice supply in the southern part of China is insufficient and the rice prices there turn to be higher due to the high costs for transporting rice between the two regions. As a countermeasure, the government introduced the freight subsidy policy to stabilize the japonica rice price in the south.

In addition, the Chinese government raised the minimum rice procurement prices three times, in February and March 2008 and in January 2009 (Table 4.3.4). There were three adjustments for increasing the price standard since Feb. 8, 2008.

Table 4.3.4 Minimum procurement prices for paddy in China (US dollar/ton)

Applied Dates	Early indica	Late indica	Japonica
Before Feb. 2008	200.0	205.7	214.3
Feb.8 - Mar.27, 2008	214.3	217.1	225.7
Mar.27, 2008 - Jan.24, 2009	220.0	225.7	234.3
After Jan.24, 2009	257.1	262.9	271.4

Source: Chinese Ministry of Agriculture, http://www.agri.gov.cn/

Compared with $200/ton before the price hike, the minimum rice procurement price of early indica paddy was increased by $14/ton in the first adjustment, and during the second adjustment, the price was raised up to $220/ton, while during the third adjustment, it reached $257/ton.

For the late indica paddy, the price increased by $11/ton, $9/ton, and $37/ton during the series of price adjustments, and finally to $263/ton. Likewise, the procurement price of japonica paddy was increased by $12/ton, $8/ton and $37/ton in February and March 2008 and January 2009, respectively, to $271/ton after January 24, 2009.

The minimum procurement price helped the government to collect more grains from farmers, and through this, the government held greater power in the domestic rice market to stabilize the domestic rice prices. When the market supply is insufficient, the government can use the storage to meet the shortage, while when the surplus supply pulls down the market prices, the minimum procurement grain price plays its role in covering producers' loss, thus encourage their grain production.

In addition, the government's policies to raise the minimum procurement prices encouraged the rice farmers to sell their rice to the government rather than to the rice enterprises. The rice collected from the market was used to increase the national stocks. Under the sufficient rice reserve, the government was able to stabilize the domestic rice prices in 2008 despite the skyrocketing world prices.

The Chinese government took another measure to stabilize the domestic rice price, a new revitalized trade policy. Although the expansion of rice exports may bring substantial benefits under a strong demand for rice and high world rice prices, the government decided to control exports of rice and rice flour. The government emphasized food security to protect the low income consumers in particular (Table 4.3.5).

Firstly, an effective policy measure refers to an export tariff adjustments. The Chinese government abolished the export tax rebate for rice and rice flour in late 2007.

Moreover, throughout 2008, the government maintained a 5% tariff on rice exports and a 10% tariff on rice flour exports. Then, after the spike of world grain prices, from December 2008 until July 2009, the tariff standard was reduced to 3% for rice exports, and to 8% for rice flour exports. The rice export volume plunged in April 2008 and remained at a low level thereafter.

Table 4.3.5 Rice export tariff adjustments in China in 2008 (US dollar/ton)

Time	Issues
Late 2007	Abolish export tax rebate of rice and rice flour.
Jan. 1, 2008	Levy 5% tariffs on rice export, 10% tariffs on rice flour export.
Dec. 1, 2008	Levy 3% tariffs on rice export, 8% tariffs on rice flour export.

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

Secondly, China reduced export volume for exporting enterprises. The rice export volume in China recovered to a certain degree in August 2008 but remained lower than the volume in 2007 (Fig. 4.3.9). Rice export volume in China shows a significant season trend in China as the harvest period increased the possibility for exporting, especially in March, August and October every year in China.

Monthly rice export volume before March, 2008 all increased than that of in 2007, and even more that in 2009. And the highest volumes in March appeared as about 270 thousand tons in 2008. However, the rice export volume reduced dramatically since April, and after that it was always lower than the export volume in 2007. The special movement for rice export volume implies that China cut the benefit chains for export companies to sell the domestic grains to the world market, in order to ensure the domestic food self-sufficiency.

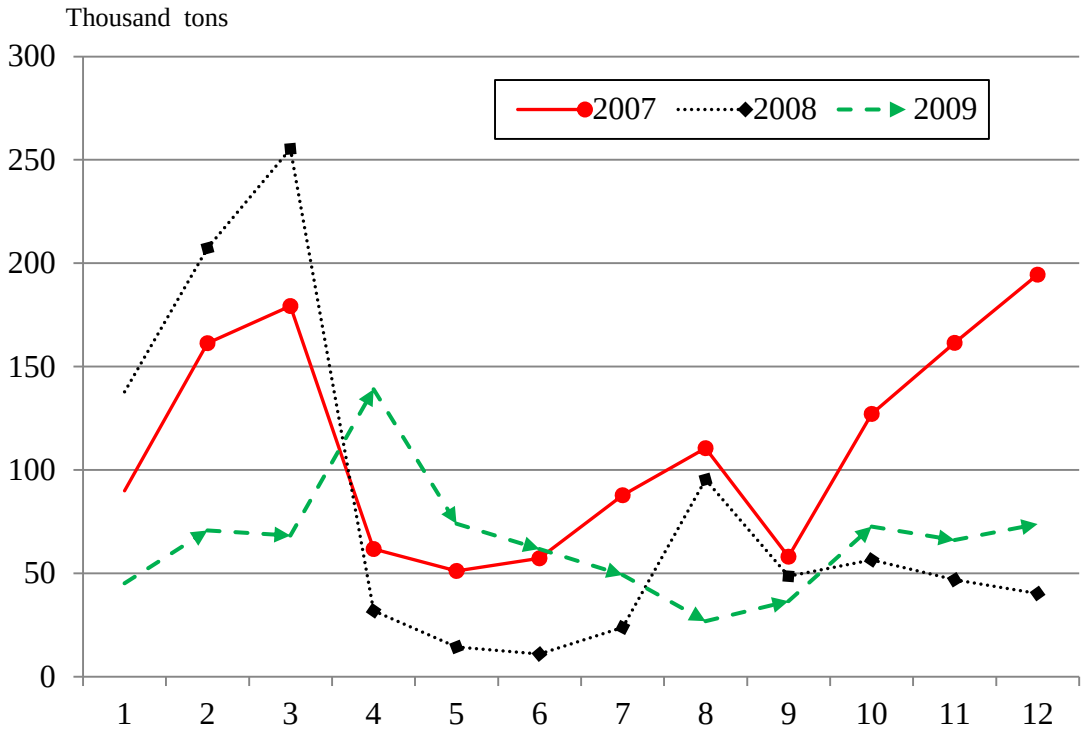

Fig. 4.3.9 Monthly rice export volumes in China in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

Among the rice export enterprises, all of them cut down the rice export volume in 2008 during the world rice price spikes. The Chinese government set a quota for the export sector, and export enterprises that held the quota needed to apply for an export license from the government to export.

Although the quota was shared, the government could also limit the export volume by controlling the number of licenses. The state-owned enterprises increased by about 2,400 tons for rice exports in May 2008 in comparison with the same month in 2007, to 15,459 tons, but were reduced by about 6,000 tons of rice in August 2008 to 4,157 tons (Fig. 4.3.10).

The exports decreased dramatically in May 2008 but the world prices remained above the domestic prices. The government considered the food security and held strong power to limit the export volume, although it could reduce the great benefit from rice export.

Likewise the foreign-funded enterprises cut about 40,000 tons of rice for export on May 2008 to 10,182 tons, and continued to reduce export volumes in August 2008 to 90,807 tons (Fig. 4.3.11). Collectively-owned enterprises did not export rice at all in August 2008 (Fig. 4.3.12.) and the private-run enterprises reduced volumes sharply in August, from 7,000 tons of rice in August 2007 to 450 tons(Fig. 4.3.13).

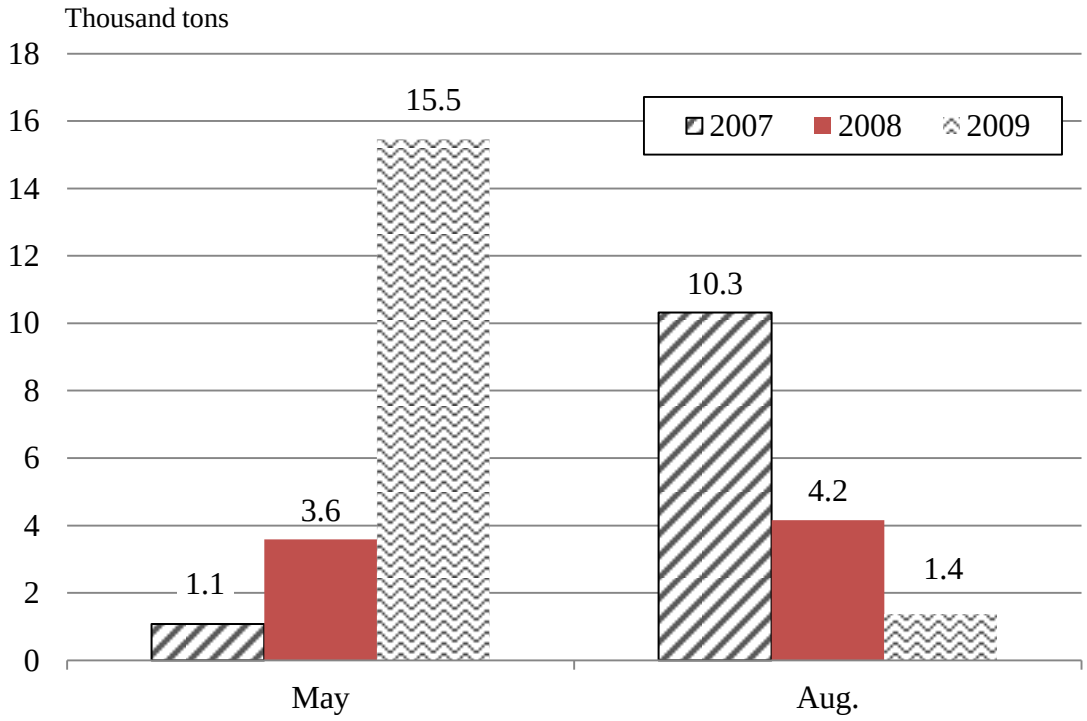

Fig. 4.3.10 Export volumes for state-owned enterprise in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

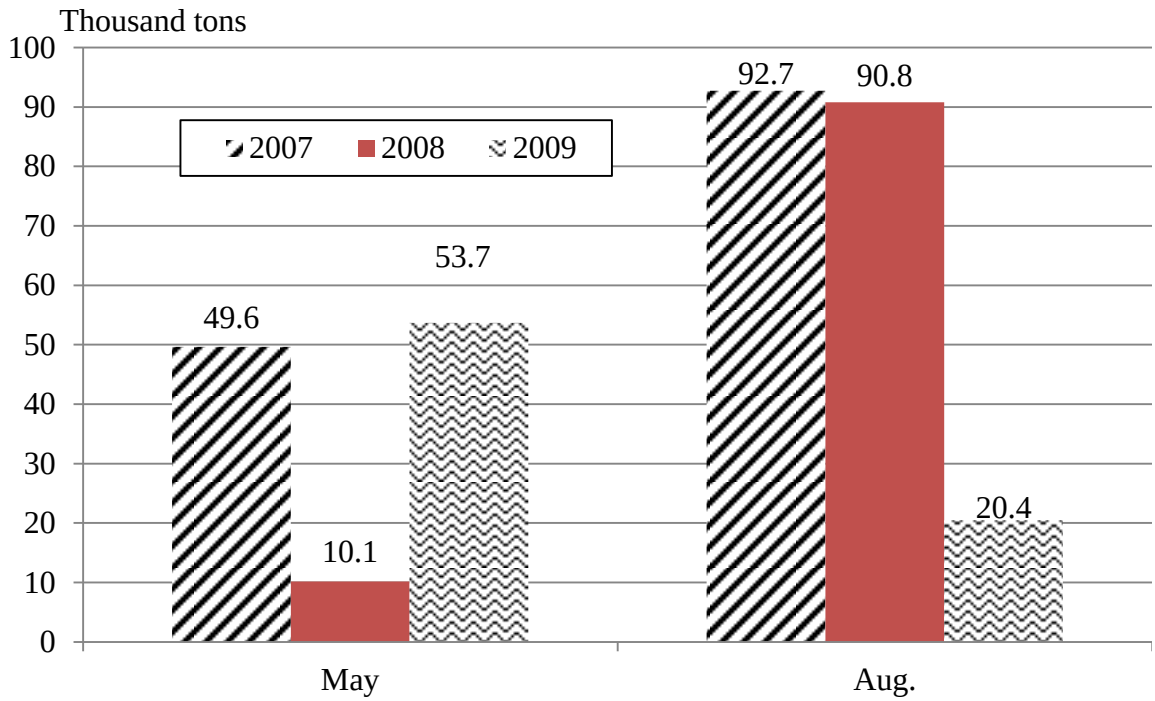

Fig. 4.3.11 Export volumes for foreign-funded enterprise in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

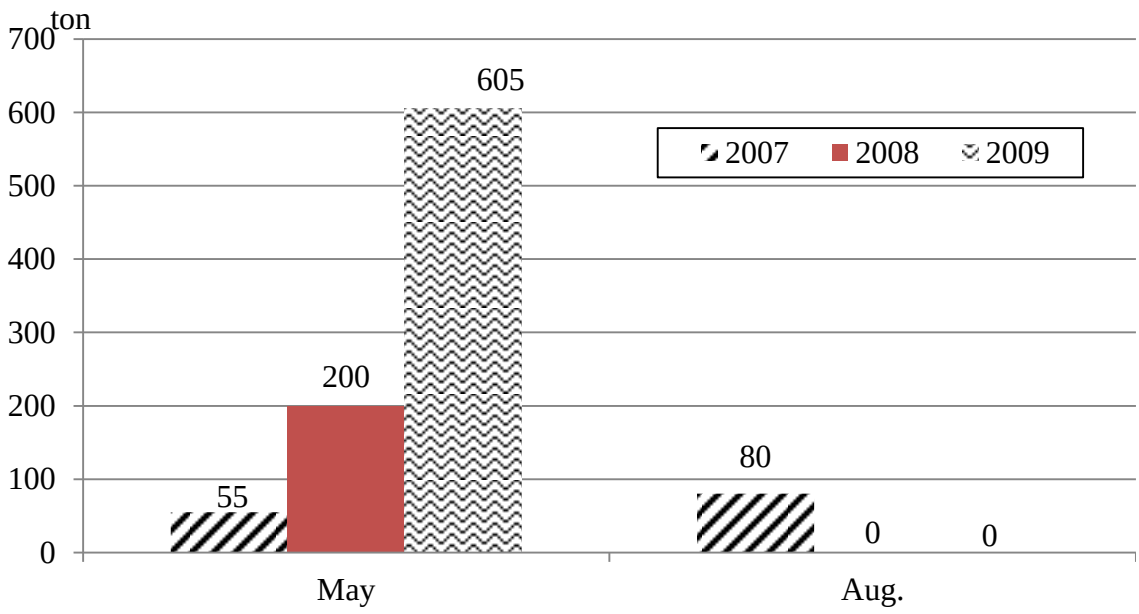

Fig. 4.3.12 Export volumes for collectively-owned enterprise in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

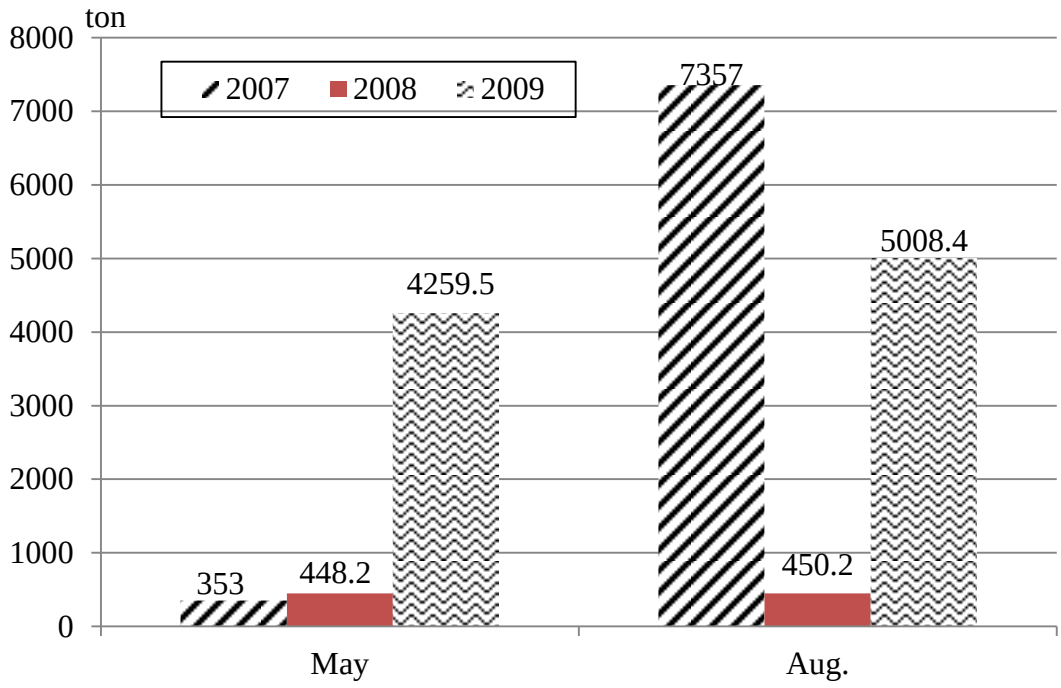

Fig. 4.3.13 Export volumes for private-run enterprise in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

Similar to monthly rice export volume in China, monthly rice export value is also shows a strong seasonal trend (Fig. 4.3.14). The top export value in February reached 1 billon US dollars, and since April, 2008, the export earning had fallen suddenly. The export value in August is more than that in 2007 although the volume actually less that in 2007, the reason was that the rice price turned out to be higher than the same time in 2007. As the falling of the world rice prices, and the harvest of world main export countries, the export prices for rice in China started to reduce since then. Duo to the reduction of volume for exporting, export returns also dropped in 2008 significantly. A regulated policy control for grain exports showed its effectiveness to ensure the grain traders cut down their export volumes, as a result of which Chinese domestic grain prices were hardly to fluctuated with the world prices.

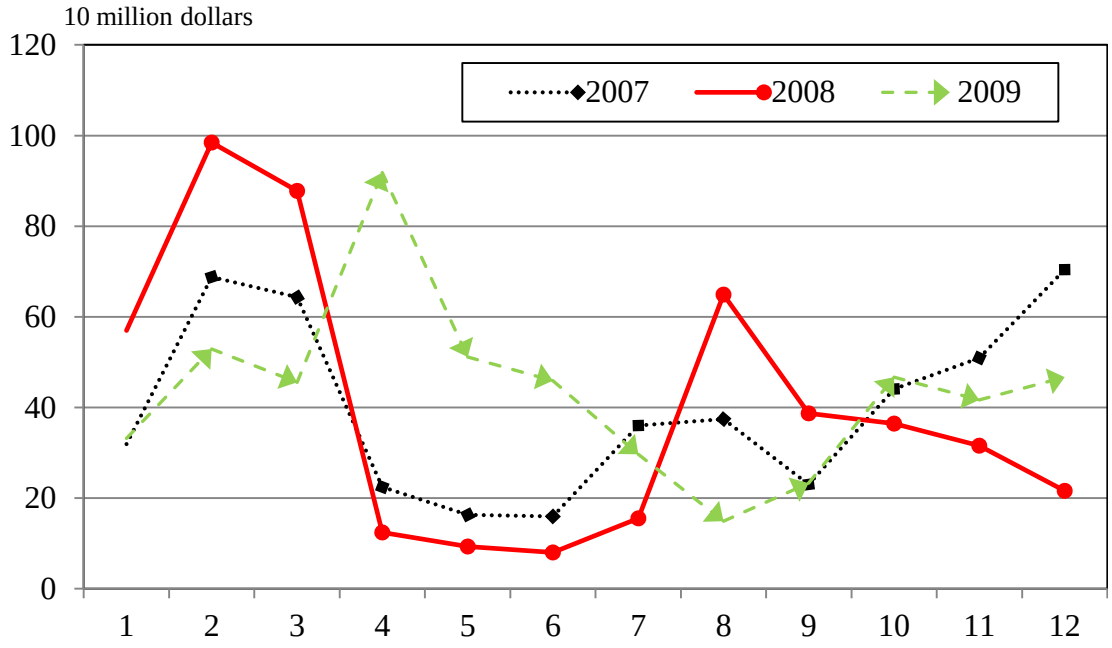

Fig. 4.3.14 Monthly rice export value in China in recent years

Source: General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

As a consequence of the new rice trade policy examined above, the Chinese rice export price has surpassed the world market price since June 2008 (Fig. 4.3.15). As a result, China's rice export lost its price advantage. With major rice harvest countries in the world market, the rice prices started falling and China's rice export prices remained way above the US prices. By using monthly grain export volume and value, we calculated the monthly grain export prices in China. Then, we compared them with the US prices. The results show that China lost its price advantages for rice since June 2008, despite the government reduced the export tariff level after November 2008. Export prices for wheat were lower than the world prices at the beginning of the world prices skyrocketing, but the China stopped exporting wheat since April

2008. Corn export prices in China were higher than the US prices since February 25, 2008, so there was no price advantage for China to export its corn to the world market.

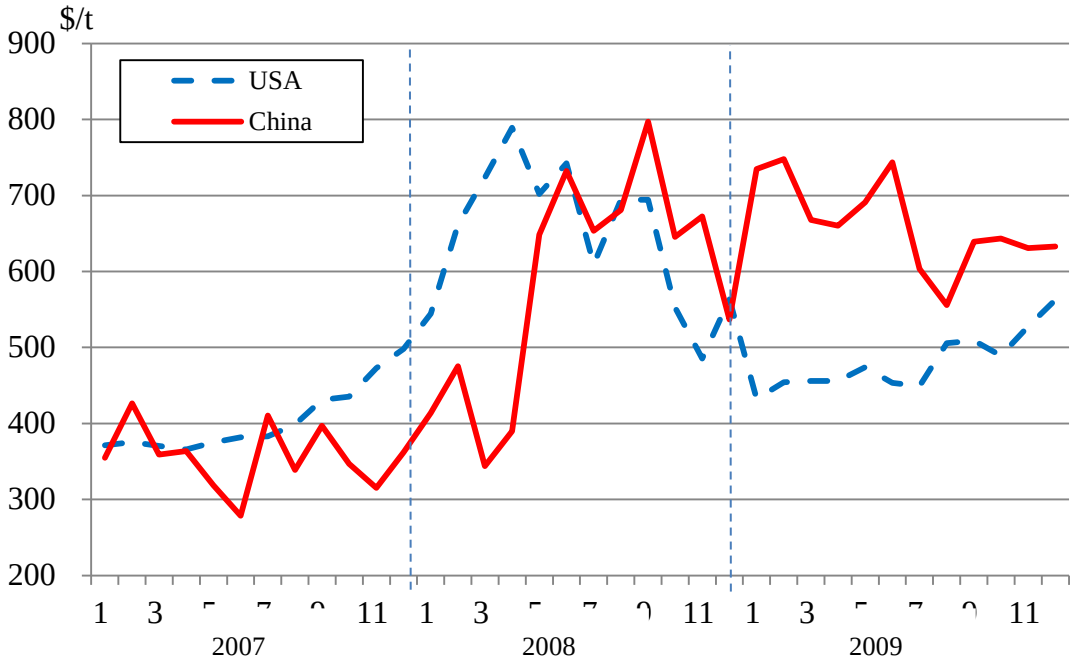

Fig. 4.3.15 Monthly rice export prices in China and US

Source: Calculated from the published data of General Administration of Customs of China, http://www.customs.gov.cn/publish/portal0/

To calculate the stabilization index for grains in China, we firstly computed the standard deviations for $\widehat{P}$ of grains in Chinese and US' markets. In order to compare the both differences among grains and each grain in the two countries, we indexed standard deviation for $\widehat{P}$ for each grain. In addition, we set the index for standard deviation for $\widehat{P}$ for Chinese wheat as 100, thus we can compare our estimated results. The result shows that for all grains, standard deviations of $\widehat{P}$ in China are lower than in the US. And the differences between the two markets are larger for rice and corn, and that of rice are mediate, while the case of soybeans are smallest. In addition, the

result for wheat in US showed the largest while wheat in China located the smallest. We calculated the Stabilization Index for various grains in China in the following step by using the results of standard deviations for $\widehat{P}$. Anderson's equation (5) was the used in this step and the final results are listed in Table 4.3.6.

Table 4.3.6 Indices for standard deviation for $\widehat{P}$ for grains in China and the US

Grains	Indices for standard deviation for $\widehat{P}$
US milled rice	690
CN indica rice	148
CN japonica rice	120
US wheat	966
CN wheat	100
US corn	950
CN corn	222
US soybeans	655
CN soybeans	563

Note: We set the index for standard deviation for $\widehat{P}$ for Chinese wheat as 100 (Chinese wheat=100).

Source: China Grain Data Center, http://datacenter.cngrain.com

The Central Parity of RMB, State Administration of Foreign Exchange,

World Grain Prices and Graphs, http://worldfood.apionet.or.jp/pricechart/chartE/No1-3.html

We can conclude in Table 4.3.7 that all of stabilization indexes are positive, and wheat prices in China are the most stable ones, with a highest SI of 89.6. SI of japonica rice, indica rice and corn are followed, with the results of 82.8, 78.5 and 76.7, respectively. However, the stabilization index of soybeans is just 13.9, showing the lowest among all grains, which indicates that soybean prices are less stable than other grains. Our results proved that for grain that high relayed on the world market, such

as soybeans, can easily fluctuated with the world price, which may have the quite serious risk once the food insecurity happened.

Table 4.3.7 Stabilization Index (SI) for various grains in China

Grains	Stabilization Index (SI)
indica rice	78.5
japonica rice	82.8
wheat	89.6
corn	76.7
soybean	13.9

Source: Results of Table 4.3.6.

4.4 Conclusions and policy implications

4.4.1 Summary of analysis

This study attempted to analyze China's grain prices and the related policies in 2008, during which China tried to stabilize the domestic grain prices. Our study proved that Chinese prices of rice, wheat and corn were insulated from the global price hike, while soybeans prices have strong relationship with the US market.

The effective but costly grains policy measures in China in 2008 cut off the relationship between the domestic and the international market, and thus helped stabilize the domestic prices. Firstly, the temporary storage plan made the government able to collect enough grains to control supply, then to stabilize the domestic grain prices. Secondly, the minimum procurement price helped the government to collect more grains from farmers, through which the government held greater power in the domestic grain market to stabilize the prices. In addition, the

minimum procurement prices were raised to encourage the farmers to sell grains to the government rather than to the trade enterprises. The grains collected from the market were used to increase the national stocks. Thirdly, the government was able to sell its sufficient grain reserve to stabilize the domestic rice and corn prices in 2008 despite the skyrocketing world prices. Fourthly, the government introduced the freight subsidy policy to stabilize the japonica rice price by treating the local excess rice volume in north regions and insufficient supply in south regions. Most importantly, China could control grain trade by releasing tariff and reducing permitted amounts to export enterprises. The Chinese government has great power to control the state-owned enterprises, because of which the state owned enterprises can reduced their export volume rapidly.

We also conclude that NRA of soybeans and corn in China are basically positive, but rice and wheat show the negative sign in 2007 and 2008. NRA of rice and corn remarkably drops from late October, which means the cost for tax increase or export quota is issued. Also, according to our estimate, SI for wheat in China is the largest, followed by japonica rice, indica rice, and corn, but SI for soybean located the lowest.

4.4.2 Conclusions

In 2008, global prices of agricultural products skyrocketing increases and reached a record, although the increasing levels of price various among different agricultural products, including rice. However, China hasn't been influenced by the international food crisis due to adequate food stocks in 2008, and main domestic grain prices in China remained relatively stable. This study attempted to analyze China's rice market

and rice policies in 2008 during which China stabilized domestic grain prices, especially rice, and showed important implications for other countries.

Weekly grain prices in China from March 25, 2007 to February 7, 2010 were collected from the China Zhengzhou Grain Wholesale Market, where China's average grain prices are published every week. Data of weekly grain prices in the United States from March 25, 2007 to February 7, 2010 were collected from the World Food Statistics and Graphics. Monthly export prices for rice in China during 2007 and 2009 were taken from the General Administration of Customs of China. And other sources of data have been collected from statistical information provided by World Food Statistics and Graphics, Commerce Department of China, China Grains Information Center, Chinese Ministry of Agriculture, and General Administration of Customs of China.

Base on the calculation correlation coefficient, this study analyzed the relationship between the domestic grains' price and the US prices, and the result finds that only the soybean prices in China has a strong relationship between the domestic market and the world market. But the prices of indica rice, japonica rice, wheat, and corn show no significant relationship. Soybeans in China were more influenced by the world market. In 2008, the rice market was protected best, while soybeans' price was more influenced than other grains in China during the world price hike.

We conclude that in 2008, japonica rice is more expensive than indica rice in China's domestic rice market. Before May 2007, the US milled rice price was similar to the japonica rice price; however, the US rice price shot up and reached its peak on 27th April 2008, which is double as high as before the price spiked. But rice price in China showed a different development. Japonica rice price in China reached its peak

on 14th September 2008, increasing by 35%, compared with 6th May 2007. Meanwhile indica rice in China reached its highest price on 28th December in 2008, which had increased by 28%, compared with the wheat price on 6th May 2007.

This study tested the correlation coefficient of indica rice, japonica rice, wheat, corn and soybeans. The result shows that the soybean prices had a strong relationship, with a correlation coefficient of 0.278, while other crops show no significant relationship and these crops were insulated from the global price hike.

The reasons for the stability focusing on rice prices were found and summarized as follows: Firstly, on the supply side, 2008 was the 4th continuous year of production increase. In 2008, rice production increased by as much as 3.2%, over 2007. About 29.4 million hectares of rice were sown in 2008, and rice yield reaches 4.63 ton/ha. Rice supply in recent era in China make it possible for the government to adjust is amount in the rice market.

Secondly, on the demand side, reduction in industrial use of rice contributed to protect food consumption. The greatest part of rice production in China is for human consumption. In 2008, industrial use of rice was decreased from 11 million tons to 10.5 million tons (paddy basis). Feed and losses also dropped from 16.6 million tons to 15 million tons. The use for seed remained unchanged, but export was reduced to 1.5 million tons. Total demand for rice remained fairly steady in 2008/2009. The absolute quantities of rice supply were greater than the demand, so the overall balance in stocks was positive and increased to 9.8 million tons in 2008/2009, and the reduction in feed and industrial use in 2008/2009 made a positive contribution to rice price stabilization. In addition, the temporary storage plan created a “reservoir” to make the rice market much more stable. In total, 8.5 million tons of japonica rice in

Northeast China and 9 million tons of indica rice were kept in storage. The temporary storage plan proved important to stabilize the rice price in China in 2008 due to the fact that this policy made the government able to collect enough rice to control supply, then to stabilize the domestic rice prices.

Thirdly, the freight subsidy in 2008 helped the Northeast's rice circulate to the southern markets in China. This policy covered 3 main japonica rice producing provinces in northeast of China, and it solved the problem of the excess supply in the northern part of China. The freight subsidy in 2008 balanced the local rice prices both in the northern part of China and in the southern part of China, which stabilized the japonica rice price. And the minimum procurement price policy adjusted the rice market and encouraged producers to sell their rice to the government rather than to export enterprises. By raising minimum procurement price three times under the pressure of world high prices, the governments succeed to encourage the rice farmers to sell their rice to the government rather than to the rice enterprises. The rice collected from the market was used to increase the national stocks. Under the sufficient rice reserve, the government was able to stabilize the domestic rice prices in 2008 despite the skyrocketing world prices.

Finally, during the skyrocketing world grain prices in 2008, China changed its rice stock policy, and the government could control the rice trade by releasing tariff and reducing permitted amounts to export enterprises. China took effective but costly measures to manage the domestic rice market. The export control policy in 2008 made China's rice export prices surpass the world prices, after which China's rice export prices lost its comparative advantage. The Chinese government abolished the export tax rebate and stared to collect rice tariff for rice and rice flour since 2007.

Besides, the rice export volume in China reduced dramatically since April, 2008. And all of the rice export enterprises, including the state-owned enterprises, the foreign-funded enterprises, collectively-owned enterprises and the private-run enterprises cut down the rice export volume in 2008 during the world rice price spikes because that the government considered the food security and held strong power to limit the export volume, although it could reduce the great benefit from rice export.

All these policies cut off the relationship between the domestic and international market prices, and thus helped stabilize the domestic rice prices. As a consequence, these policies played an active role in ensuring food security in China in 2008.

This study attempted to analyze China's grain prices and the related policies in 2008, during which China tried to stabilize the domestic grain prices. Our study proved that Chinese prices of rice, wheat and corn were insulated from the global price hike, while soybeans prices have strong relationship with the US market.

The effective but costly grains policy measures in China in 2008 cut off the relationship between the domestic and the international market, and thus helped stabilize the domestic prices. Firstly, the temporary storage plan made the government able to collect enough grains to control supply, then to stabilize the domestic grain prices. Secondly, the minimum procurement price helped the government to collect more grains from farmers, through which the government held greater power in the domestic grain market to stabilize the prices. In addition, the minimum procurement prices were raised to encourage the farmers to sell grains to the government rather than to the trade enterprises. The grains collected from the market were used to increase the national stocks. Thirdly, the government was able to sell its sufficient grain reserve to stabilize the domestic rice and corn prices in 2008

despite the skyrocketing world prices. Fourthly, the government introduced the freight subsidy policy to stabilize the japonica rice price by treating the local excess rice volume in north regions and insufficient supply in south regions. Most importantly, China could control grain trade by releasing tariff and reducing permitted amounts to export enterprises. The Chinese government has great power to control the state-owned enterprises, because of which the state owned enterprises can reduced their export volume rapidly.

We also conclude that NRA of soybeans and corn in China are basically positive, but rice and wheat show the negative sign in 2007 and 2008. NRA of rice and corn remarkably drops from late October, which means the cost for tax increase or export quota is issued. Also, according to our estimate, SI for wheat in China is the largest, followed by japonica rice, indica rice, and corn, but SI for soybeans located the lowest.

4.4.3 Policy implications

Based on the analysis though all the chapters, this study gives some policy implications, especially to the developing country with vast population but limited farmland.

Government should help the farmers increase production in the future by increasing the financial and technical supports. It is necessary to strengthen the protection of arable land resources and build water conservancy facilities.

Government can improve market in both facilities and management. By doing so, for example, improve the transportation can reduce the cost for grain transport. Also, the efficient market needs fast and exact information.

Foreign food companies have been or are being entered markets of China's soybean, corn, wheat, rice and other staple foods. They have been entering the field of acquainting, processing and terminal selling. These companies bring advanced technology, management experience and capital but also bring the difficult that securing the supply, stabilizing the price and so on.

In the long run, the rice stock may not sustain the price stabilization, and the Chinese government needs to prepare for face the higher price it and has its citizens to accept the main grains prices rise.

CHAPTER 5

CHINESE AND U.S. PRICE DIFFERERCES AND CHINESE INTERNATIONAL TRADE DURING 2008 AND 2009

In this part, descriptive analysis will be used in order to explain the prices and trade situation of rice, wheat, corn and soybeans in the world in recent era, especially in 2008. This study will employ some graphics and tables to show grain prices movements and the trade volumes of rice, wheat, corn and soybeans in recent years.

5.1 Grains' price differences between the Chinese and the US markets

In 2008, due to global environmental degradation, production and harvest area reduction in the world's major grain counties, combined with bio-energy demand gradually increased the proportion of total food consumption, the world food demands increased dramatically.

As a result, prices of milled rice in the world market reached a new peak in 2008. Fig. 5.1.1 shows the weekly movements of rice prices in China and the US. Before May 6, 2007, the US milled rice prices were similar to the japonica rice prices in China; however, the US rice prices shot up and reached its peak on April 27, 2008 at $874.49/ton, an increase of more than 100 percent as compared to the prices in the middle of 2007. The price increase in China was rather moderate as compared to the US market. The japonica rice prices in China, for instance, reached its peak on September 14, 2008, an increase by 35 percent as compared to May 6, 2007.

5.2 Grans' price differences between the Chinese and the US markets

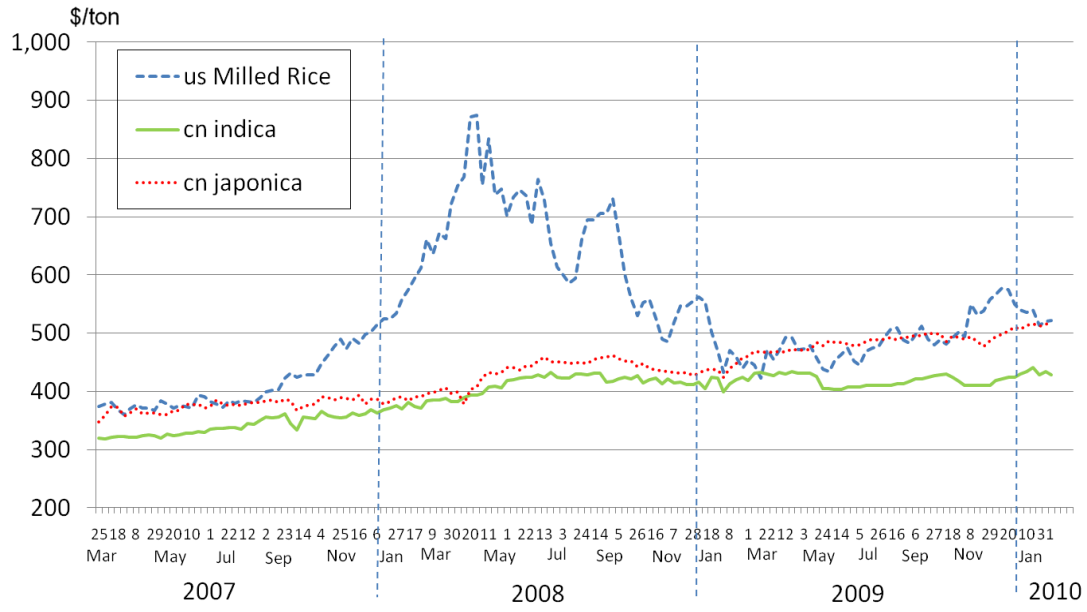

Fig. 5.2.1 Weekly price movements of rice in China and the US

Sources: World Food Statistics and Graphics, http://worldfood.apionet.or.jp; China Zhengzhou Grain Wholesale Market, http://www.czgm.com

Wheat market between China and world market is same with rice. The US wheat price took off in 2008, and reached its peak on March 16, 2008, with the price of 546.76 $/ton, which is 2.41 times than the price on 6th, May, 2007, as is shown in Fig. 5.1.2. However, wheat price in China kept steadily increase since 2007. And the highest price appeared on December 2, 2008, which increased by 11 percent compared with the price on May 6, 2007.

In addition, Chinese wheat prices became more expensive than the US prices after the late of 2008. Therefore, wheat trader have no benefits for export grains, even they get the license.

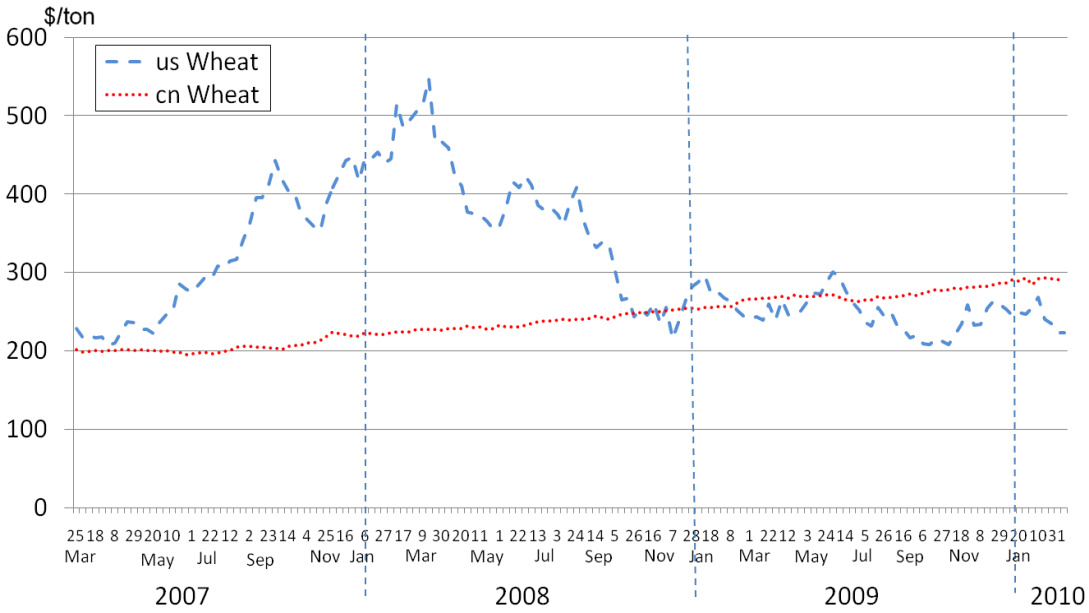

Fig. 5.2.2 Weekly price movements of wheat in China and the US

Sources: World Food Statistics and Graphics, http://worldfood.apionet.or.jp; China Zhengzhou Grain Wholesale Market, http://www.czgm.com

Corn wholesale price and soybean wholesale price in China are higher than US price in recent years. US corn price in 2008 surpassed the China's corn price. Peak price of US corn appeared on July 19, 2008, up to 297.13 $/ton, which nearly doubled compared with the price on May 6, 2007. On the other hand, highest corn price in 2008 in China appeared on July 6, which had increased by 26 percent than the price on May 6, 2007 (Fig. 5.1.3). The domestic wheat and corn prices showed the same movement as rice in China, while soybean prices in China fluctuated in a rather similar style as the US soybean (Fig. 5.1.4.). However, the Chinese domestic prices

remained more stable than the US prices. In China, the highest price is 761.82 $/ton, which was 2.05 times compared with May 6, 2007. And the US soybeans highest price was 761.92 $/ton, which was 2.26 times compared with May 6, 2007.

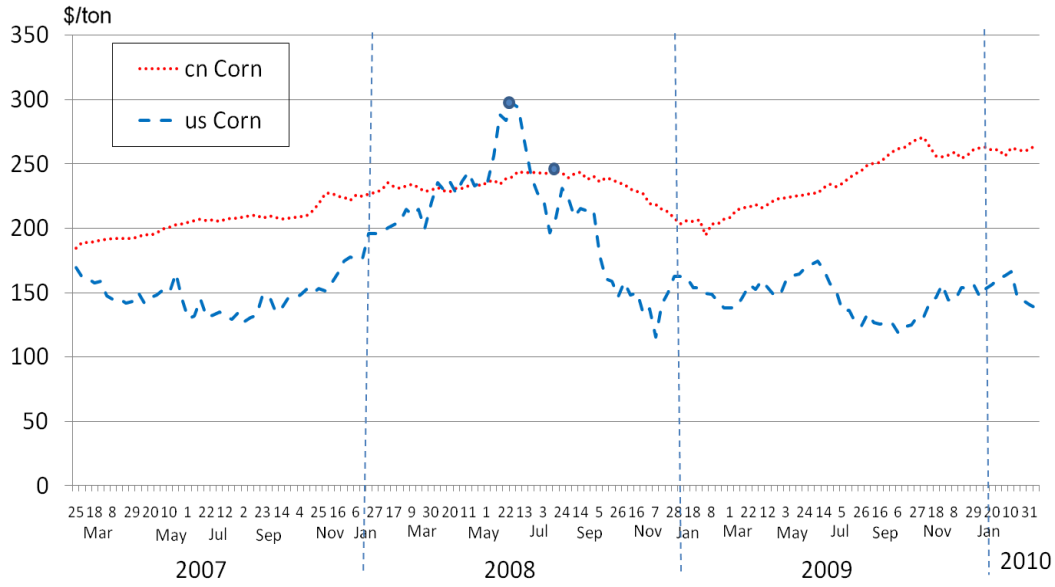

Fig. 5.2.3 Weekly price movements of corn in China and the US

Sources: World Food Statistics and Graphics, http://worldfood.apionet.or.jp; China Zhengzhou Grain Wholesale Market, http://www.czgm.com

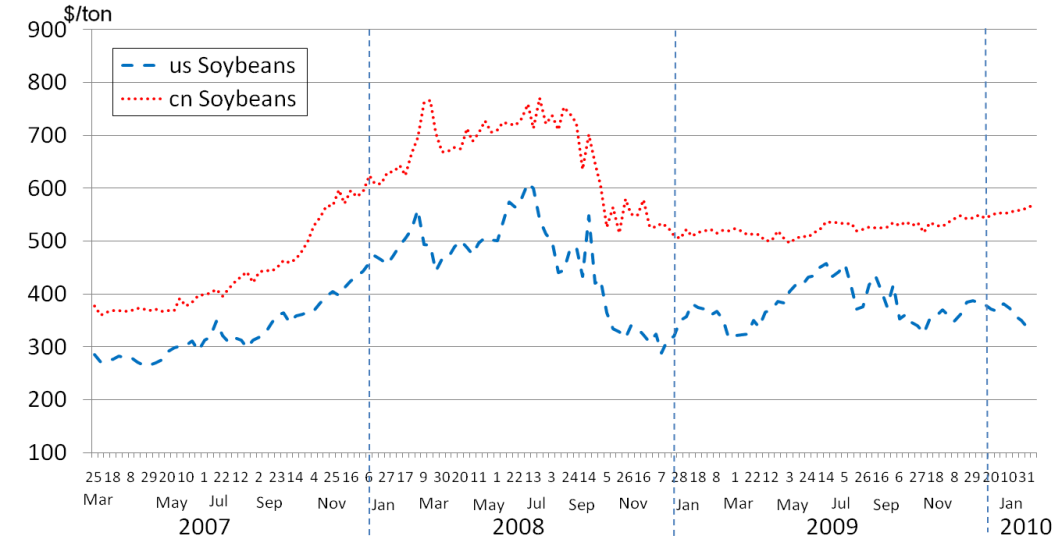

Fig. 5.2.4 Weekly price movements of soybeans in China and the US

Sources: World Food Statistics and Graphics, http://worldfood.apionet.or.jp; China Zhengzhou Grain Wholesale Market, http://www.czgm.com

5.3 Chinese grain trade and domestic production and consumption

According to the economic theory, prices is decided by the equilibrium of supply and demand in a free market. Production and consumption for grains are important factors to generate the prices in China. In particular, trade volume of grains shows the degree of factors that get influencing or influenced to the world grain market, indicating an increase or decrease to the total trade supply in world grain markets. In this part, we will analyze the Chinese grain trade, supply and demand, following the difference periods together with the price movements from 1964 to 2013. Data in this part were shown in the Appendix Fig. 7.3.1 to Appendix Fig. 7.3.9. Totally 8 periods were divided from 1964 to 2013. [1]

Production

Chinese grain production has been keep increasing in the recent years, except for soybeans (Appendix Fig. 7.3.1). Productions of wheat, milled rice and corn during P0 and the middle of P4 show approximately linear increases. Among that, production of milled rice increased from 58.1 million tons in 1964 to 140.5 million tons in 1997, which suggests a 141.8% increase. Wheat production shows a greater increase (491.6%), changing from 20.8 million tons in 1964 to 123.3 million tons in 1997. Corn production in 1997 dropped to 104.4 million tons in 1997, comparing to the previous year. However, there is still a dramatically increase by 359.7% to that of 1964. Production of soybeans is merely 14.7 million tons in 1997, which is a 87% increase from 1964.

[1] Note: 8 periods: P0 (1964 – 1977), P1 (1978 – 1984), P2 (1985 – 1992), P3 (1993 – 1995), P4 (1996 – 2000), P5 (2001 – 2003), P6 (2004 – 2008) and P7 (2009 – 2013).

A different change happens in grain production form the middle of P3 to P5. Productions of milled rice and wheat gradually drop by 19.9% and 29.8% in 2003, comparing to 1997. But those of corn and soybeans increase by 11.0% and 4.5%, up to 115.8 million tons and 15.4 million tons, respectively.

After that, grain productions start increasing again in P6 and P7, except for soybeans. For example, productions of milled rice, wheat and corn grow rapidly to 144.0 million tons, 121.0 million tons and 212.0 million tons, respectively, which are 14.9%, 31.6% and 62.7% higher than in 2004. However, soybean production during P6 and P7 dropped to 12.0 million tons, a 31.0% decrease than in 2004.

Harvest areas

There is a significantly drop for grain harvest areas during 1996 to 2004, during which the harvest areas decreased (Appendix Fig. 7.3.2). Harvest areas for milled rice and wheat moved similar, as both of them belongs to ordinary food. There is an increase trend during P0, but milled rice expands more areas. Milled rice area in P0 increased by 20%, up to 35.5 million hectares, while wheat area increased by 10.5%, reaching 28.1 million hectares. Corn area also increased by 27.9%, and up to 19.7 million hectares.

However, harvest area for soybeans dropped by 31.6% in P0 and its area was 6.85 million hectares in 1977. After that, harvest area for milled rice gradually decreased from P1 to P5, down to 26.5 million hectares in 2003. But the wheat area kept stable until the middle of P4, moving around 27.0 million hectares. Then its area dropped sharply to the bottom, down to 22.0 million hectares in 2003. But the corn area was cut down in the middle of P1, but soon recovered since P2. Harvest area for corn

increased dramatically after that, although there was a drop in 2002. Its area is estimated by USDA to reach the peak, up to 36 million hectares in 2013.

And harvest areas for milled rice and wheat started increasing steadily since 2004, which include P6 and P7, up to 30.6 and 24.25 million hectares, respectively. However, soybeans area has not changed too much before P6, but in the recent year in P7, its area dropped year by year, and will down to 6.5 million hectares in 2013.

Yield

A major factor for China increasing its production is due to the increasing yields, especially for corn, rice and wheat (Appendix Fig. 7.3.3). For example, Chinese farmers increased their grain yields significantly, especially in P1 for milled rice and wheat, both of which belong to stable food in China. At that time, yield for milled rice, wheat, corn and soybeans increased by 29.1%, 78.1%, 69.6% and 34.1%, up to 2.53, 1.46, 2.51 and 1.06 ton/ha, respectively. After that, grain yields were mostly improved year by year, so the technology brought great contribution to Chinese grain production.

Compare with other grains, yield of soybeans was not improved efficiently. Chinese grain yields are estimated in 2013 by USDA to reach 4.71, 4.99, 5.89 and 1.82 ton/ha for milled rice, wheat, corn and soybeans, respectively.

Consumption

Grain consumption also increased, among which consumption for soybeans started increasing dramatically since 1993 (Appendix Fig. 7.3.4). Chinese rice consumption stable from P0 to P4, from 59.1 million tons in 1964 to 136.5 million

tons in 1991, with a 130.9% great increase. While wheat consumption in this period increased from 26.3 million tons to 108.7 million tons, showing a 314.1% increase, and especially its consumption begun increasing sharply since P2.

Following that, consumption for both milled rice and wheat decreased in P5, then recovered since P6, and their consumption volumes meet 147 million tons and 120.5 million tons for milled rice and wheat. Corn consumption also increased year by year, and its volume got greatly improved since P2. And in the recently period of P7, corn consumption became more and more expanding, and it is estimated to reach 224 million tons in 2013, which is the peak volume in the history. Fluctuation for soybean consumption showed modest till P3, and its demand increased sharply afterwards. It is estimated that soybean consumption in 2013 will be 78.6 million tons in China.

Gap between Chinese domestic grain production and consumption

Fluctuated gap between Chinese domestic grain production and consumption shows that China is short for soybeans since 1996, and the gap for corn is enlarging in the recent years (Appendix Fig. 7.3.5).

As China held the high grain self-sufficiency, domestic grain production is the major factor for the market supply. While China is not so active in the grain trade market before, so the major demand is its domestic consumption. Therefore, we calculated the difference between Chinese anural grain consumption and production. If the result is positive, namely grain shortage in that year, it is indicated that volume of grain consumption is greater that the production, so as to increase its imports from the world markets or release its domestic grain storage. Otherwise, a negative result namely over supply implies that Chinese domestic grain production can meet the

demand, leading export or keeping national storage. When the result becomes to 0, we can say that Chinese grains are market clearing.

Our calculation suggested that there was market clearing basically in P0. Grain shortage may lead a high grain price, while an oversupply can bring a low grain price. Wheat shortage happened from P1 to P3, and also P5. But it was oversupplied during P4, and there is about 0.5 million tons of oversupply in 2013. Milled rice was oversupplied from P1 to P2, and then turns to shortage in P3, after which oversupply appeared in P4 and again shortage took placed in P5.

At present, 3 million tons of shortage in 2013 is estimated by our results. Gap between Chinese domestic corn production and consumption showed that corn was oversupplied before the middle of P4, and shortage followed in P5 and P6. This gap positively expanded in P7, although there used to be a transient oversupply in 2009 and 2010, which indicates that China will need more and more corn in the recent years. Particularly, soybeans were basically oversupplied until a positive 0.6 million tons gap appeared in 1995. After that, shortage for soybeans lasted till P7, and the positive gap continuously expanded greatly, causing a 66.6 million tons gap in 2013.

Export volume

Export volume for Chinese grains suggests that China used to export a great number of corns. But its volume reduced significantly in the recent years (Appendix Fig. 7.3.6).

China used to export great volume of milled rice in the middle of P0 and P4 due to the domestic surplus. But the volume was cut to about 0.2 million tons in 2013. Export volume for wheat became about 3 million tons in P5 and P6, and then its

volumes were cut to 1 million tons in 2012 and 2013. Soybeans exports used to be 2 million tons all so during late of P1 and P2. Its export was almost flat in the other periods until its export volumes in 2013 reduce to 0.3 million tons. Corn exports fluctuated most among 4 grains, especially in P2, P4 and P5. And the peak export volume in 2012 even reached about 15 million tons. However, its volume dropped dramatically in P3 and P6, and merely 0.05 million tons of corn is estimated to be exported in 2013.

Import volume

While import volume indicates that Chinese soybean shortage are relay on the world market for about 20 years. As the grain globalization and the increasing demand for China, grain import started increasing in the recent years (Appendix Fig. 7.3.7).

China used to import about 5 million tons of wheat in P0, after that the volume increased to about 15 million tons until P3. In addition, China also imported about 4 million tons of wheat in 2003, and 6.7 million tons in 2004 due to its food shortage. Import volumes for soybeans have increased sharply since 1996, and reach its peak to 69 million tons in 2013, accounting for 87.8% of China's total consumption. Milled rice and corn import volumes are not significant in the history, although there were some small amount of corn import during P1 and P3. In particular, China increased its grain import volumes significantly in P7, especially for corn, milled rice and soybeans, all of which meet their import peaks, up to 3 million tons, 3.5 million tons, 7 million tons and 69 million tons for milled rice, wheat, corn and soybeans, respectively. This supported the assumption of this study that China is getting

influenced by the world grain market with the development of the grain globalization in the recent years.

Stocks-to-use ratio

A stocks-to-use ratio is one of the most important measures of market fundamentals. The relationship between this ratio and price is certainly intuitive. If stocks are low relative to annual use, then the price is expected to be strong or rise over time, and vice versa if the stock-to-use ratio is low. Development of Chinese grain stocks-to-use ratio suggested that stocks-to-use ratio in China has fallen down since China joined WTO (Appendix Fig. 7.3.8). However, the ratio got recovered from 2004 and mainly because the government procumbent prices and production promotion.

Trends of milled rice, wheat and corn basically showed the same, which reported that the ratio increased in P0, then recovered in P1 to P3, but their ratios decreased sharply since the late of P4, until met turning points in P6. This movement also consistent with the change of Chinese grain prices indices. Among that, ratio of milled rice was less fluctuated than wheat and corn. However, ration of soybeans was nearly to be 0 until P4, since which the ratio started to increase to about 20%. Nowadays, stock-to-use ratio for Chinese milled rice, wheat, corn and soybeans will be expected to be 31.5%, 50.8%, 26% and 17.1%, respectively.

Per capital consumption and population

Chinese per capital consumption for rice and wheat decreased, while that of corn and soybeans increased (Appendix Fig. 7.3.9). . In addition, growth rate for Chinese

population is slower in the recent years, increasing from 696.1 million to 1375.5 million, nearly doubled. During these 49 years, Chinese consumers have changed their food structure, and this is mainly because Chinese consumers have more expenditures affording for high level food, such as meat, eggs and milk. Therefore, per capital consumption for showed differently during the different periods.

Per capital consumptions of rice, wheat, and corn increased in P0 and P1, especially great increase at the beginning of P1 because of the food shortage. After that per capital consumptions for milled rice and wheat were stable until they decreased in P5 and recovered in P6 and P7, reaching 106.9 kg/capita for milled rice and 87.6 for wheat. While per capital consumption of corn in China increased sharply from P2 to P5 because the usage for feeding. In addition, usage for bio-energy starting from 2006 increased this consumption. Nowadays, per capital consumption of corn increased significantly in P7, up to 168.2 kg/capita in 2003. Per capital consumption of soybeans in China started increasing since P3, and it shoot up dramatically to 57.2 kg/capita.

5.4 International trade for grains in major trade countries during the food crisis

In this chapter, major importers and exporters will be described to show their contribution to the world grains trade in recent era. The total trade volume can influence the world grain prices, and during the world prices for rice, wheat, corn and soybeans shot up in 2008, major exporters reduced their exported volume to protect their domestic grains, while the major importers had to increase the production. And the exporting countries for the grains might lost the opportunities to add their export

benefit if their grain production did not increased, while the importing countries for the grains would suffer the high prices if they failed to expand their grain production.

5.2.1 Rice trade in recent era

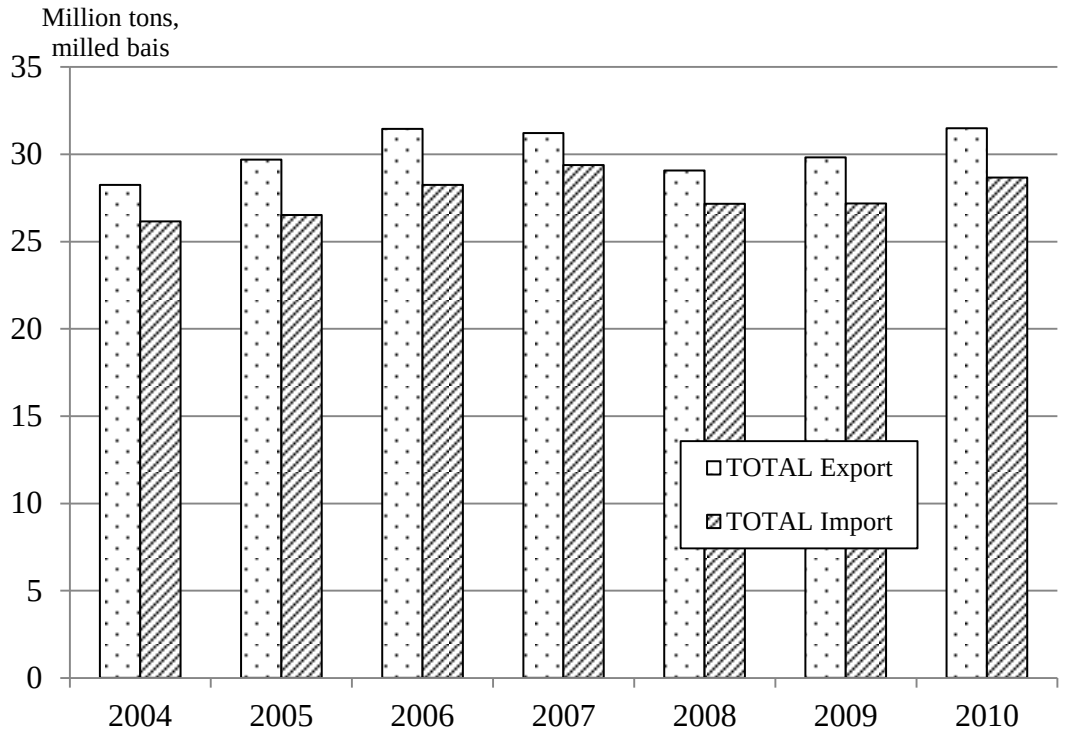

Fig. 5.4.1 Total world trade volume of rice

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

The world total trade volume of rice fell dramatically in 2008, decreasing by 7.22 percent. Both the total import and total export volume in the world dropped significantly in 2008 (Fig. 5.3.1). The total volumes of rice import had decreased by 7.57 percent in 2008, compared with the increase situation in other year between 2004

and 2008. The total volumes of rice export started dropped since 2007, with a level of merely 0.78 percent, while it suddenly declined by 6.88 percent in 2008. In 2008, global rice trade dropped and extremely high trading prices appeared. In response, major importers increased production to reduce dependence on imports.

Rice imports

Indonesia was once the world's largest rice importing country in recent years. Rice imports by Indonesia will increase year after year, although its production consecutive increasing in recent years, among which the fastest increasing in 2007, with an increase of 0.9 percent, up to 37 million tons. However, the rice import volume shot off in 2006, with a record of 2 million tons. After that, it dropped to 350 thousand tons in 2007. But it was not the end of continually decreasing, because the rice import volume in 2008 fell to 250 thousand tons and kept the same amount in the following two years.

Nigeria brought down the rice import volume in 2008 by 2.8 percent, to 1.75 million tons. However, the rice production in Nigeria continuously increased in recent era. That was because the government of Nigeria has promoted both area expansion and the use of higher yielding seeds developed specifically for Africa's soil and climate to boost production and reduce imports. Yet Nigeria was unable to achieve self-sufficiency or significantly reduce imports. About 50 thousand tons of imported rice was reduced during the world rice price spiked in 2008, compared with increasing imports in most of other years.

As one of the world's largest rice importing country in recent era, the Philippines imported a record 2.6 million tons of rice in 2008. Rice imports by the Philippines

have increased sharply in recent years, despite consecutive record crops production. The Philippines experiences substantial post-harvest loss, which was a major factor caused it rising imports.

Iran reduced its rice production because of fewer rainfalls in 2008, with the harvest volume of 1.5 million tons. However, the import amount and the production of rice in Iran hold the similar line in recent year. It was concluded from Fig 4.6 that rice import volume decreased 80 thousand tons in 2008 and 170 thousand tons in 2009. However, the rice production in 2009 increased sharply to 2 million tons. So Iran as a Middle Eastern country, suffered less of rice in 2008 during the world grain prices spiked.

Iraq, another Middle Eastern country, increased 114 thousand tons of rice in 2008, up to 1 million tons. Iraq raised its rice import volume since 2006, especially a 59 percent increase in 2007. Domestic production cannot meet the demand, and most of rice in Iraq quite relay on importing. So during the world rice skyrocketing, Iraq paid more money to get the rice for domestic consumption.

Senegal is also a country that as a major rice importing. Domestic rice production increased 135 percent in 2008, up to 265 thousand tons. But the domestic demand of rice was larger than that. As a result, the rice volume of importing was about 7 times than the domestic rice production in Senegal. However, a 20 percent decrease of rice importing in Senegal led the importing volume reduced to 683 thousand tons.

Saudi Arabia does not produce rice, but its total domestic rice consumption is around 1 million tons. All of these volumes come from importing. The government had used its rice stocks in 2006 and 2007 hence the import volume reduced sharply.

But in 2008, the rice stocks amount were less, so the import volume increased 20percent, up to 1.17 million tons.

Brazil increased 570 thousand tons of rice production. In fact, many Brazilian producers preferred to growing soybeans to rice. The reason for that was soybeans are less input-intensive crops but more profitable. Also, Brazil increased 19 thousand tons of rice importing in 2008 during the world rice price skyrocketed.

Rice exports

As mentioned above, the total volumes of rice export suddenly declined by 6.88percent in 2008, due to restrictions and bans implemented by several major rice suppliers. As a result, the global food prices were driven skyrocketing, which brought much worries for food security in many developing countries.

Among those major rice exporting countries, Thailand cut its rice exporting by about 17percent, to 8.6 million tons (Fig 5.3.2). As the largest rice-exporting country, Thailand held the low price advantages because the Thailand government intervened purchases that temporarily keep rice off the market. Furthermore, Thailand's rice is considered to be a higher-quality than any other suppliers.

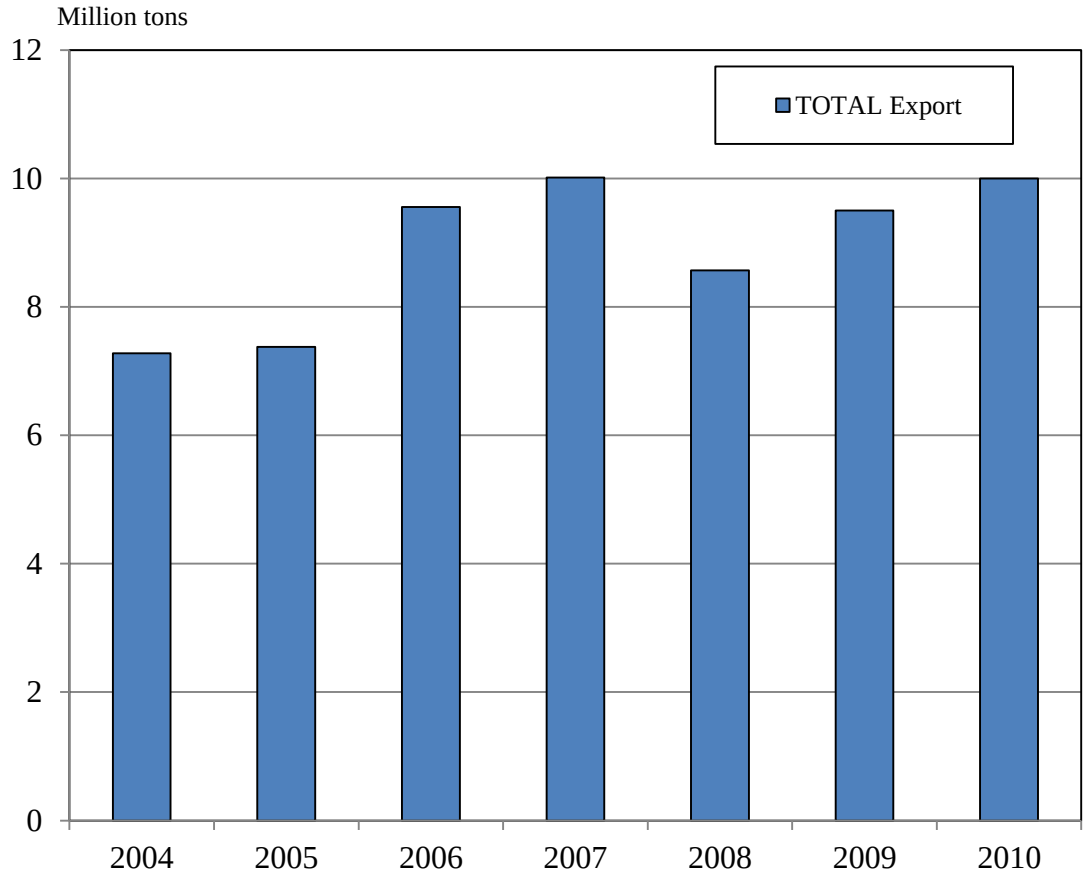

Fig. 5.4.2 Total rice export volume in Thailand

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Vietnam is the second-largest rice exporting country in recent eras. It almost exclusively exports long-grain milled rice, mostly in the medium- and low-quality categories, and is a big supplier to Southeast Asia and Cuba.

Vietnam exported about 1.3 million tons of rice in 2008, with its rice production just increasing 18 thousand (Fig 5.3.3). Although the Vietnam earned a lot of benefit by exporting its rice during the high rice prices, the government implemented restrictions and bans to stopped export rice in 2008.

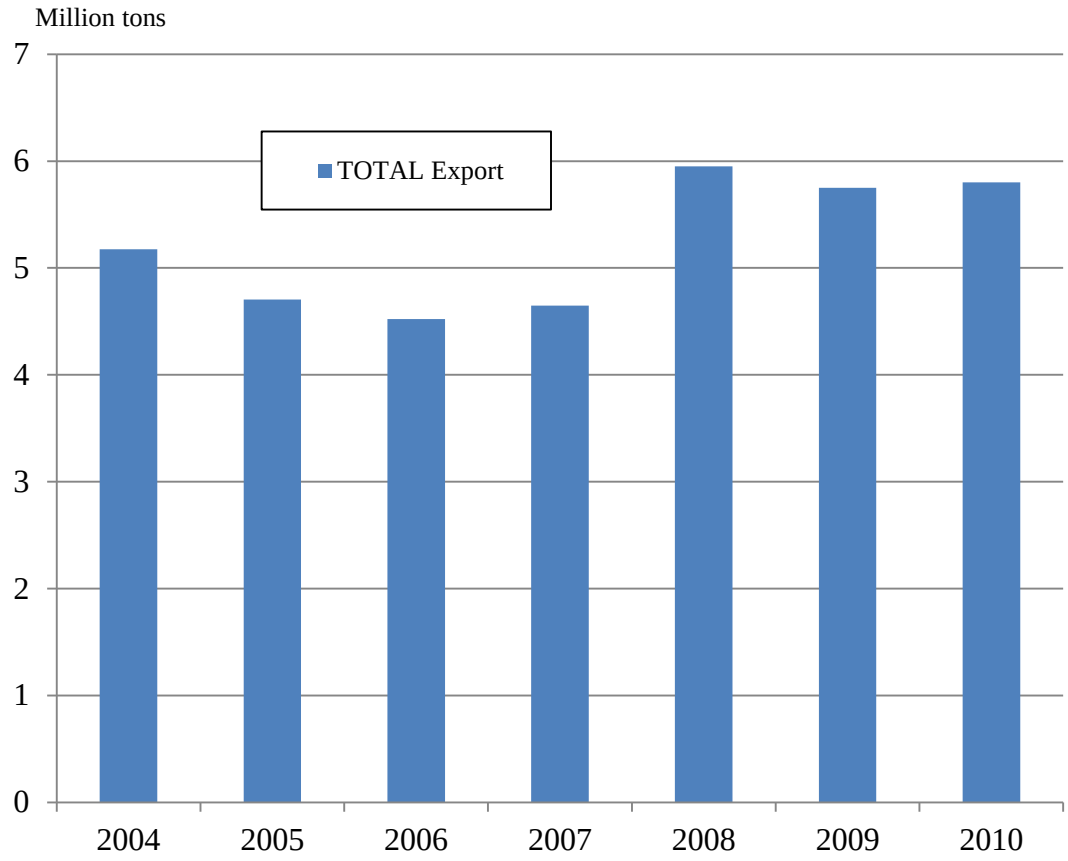

Fig. 5.4.3 Total rice export volume in Vietnam

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

The United States, another major rice exporting country, recovered its rice production in 2006, and kept increasing its rice production after that.

And we can see from Fig 5-8 that rice production reached 6.4 million tons, increasing about 300 thousand tons than the production in 2007. On contrary, the rice export volume dropped about 300 thousand tons, to 3.3 million tons.

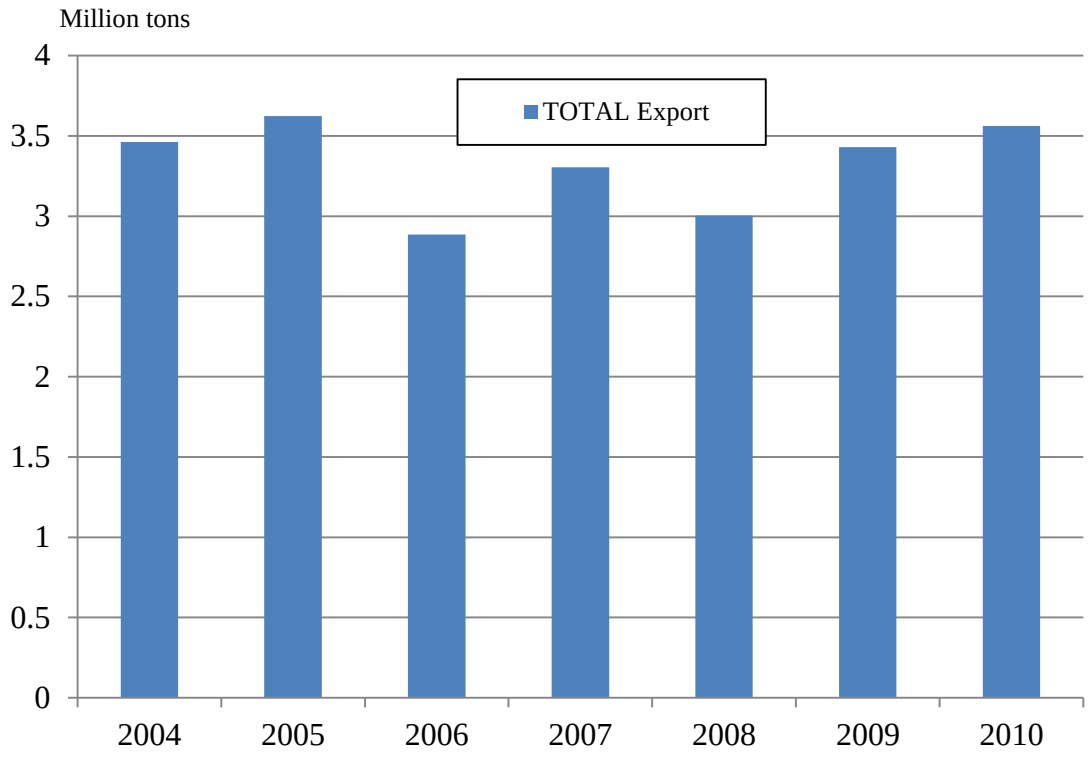

Fig. 5.4.4 Total rice export volume in the United States

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Pakistan increased 1 million tons of rice in 2008, but total rice consumption also increased 700 thousand tons. But Pakistan mostly exports low-quality long-grain milled rice, and its total rice export volume was 2.9 million tons, merely a 70 thousand tons reduction. Pakistan increased its production because of the skyrocketing trading prices and trade restrictions by several competitors.

India sharply reduced its rice export volume by 56percent in 2008 compared with the previous year, to about 2 million tons, although its rice production increased 2.5 million tons. The reason why Indian government implemented ban on non-basmati sales was that the government wanted more rice available for the domestic market.

5.2.2 Wheat trade in recent era

The world total trade volumes of wheat were around 110 million tons in recent years. But the total wheat production increased by about 12 percent, up to about 683 million tons. Also, the skyrocketing rice price drove more consumers to choose other food for substitute. As a result, despite the world wheat prices spiked as rice did, both the total import and total export volume for wheat in the world sharply increased in 2008 (Fig. 5.3.5). Total volumes of wheat import had increased by 20 percent in 2008, up to about 137 million tons. While total volumes of wheat export were up to about 143 million tons, a 22 percent increase in 2008.

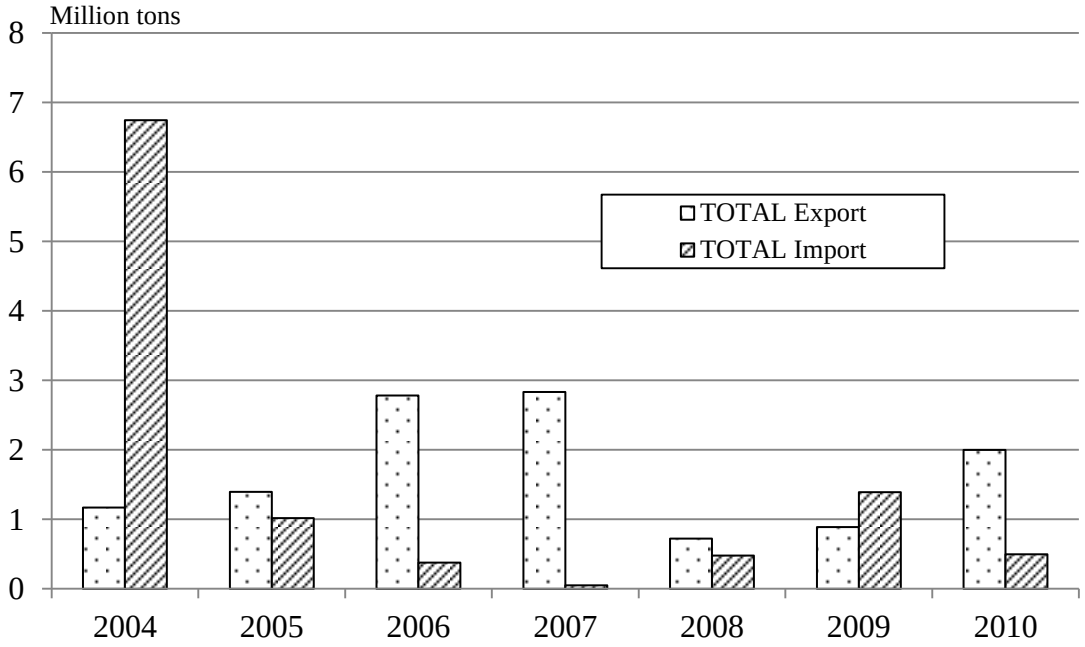

Fig. 5.4.5 Total world trade volumes of wheat

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Wheat imports

Egypt as the largest importing country for wheat, nearly half of its wheat domestic consumption comes from importing from other countries. Especially in 2008, wheat exporting increased by 28percent, up to 9.9 million tons. That was because wheat production in Egypt in 2008 had sharply reduced 300 thousand tons.

On the other hand, wheat production in Brazil had continuously increased since 2006, and reached its turning point at 5.8 million tons in 2008, a 55 percent increasing to 2007. A reason for this was that the wheat ending stocks became smaller duo to the huge amount in domestic use in 2007. Brazil's extra wheat production had weakened the amount of importing in 2008.

Indonesia did not grow wheat in recent eras, so it is a net import country for wheat, and the import volumes were around 5 million tons every year. And the most of importing wheat were consumed as food by human beings. There was a 7 percent decrease in 2007. But the amount recovered in 2008, with an about 4 percent ascending.

Wheat import in Japan during these years wondered at 5.5 million tons and the domestic production was just less than one sixth of the export volumes. Hence Japanese wheat market also quite depends upon the world market. Wheat import had reduced by 11 percent in 2008.

Algeria belongs to another major importing country for wheat. Wheat import volume starting climb since 2006 and reached its peak in 2008 at about 6.4 million tons. Domestic wheat was not sufficient for food consuming during recent years, and the volume was just alike half amount of the import volume.

Wheat importing in South Korea is similar to Indonesia, although there were only a few domestic production recently. So we can consider it as a net import country for rice. The import volumes were around 5 million tons per year. Most of importing wheat was consumed as food. The import volume reduced by 11 percent in 2007, to 3.1 million tons, while the recovered volume in 2008 was a 9 percent rising and moreover a 33 percent ascending. However, the use for feed by wheat was around 1 million tons in recent years in South Korea, which was the highest in all the major wheat importing countries.

Likewise to South Korea and Indonesia, the case of Nigeria also can be considered roughly as a net importer country for wheat. Yet, import volume for wheat dropped by 22% in 2007 and recover in 2008 as an increase of 33 percent, up to 3.6 million tons. But the peak for it appeared in 2009, at 3.9 million tons.

Wheat production in Iraq sharply fell to 1.3 million tons in 2008, a cut of 92 percent compared with in 2007. In addition, the wheat import in Iraq in 2008 was up to 3.9 million tons, an increase of 13 percent. The wheat production in the following two years kept continuously moving on up, which led the import reducing year after year. In addition, the amount of use for wheat for feed was around 500 thousand tons.

Turkey is one of a major large country in production, import and export for wheat. And the turn point appeared in 2007 for the wheat production recovering, with the lowest volume of production at 15.6 million tons. After creeping by 8 percent and 10 percent, the volume for wheat production were up to 16.8 million tons in 2008 and 18.5 million tons in 2009, respectively. Besides, the feed use for wheat in Turkey was about 800 thousand per year.

Wheat production fluctuated in Morocco in recent eras. But from 2007 to 2009, it kept gathering, decreasing 136 percent in 2008 and 71 percent in 2009, respectively, and finally came to 6.4 million tons. But it went down in 2010, with a 42 percent dropping. The trends of the rice importing volume performed just the reverse, which reduced by 11 percent in 2008 and 36 percent in 2009, respectively. While it was pulled up by 50 percent and reached 3.6 million tons.

Wheat exports

In the United States, the wheat production had started to increasing since 2006, duo to the yield increase and the expander of area harvested, especially in it climbed by 22 percent, up to 68 million tons. About half of wheat was used for exporting, and its peak volume was in 2007, afterwards the export began to reduce, specially a reduction by 24 percent. At the same time, the import volume for wheat in the United States had increased in 2008, a 10 percent increasing of about 400 thousand tons.

Wheat production dropped sharply in 2007 dues to Canada cut the area harvested and the reduction for yield. However, a 43 percent growth rate for production, reaching 29 million tons, could supply an additional 2.7 million tons of wheat.

As one of the main wheat export countries, Russia had increased its production gradually by years since 2006, and the peak production was 64 million tons in 2008, a 39 percent of increasing compared to 2007. Also, the export volume remained stable increasing with the fastest speed was 35 percent in 2008 compared to 2007.

Oceania increased by 96 percent of wheat export in 2008, up to 14.8 million tons. At the same time, the production increased by 57 percent, up to 21.7 million tons. In fact, the volume for wheat production and export returned the standard as in 2004 and

2005. The wheat yield in 2006 was so low that the production failed to catch up the previous year, which caused the wheat volume available for exporting to reduce by 83.3 percent. We also noticed that the use of wheat as feeding in Oceania wondered around 4 million tons, and the reason was that Oceania courtiers encourage their farmers to be engaged in breeding livestock, especially feeding cattle etc.

Kazakhstan is another country for major exporting wheat in the world, with total domestic consumption of 7.5 million tons and feeding use of 2.7 million tons, stably. Specially, wheat production reduced to 33 percent, to 12.5 million tons in 2008, while the export volume cut 81.8 percent, to 4.5 million tons.

Ukraine had suddenly improved both its harvest area and yield for wheat in 2008, due to which the wheat production sharply increased by 86.3%, up to 25.9 million tons. Consequently, the export amount jumped by 955 percent compared with 2007, up to a high record of 13 million. As the domestic food use, feed use and stocks for wheat all keeping stable in recent era, Ukraine could get a huge of extra benefits in 2008 during the world wheat price spiked by export such a lot of wheat.

Unlike Ukraine, Argentina's wheat production and export became constrictive in 2008. The reason was that Argentina cut wheat area harvested and yield, and finally the production reduced by 84.2 percent, to 10.1 million tons. The export volume also reduced by 65.6 percent in 2008, to 6.77 million tons, and about half of the production were used for domestic food consumption, which nearly unchanged in recent years. So Argentina failed to gain more benefit though export wheat to the world market, where had got skyrocketing high prices in 2008.

China posted to be the largest country for wheat production all over the world, and its growth rate of wheat production was positive except in 2010. Also, China is a

net export country for wheat in the world and the import amount recovered in 2007, and China used to be a large wheat import country, for example, the import volume was around 6.5 million tons (Fig. 5.3.6). On the other side, the total export for wheat had fluctuated since 2004, but after China experienced a hard time for export wheat, China had lost its competition advantage nowadays in the international markets.

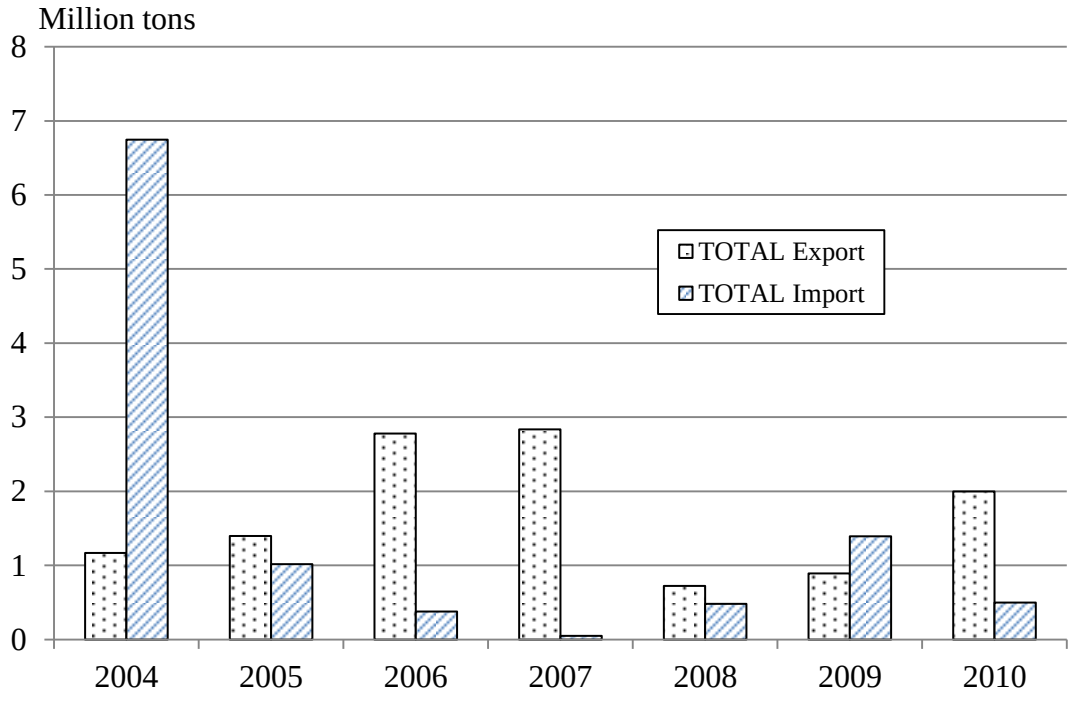

Fig. 5.4.6 Total wheat export volume in China

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

5.2.3 Corn trade in recent era

The world total production of corn started significantly increasing in 2006, but experienced a sharp return in 2008. The reason is mainly because that the main

producing countries had expanded their corn production as the industrial use of corn for ethanol became larger and larger during these years.

In addition, the greatest increase for corn production was in 2007 in the world and reached 793.6 million tons, increasing 80.2 million tons. The most part of these increase covered the growth in the United States, who had expanded 63.7 million tons.

Total trade volumes of corn were less than 90 million tons in recent years. During the world corn prices spiked, both the total import and total export volume for wheat in the world sharply increased in 2008 (Fig. 5.3.7). The total volumes of wheat import had decreased by 20 percent in 2008. While the total volumes of corn export reduced by 16.8 percent in 2008.

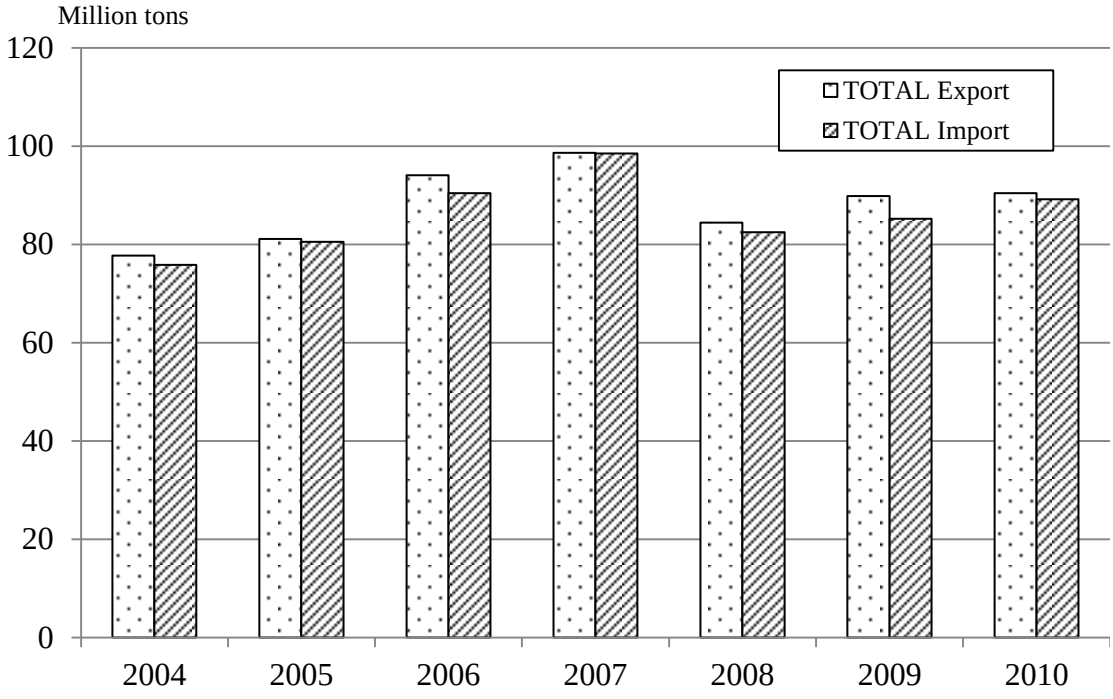

Fig. 5.4.7 Total world trade volumes of corn

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Corn imports

Japan import about 16 million tons of corn every year, and its domestic production is low, at about 1 thousand tons per year. The demand for corn in Japan is stable in recent year, and the import volume 81 thousand tons in 2008.

Mexico import about 10 million tons of corn in recent years, which is about half of its domestic corn production. In 2008, corn production increased 2.7 percent, up to 24.2 million tons, but the import sharply decreased by 23 percent, compared to the situation in 2007.

The domestic corn production in South Korea increased 9 thousand tons in 2008, which seems to be a great increase, however the real amount is much less than what the country need. South Korea sharply lost its corn import in 2008, with a decrease of 29.5 percent.

Egypt increased both its corn production and import in 2008. The domestic production in Egypt rose up to 6.5 million tons in 2008, while its import volume jumped by 21.1 percent, up to 5.0 million tons.

The European Union successes to raise their corn production in 2008, and they worked on increased the corn production, with an increasing rate of 31.1 percent compared with 2007. However, the import volume for the European Union fell from 14 million tons in 2007 to 2.7 million tons in 2008.

Colombia import about 3.4 million tons of corn every year in recent era, and the domestic production is merely half of the total import volume. In 2008, the corn import volume reduced by 6 percent and reached 3.3 million tons.

Canada is one of the biggest corn producing countries, with average production at about 10 million tons every years recently. Yet it import about 2 million tons of

corn every year. In 2008, Canadian domestic corn production and total import amount both reduced by 10 percent and 73 percent.

Malaysia's corn production is less than 0.1 million ton every year, and the import volume is about 2.5 million tons each year recently. In particular, corn import volume sharply was increased in 2007 and later suddenly reduced to the average level in 2008.

As shown in Fig. 5.3.8, China used to be a big corn exporting country before 2007. However, the export volume for corn in China has decreased to a small amount since 2007. On the other hand, total import volume for corn is raised to about 1 million ton in 2009 and 2010. So China's exporting amount for corn are become less and less, and China has already become a net importing county for corn.

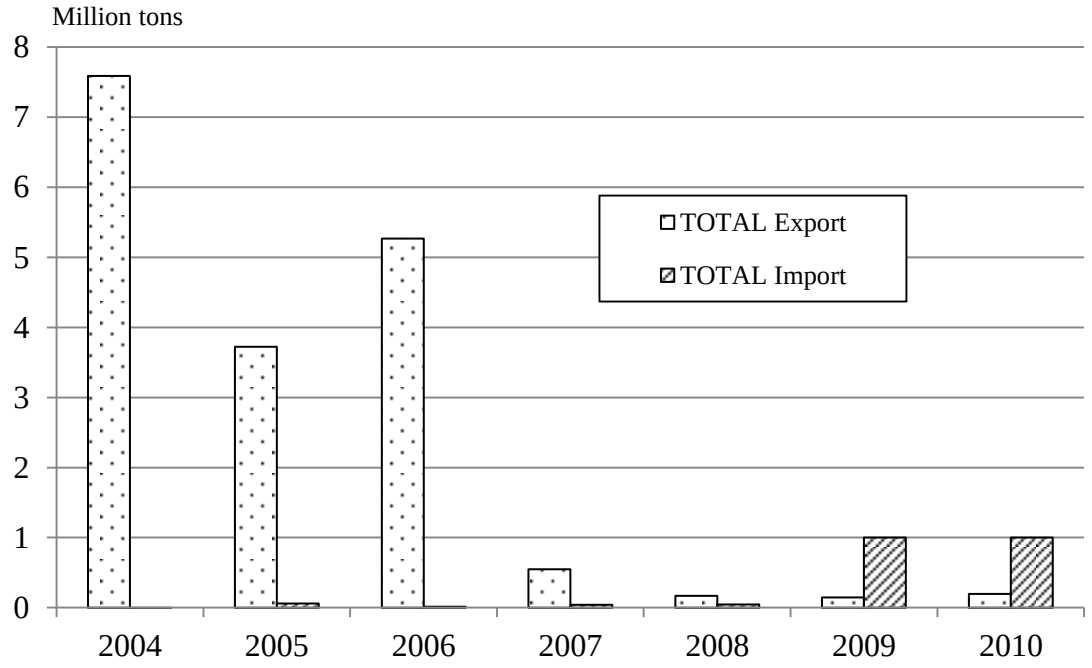

Fig. 5.4.8 Total corn import volume in China

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Corn exports

The United States produces about 300 million tons of corn in recent years. But in 2008 when the world corn prices increased a lot, the corn production in the United States reduced by 8 percent, to 307 million tons. And the export amount also reduced by 31.8 percent, to 47 million tons. (Fig. 5.3.9)

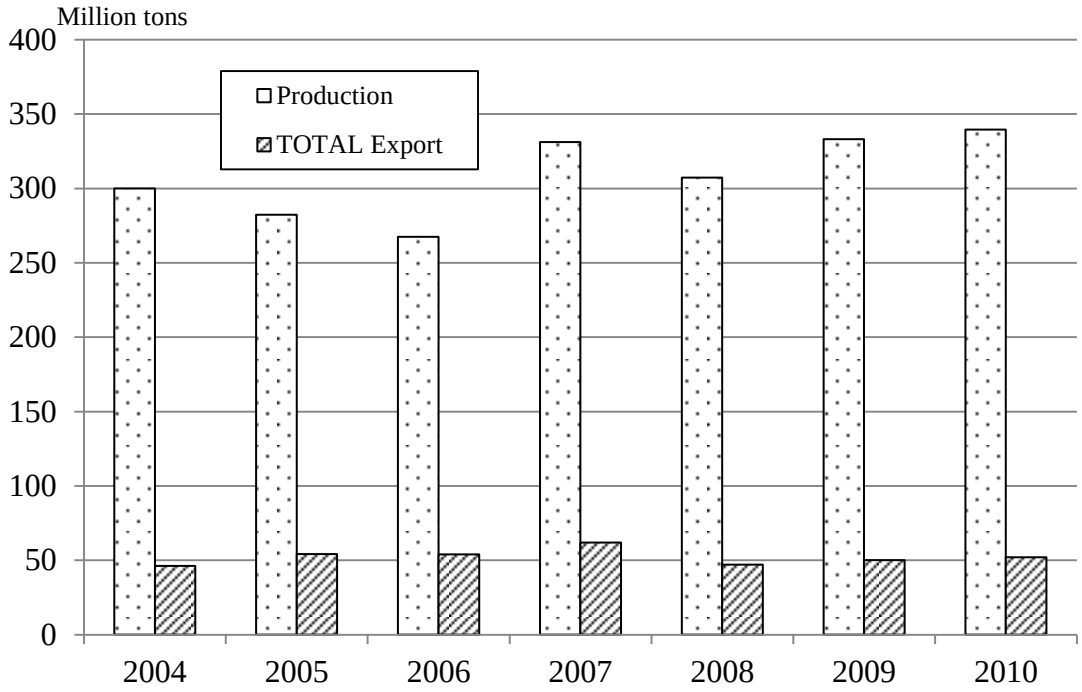

Fig. 5.4.9 Total corn export volume in the United States

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Argentina reduced both its corn production and corn export volume in 2008 sharply, with a 46.8 percent reduction for corn production and a 43.4 percent reduction for corn export (Fig. 5.3.10). It is obviously that Argentina export most of

its corn to the world market, so as the harvest became less in 2008, the ability for supplying the world market turned to be weaker. Although the demand for corn increased in 2008, Argentina failed to get more trade benefit though corn export during the world corn prices skyrocketing.

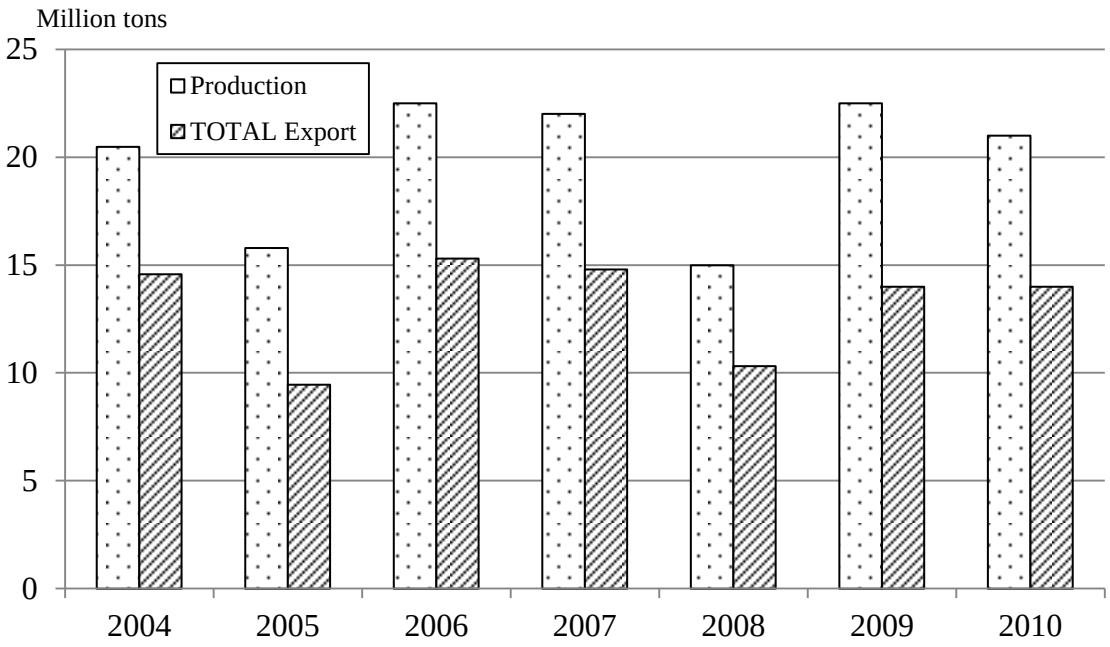

Fig. 5.4.10 Total corn export volume in Argentina

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

The case of Brazil's corn is similar to Argentina, and Brazil cut its corn production by 14.9 percent, reducing to 51 million tons. And it reduced its corn exporting volume by 9 percent, to 7.1 million tons (Fig. 5.3.11). But Brazil uses more corn in domestic demand, unlike Argentina.

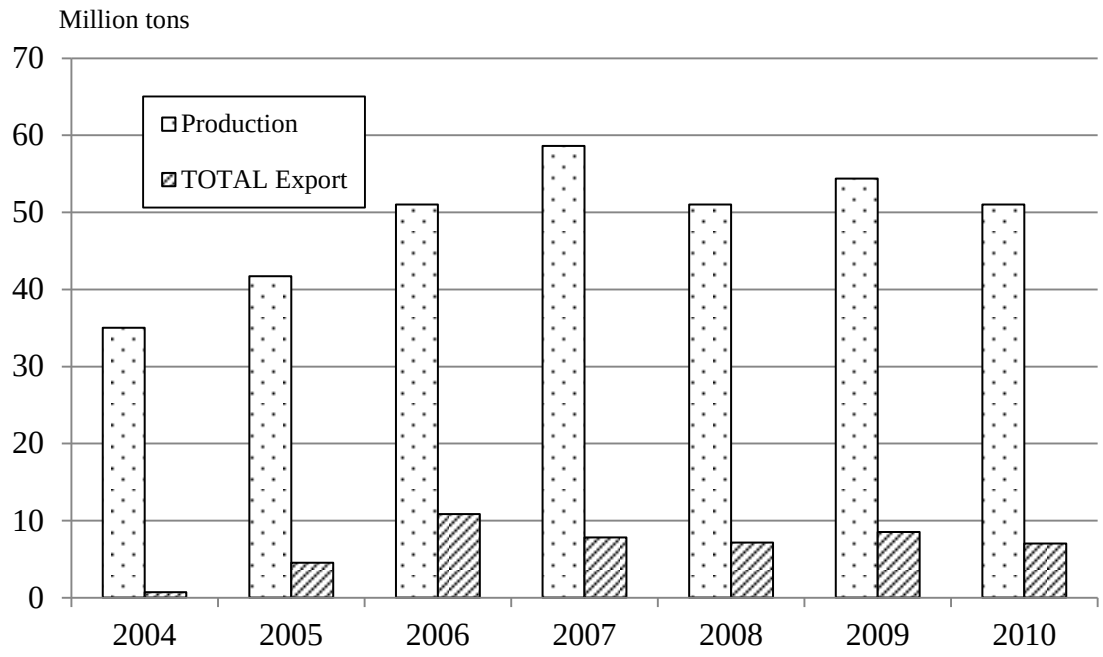

Fig. 5.4.11 Total corn export volume in Brazil

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Ukraine is a major exporting country for corn, and it particularly raised its production by 54 percent in 2008, up to 11.4 million tons, which is a record since 2004. As a result, Ukraine expanded its corn export volume by 165 percent, up to 5.5 million tons in 2008, which brought a great benefit for the country through the global corn exporting.

South Africa takes most of its corn into domestic use, and after 2007 it increases the corn exporting due to the raised corn production. However, the production in 2008 suddenly reduced to 12.6 million tons, a 5 percent drop over 2007, together with a 29 percent reduction in corn exporting.

Export Volume for corn in Canada does not have a high amount, although the country grows about 10 million tons of corn. Most of the corn is used in the domestic

demands. And in the world corn prices increased in 2008, Canada cut down its export volume by 153 percent because the production decreased by 10 percent and the government has to meet the need for the domestic use.

5.2.4 Soybeans trade in recent era

The world total trade volume of soybeans fell dramatically since 2008, with a decreasing rate of 19.4 percent of the total import volume and 17.2 percent of the total export volume (Fig. 5-3.12). And since that the world trade for soybeans keeps lower level.

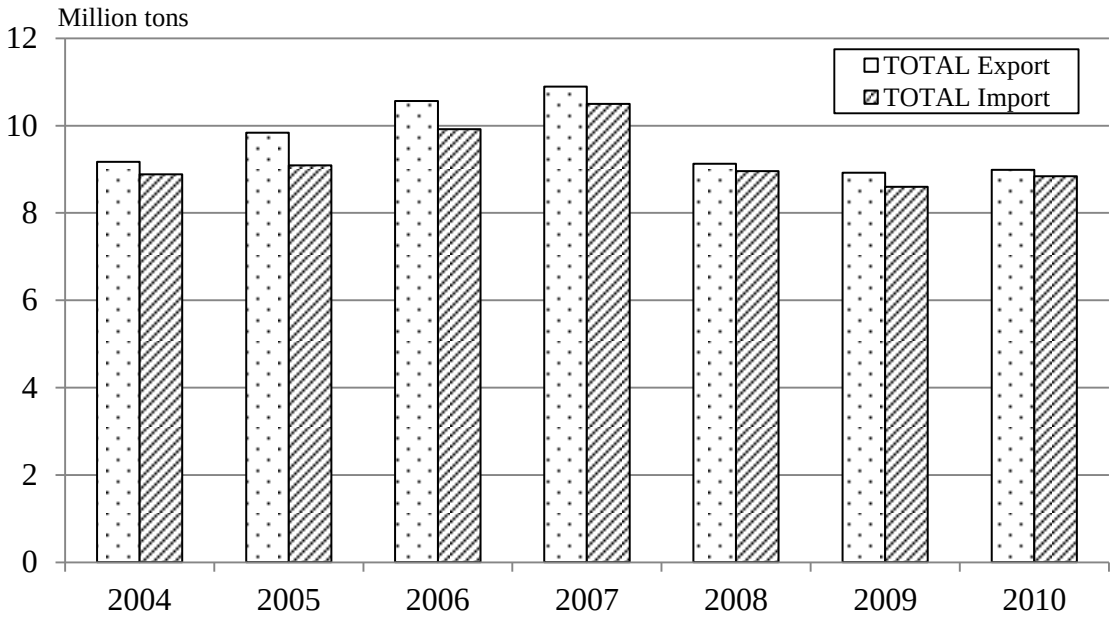

Fig. 5.4.12 Total world trade volumes of soybeans

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Soybeans imports

The European Union, as a group to import soybeans, imports about 13 million tons of soybeans. Soybeans production in the EU is so low that it cannot meet the demand. EU reduced a 14.5% soybeans importing dramatically in 2008..

Japan produces about 0.22 million tons of soybeans in the recent era. And it import about 3.5 million tons of soybeans each year. But the importing reduced by 18.2%, to 3.4 million tons due to main exporter reduced the trading volume in 2008.

Soybeans production in China faces the difficulties in greatly expanding in the recent years, although the domestic demand keeps increasing. Production was increased by 11%, up to 15.5 million tons. The import volume also was increased by 7 %, up to 41.1 million tons (Fig 5.3.13).

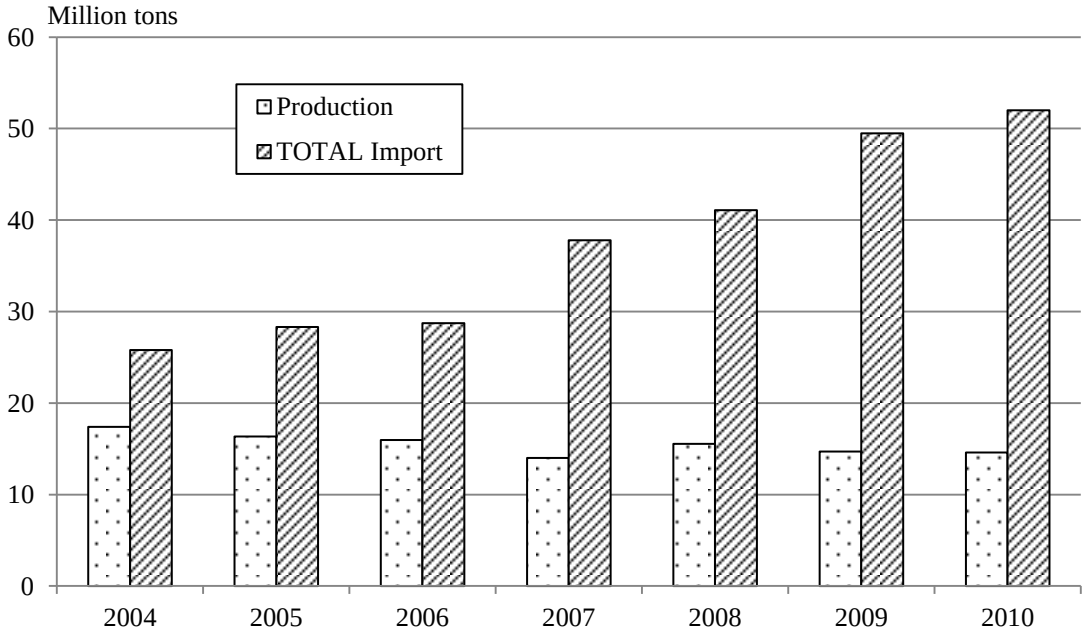

Fig. 5.4.13 Total soybeans production and import volume in China

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Soybeans exports

Main exporting countries for soybeans in the world concentrates to three countries in American countries, which are the United States, Argentina, and Brazil. These three countries have the similar environment to harvest soybeans. And duo to the technology improvement, soybeans are widely grown.

The United States, as the greatest soybeans exporting countries nowadays, has increased its soybeans production since 2007, and reaches about 90 million tons (Fig 5.3.14). And its export volume has been increased since 2005, and reaches about 40 million tons at present. Specially, the United States expanded its soybeans export by 10.4%, up to 34.8 million tons in 2008.

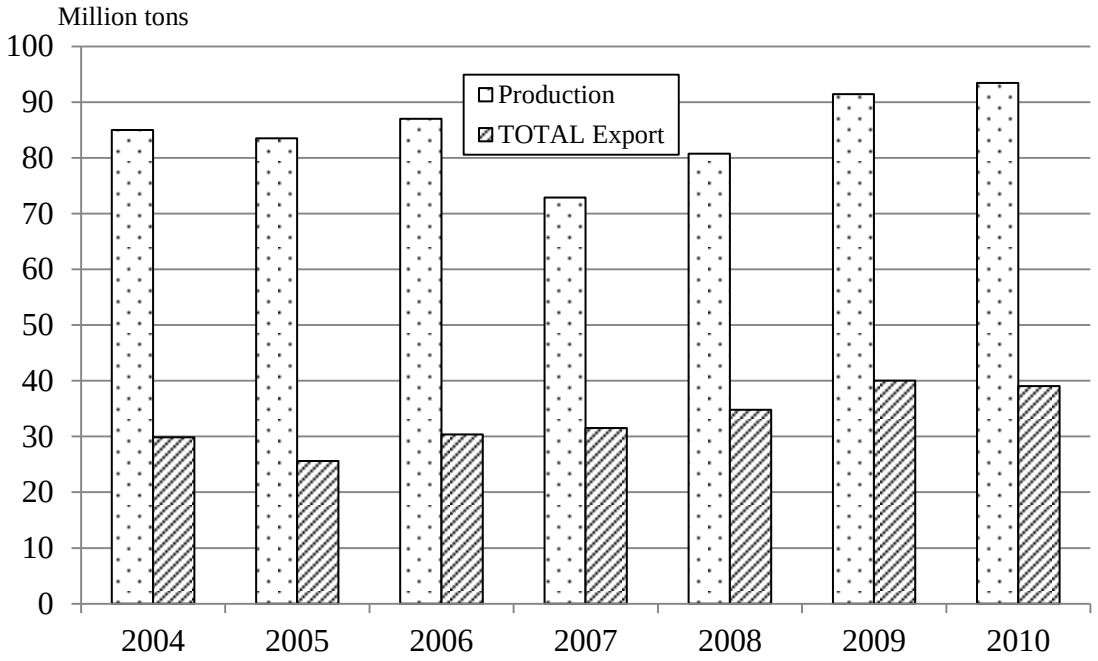

Fig. 5.4.14 Total soybeans production and export volume in the United States

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Another main soybeans exporting country, Argentina, reduced both its production and its export volume in 2008. In particular, production decreased by 44.4 percent, to 32 million tons. While the export volume for soybeans decreased by 148 percent, to 5.6 million tons (Fig. 5.3.15).

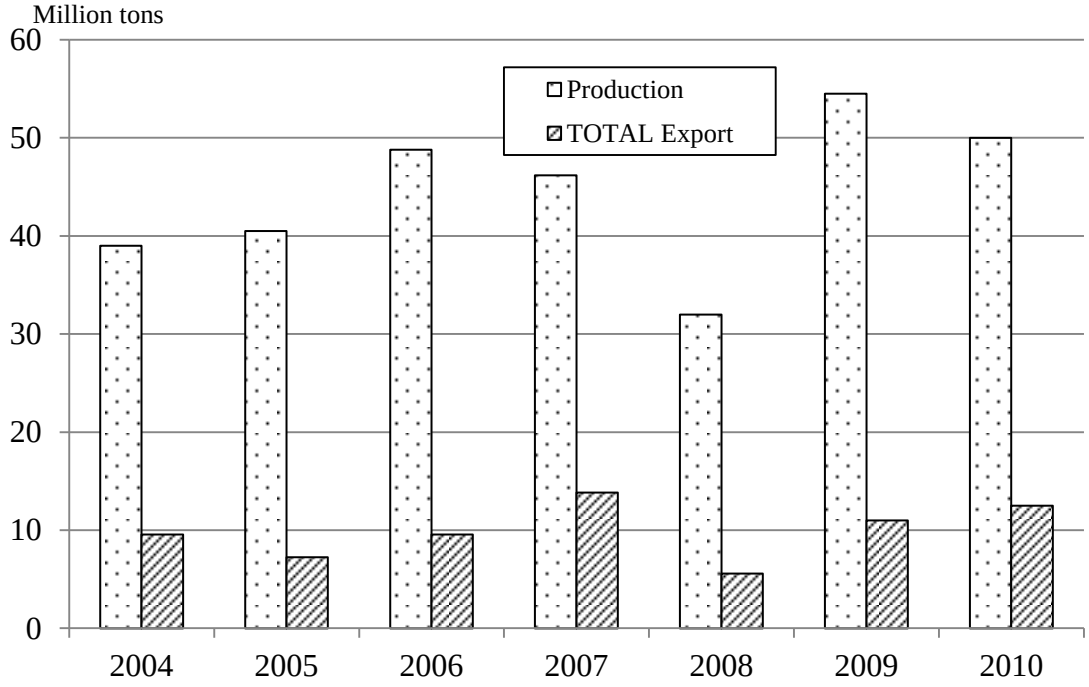

Fig. 5.4.15 Total soybeans production and export volume in Argentina

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

In the case of Brazil, soybeans production reduced by 5.5 percent, but it still expanded soybeans export by 18 percent, up to 30 million tons. So Brazil took the opportunity to increase its trading benefit during the world soybeans prices shoot off in 2008 (Fig 5-3.16).

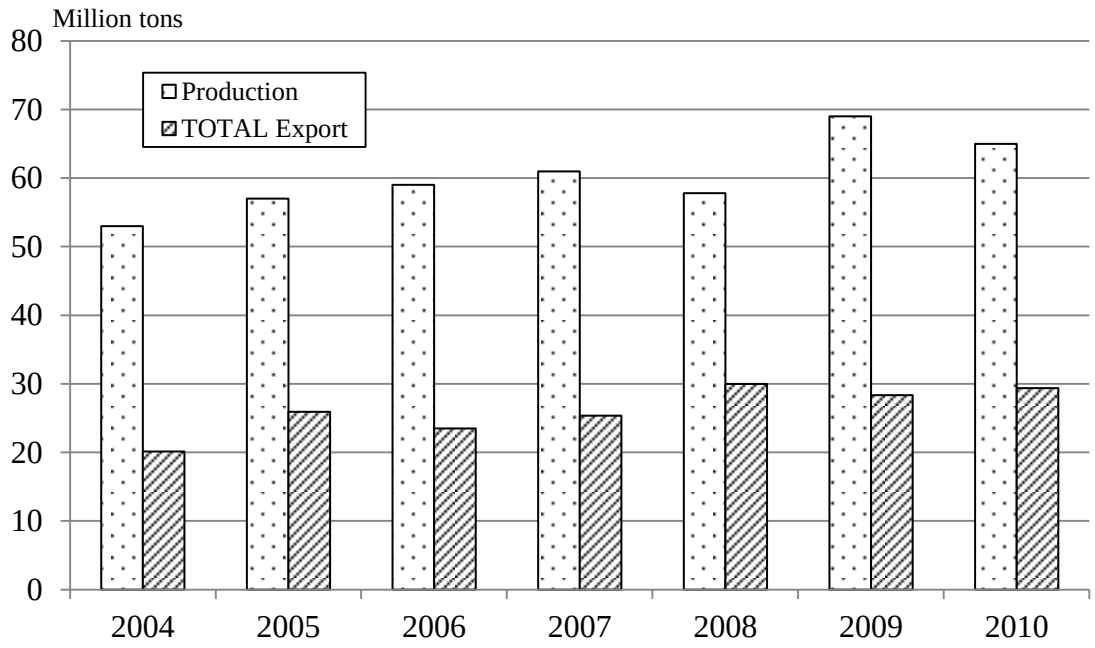

Fig. 5.4.16 Total soybeans production and export volume in Brazil

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

5.5 Summary of this chapter

Wheat price in China had kept steadily increasing since 2007, which appeared to be an 11% increase before the world prices spiked. Corn wholesale price and soybean wholesale price in China were higher than US price during recent years. However, the US corn price had surpassed the China's corn price during the world prices spiked. Soybean price in China shifted in the same direction as the US soybeans prices. Yet the China soybean price remained above the world market price.

The trade situations of main grains in 2008 were various in different countries. Major importing and exporting countries for grains adjusted their policies under the

influence of the world high prices. Among those, the world total trade volume of rice fell dramatically in 2008, decreasing by 7.22 percent. Both the total import and total export volume in the world dropped significantly in 2008. The total volumes of rice import had decreased by 7.57 percent in 2008, compared with the increase situation in other year between 2004 and 2008. The total volumes of rice export started dropped since 2007, with a level of merely 0.78 percent, while it suddenly declined by 6.88 percent in 2008. And the main import counties for rice such as Indonesia, Nigeria, Iraq, and Brazil all tried to increase rice production to reduce dependence on imports in response to the difficulties in importing rice from the world markets at doubled prices. If the major importers for rice such as Iran, Senegal, and Saudi Arabia failed to expand their rice production, they had to seek and cost more to buy the rice from the world market even the world rice prices shot up. While the major rice exporters, for example, Thailand, the United States, Pakistan, and India reduced their export volume in 2008. However, Vietnam got benefit from expanding its rice export; in fact Vietnam also limited its exporting during the world rice prices sharply increased.

The skyrocketing rice price drove more consumers to choose other food for substitute. As a result, despite the world wheat prices spiked as rice did, both the total import and total export volume for wheat in the world sharply increased in 2008 The total volumes of wheat import had increased by 20 percent in 2008, up to about 137 million tons. While the total volumes of wheat export rose up to about 143 million tons, a 22 percent increase in 2008, compared with the volume in the previous year.

Major producing countries had expanded their corn production as the industrial use of corn for ethanol became larger and larger during these years. And the greatest increase for corn production was in 2007 in the world and reached 793.6 million tons,

increasing 80.2 million tons. The most part of these increase covered the growth in the United States, who had expanded 63.7 million tons.

The world total trade volume of soybeans fell dramatically since 2008, with the decreasing rate of 19.4 percent of the total import volume and 17.2 percent of the total export volume. And since that the world trade for soybeans keeps lower level.

CHAPTER 6

GRAIN PRICES TRANSMISSION FROM INTERNATIONAL MARKETS TO CHINESE DOMESTIC MARKETS

6.1 Background and literature review

After joining WTO, Chinese agricultural commodities linked with the international markets to a certain extent. Therefore, fluctuations of international grain prices started influencing Chinese domestic grain markets, which indicated that the volatility of international grain prices brought new challenges to Chinese grains' price stabilization. Weekly prices of milled rice, wheat, corn and soybeans showed that Chinese grain prices are more stable than the international grain prices from February 25, 2007 to February 24, 2013 (Fig.6-1).

On the other hand, Chinese domestic grain prices were rather moderate as compared to the US market. However, the fluctuations of the two grain markets are also simultaneously, which suggest that there is consistency between the domestic grain prices in China and the US future grain prices. The reason for this is due to the CBOT prices played a decisive role in announcing price information, by which Chinese domestic grain prices are influenced, such as soybean prices in China fluctuated in a rather similar style as the US soybean prices.

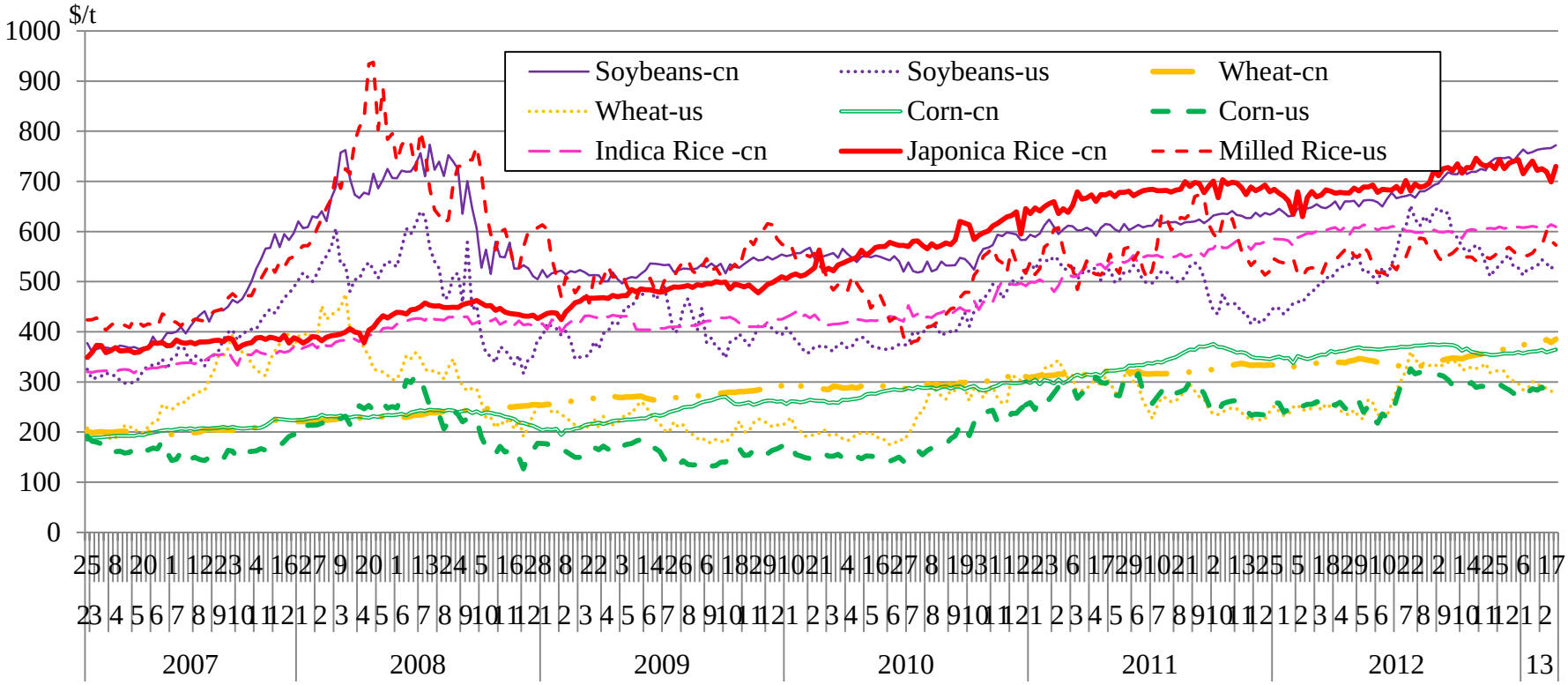

Fig. 6.1.1 Weekly grain prices in China and the US markets

Source: Price data, China Grain Data Center, http://datacenter.cngrain.com

GFT - Online Futures Trading, http://futures.tradingcharts.com

The Central Parity of RMB, State Administration of Foreign Exchange, http://www.safe.gov.cn

Bureau of Labor Statistics, United States Department of Labor, http://www.bls.gov

Chinese grain prices increased rapidly during the recent 6 years（Table 6.1.1）. Chinese wholesale grain prices were increased by 69.75%, 66.10%, and 60.04% for japonica rice, soybeans and corn, respectively. In addition, domestic wholesale prices of wheat and indica rice were also increased by more than half of their prices, comparing to the prices during the beginning of 2007. We excluded the influence from the inflation by calculating grains real prices. After depreciating, the Chinese grain prices showed doubled, comparing with their prices on February 25, 2007, especially that the prices of japonica rice and soybeans accounted for the highest two growth rate. There are many reasons for the rapid increase of grain prices in China, including the government policies for encouraging farmer's benefits, such as the Chinese grain minimum procurement prices. Other factors also raised the Chinese domestic grain prices, such as the Chinese high economic development and population growth, rising costs of agricultural production, inflation expectations, excess monetary supply and natural disasters in the recent years (Wang and Xie, 2012). Especially, the impact from the fluctuations in the international grain markets also play important role in increasing the Chinese domestic grain prices.

Table 6.1.1 Increase rate of Chinese grain prices (Feb. 25, 2007 to Feb. 24, 2013)

Grains	RMB base(%)	Dollar base(%)
soybeans	66.10	104.7
wheat	55.04	91.10
corn	60.04	97.30
indica rice	54.48	90.40
japonica rice	69.75	109.2

Source: Authors' calculation.

A significant evidence for China to play an increasingly important role in the world grain markets was that the trade shares for grains after China joined WTO in Fig. 6.1.2. Especially, import shares for Chinese grains increased while its export shares reduced in the recent years, which suggested that the China turned to increase

its grain demands from the world markets. China grew a great volume of grains to feed the largest number of population in the world. However it began importing more grains from the world grain market, especially for corn and soybeans. As a result, the international grain prices might influence the Chinese domestic grain markets. In addition, prices of rice and wheat as the stable food in China may be influenced by the fluctuation imported grain prices due to the substitutions among the domestic grains.

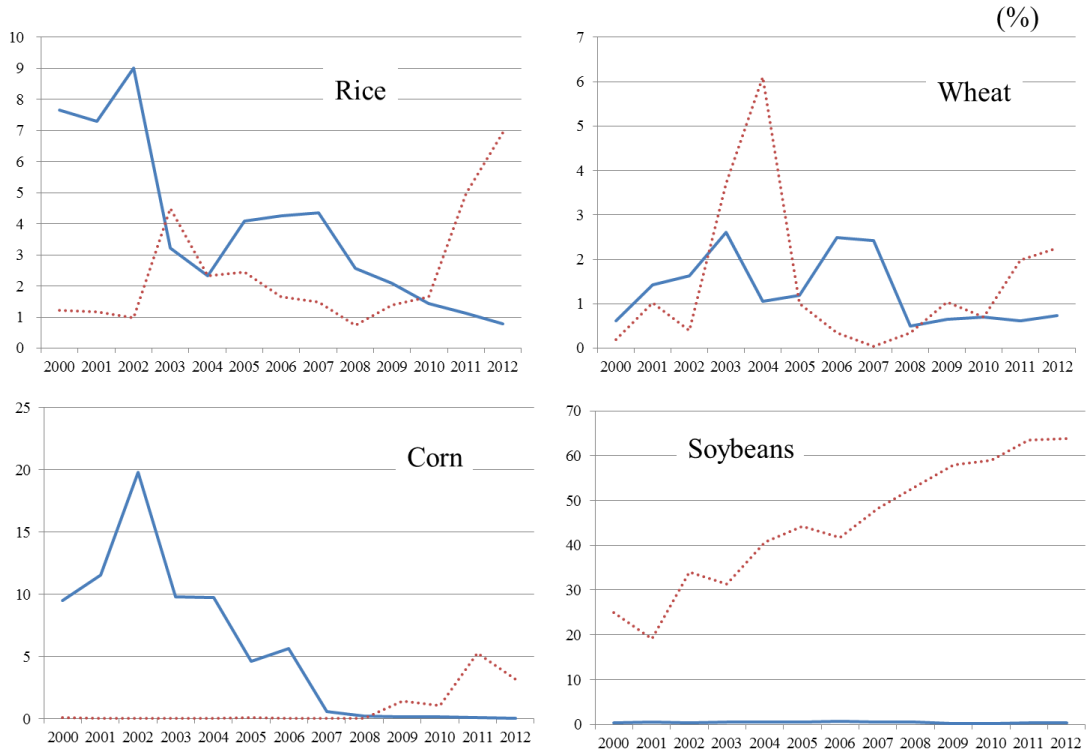

Fig. 6.1.2 Trade share of Chinese grains after China joined WTO

Source: US Department of Agriculture: PS&D Online.

Note: Real line – export share, dotted line – import share

There were a number of early papers which discussed and proposed the grain price transmission from the world markets into the Chinese domestic markets. Among previous researches, correlation between the Chinese domestic grain prices and the world grain prices was not significant before China joined WTO, such as Zhang (1999) showed that integration of the domestic and international grain markets were not high. Studies focusing on the grain prices after China joined WTO

suggested that prices transmission from the international grain markets to Chinese domestic grain markets became significant. However, researchers have not obtained conformance conclusions on interactive relationship between Chinese and international grain prices. Luo (2009) reported that changes for international grain prices on Chinese domestic grain prices becoming significantly. Cao, *et al.* (2012) found that soybean prices had a strong relationship between China's and the US, while indica rice, wheat and corn show week relationship. Miao, *et al.* (2012) obtained long-run relationship between the international and Chinese domestic rice prices.

In addition, many researchers focused on the great spiked grain prices, such as in 2008. For example, Sarris (2008) argued that the causes of high commodity prices in 2008 included for parts. Firstly, and sustained historically high economic growth worldwide offered strong growth in food demand. And bio-fuel feedstock demand, particularly for maize and vegetable oils increased demand. Also, stronger currencies/ weak USD made the real price of food more expensive. Secondly, constrained supply appeared such as high energy related input costs. And crude oil up since 2000, also it due to the repeated yields shortfalls in key areas. Thirdly, low commodity stocks reduced because of the increased speculation and demand to rebuild. And these increased activities on commodity exchange were higher volatility. Finally, policies and policy changes in many countries, for example, tariff liberalization by importers, decoupling of subsidies, reduction in export subsidies, lower public stocks, increased use of export taxes and bans, and bio-fuel subsidies and tariffs or tax credits.

Braun (2008) studied the impacts of high food prices in 2008, and he noticed that higher food prices have radically different effects across countries and population groups. At the country level, countries that are net food exporters will benefit from improved terms of trade, although some of them are missing out on this opportunity by banning exports to protect consumers. Net food importers, however, will struggle to meet domestic food demand. The nutrition of the poor is also at risk when they are not shielded from the price rises. Higher food prices lead poor people to limit their

food consumption and shift to even less-balanced diets, with harmful effects on health in the short and long run. He also pointed out that price controls and changes in import and export policies may begin to address the problems of poor consumers who find that they can no longer afford an adequate diet for a healthy life. But some of these policies are likely to backfire by making the international market smaller and more volatile.

Headey and Fan (2008) attempted to provide a more comprehensive review of the latest issues based on the best and the most recent research, as well as on fresh theoretical and empirical analysis. They firstly analyze the causes of the current crisis by considering how well standard explanations hold up against relevant economic theory and important stylized facts. Some explanations turn out to hold up much better than others, especially rising oil prices, the depreciation of the U.S. dollar, bio-fuels demand, and some commodity-specific explanations. After that they provided an appraisal of the likely macro- and microeconomic impacts of the crisis on developing countries. They observed a large gap between macro and micro factors, which, when identifying the most vulnerable countries, often point in different directions.

Ivanic and Martin (2008) said in their paper that the recent increases in prices of staple foods have raised the real incomes of those selling food, many of whom are relatively poor, while hurting net food consumers, many of whom are also relatively poor. The impacts on poverty will certainly be very diverse, but the average impact on poverty depends upon the balance between these two effects, and can only be determined by looking at real-world data. Results using household data for 10 observations on nine low-income countries show that the short-run impacts of higher staple food prices on poverty differ considerably by commodity and by country, but that poverty increases are much more frequent, and larger, than poverty reductions. The recent large increases in food prices appear likely to raise overall poverty in low-income countries substantially.

Trostle (2008) reported that world market prices for major food commodities such as grains and vegetable oils have raised sharply to historic highs of more than 60

percent above levels just 2 years ago. Many factors have contributed to the jump in food commodity prices. Some factors reflect trends of slower growth in production and more rapid growth in demand that have contributed to a tightening of world balances of grains and oilseeds over the last decade. Recent factors that have further tightened world markets include increased global demand for bio-fuels feedstock's and adverse weather conditions in 2006 and 2007 in some major grain- and oilseed-producing areas. Other factors that have added to global food commodity price inflation include the declining value of the U.S. dollar, rising energy prices, increasing agricultural costs of production, growing foreign exchange holdings by major food-importing countries, and policies adopted recently by some exporting and importing countries to mitigate their own food price inflation. He reported these factors and illustrates how they have contributed to food commodity price increases.

Childs and Kiawu (2009) reported in their report that Global rice prices rose to record highs in the spring of 2008 was not due to crop failure or a particularly tight global rice supply situation. Instead, trade restrictions by major suppliers, panic buying by several large importers, a weak dollar, and record oil prices were the immediate cause of the rise in rice prices. The 2007-08 rice price increase followed price spikes for major agricultural commodities such as wheat, corn, and soybeans. The primary cause of the rise in prices for these commodities from 2006-08 was rising global incomes, dietary changes, increased use of bio-fuels, tight grain supplies, and increased participation in futures markets by nontraditional investors. Because rice is critical to the diet of about half the world's population, the rapid increase in global rice prices in late 2007 and early 2008 had a detrimental impact on those rice consumers' well-being. Although rice prices have dropped more than 40 percent from their April 2008 highs, they remain well above pre-2007 levels.

Braun (2008) pointed in his another paper that the sharp increase in world food prices has raised serious concerns about the food and nutrition situation of poor people in developing countries, about inflation, and about civil unrest in some countries. He briefly examines the causes of these price increases, the consequences

especially for the world's poorest households and the policy responses so far in the developing world. In the face of rising food prices, both developing and developed countries have a role to play in creating a world where all people have enough food for a healthy and productive life. Firstly, developing-country governments should expand social protection programs, and aid donors should increase food-related development aid, where needed. Secondly, investment in agriculture, particularly in agricultural science and technology and for improved market access of small farmers, at a national and global scale, to address the long-term problem of boosting supply. Thirdly, agriculture trade and energy policy reforms, and developing countries would stop the new trade distorting policies with which they are damaging each other.

Polaski (2008) examines the issues at stake in the Doha Round in light of rising food prices and their impact on global poverty. It first reviews the causes of high food prices, emphasizing those that are susceptible to action by governments. The author then presents recent evidence on how food prices affect the poor and concludes that, although many poor households will require urgent assistance, more are likely to gain from rising prices than lose. She argues that the Doha Round must allow developing countries adequate policy flexibility so that they can build up their own agricultural sectors, increase food supply in the medium and long term, and shield the poor from market failures that can affect their very survival. An agreement should sharply restrict domestic and export subsidies provided to wealthy country farmers and Allow developing countries to shield at least twenty percent of tariff lines from reductions as "special products" to foster greater domestic production and shield poor households until they become more productive or find other livelihoods.

This research is very significantly important because that we especially examined the impact from the fluctuations in the international grain markets, which also play important role in increasing the Chinese domestic grain prices. This study will use the latest data to provide the important policy implications to face the grain price globalization. The purposes of this study are to explore whether the international grain prices have an impact on Chinese grain prices in recent years, using the latest

weekly time series data and econometric analysis, to verify the causality of the domestic and international grain prices and check whether long-run equilibrium or short-run equilibrium relationship between the Chinese and international grain prices exist or not.

6.2 Materials and methods

Weekly grain prices in China were collected from China grain data center, where authoritative average grain prices are published every Monday. Ito (1991) found that the US and Thai rice exports prices are highly competiveness. So we regarded the US rice prices as the world rice prices. And we used wheat, corn and soybeans prices in US as the world prices because of its great trade share, that is the United States located as the first largest exporting country for wheat and corn, the second largest for soybeans, and the fifth for rice in the world grain export share. In addition, weekly grain future prices were collected from CBOT, whose prices played a decisive role in announcing price information to other countries. To study the latest relationship between the two markets, our data period started from February 25, 2007 to February 24, 2013. We picked Wednesday exchange rates between Chinese and US' currency to represent the weekly exchange rates, while we used the same numerical variables for US' consumer price index in the same month. All of the prices variables were calculated into the real prices because that we could exclude the influence of the domestic inflation to grain prices. We also converted our price series into the logarithmic forms, by which we could not only reduce the volatility of the prices in those two markets, but also facilitate the economical explanation to our empirical results. Table 6-3-1 provided the detail information for our data.

In this study, we will use Augmented Dickey Fuller (ADF) test to check whether each variables are stable on the first difference or not, after which a Johansen co-integration test is employed to check whether co-integration relations exist between variables. Based on their co-integration relations, we will use a Vector Error Correction (VECM) Model to show the short-run relationship between variables.

Furthermore, we will verify the causality of the domestic and international grain prices if their price showed a short-run relationship. We shall also check the impulse response function to reflect the impact of the external random shocks to the endogenous variables.

Table 6.2.1 Description of data and source in this study

Data	Variable	Description	Source
Chinese soybean prices	SC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese corn prices	CC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese wheat prices	WC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese indica rice prices	IC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese japonica rice prices	JC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Soybean prices in US	SU	weekly, future prices	GFT - Online Futures Trading, CBOT
Corn prices in US	CU	weekly, future prices	GFT - Online Futures Trading, CBOT
Wheat prices in US	WU	weekly, future prices	GFT - Online Futures Trading, CBOT
Millded rice prices in US	RU	weekly, future prices	GFT - Online Futures Trading, CBOT
Exchange rate	EX	daily	State Administration of Foreign Exchange, China
CPI in the United States	CPI-U	monthly	Bureau of Labor Statistics, United States Department of Labor
Import shares of Chinese grains	I	anural (from 2000 to 2012)	US Department of Agriculture: PS&D Online
Export shares of Chinese grains	E	anural (from 2000 to 2012)	US Department of Agriculture: PS&D Online

Note 1: Time period: February 25, 2007 -- February 24, 2013;

Note 2: Samples numbers of each prices: 314.

Dickey and Fuller(1981) developed a method, namely DF test, to avoid the bias in the traditional OLS regression. They also extended this method to ADF test to check the unit root test for variables. In our study, we must employ this unit root test to both Chinese and US' CBOT grain price series, and also their corresponding differential sequences ΔP_c andΔP_u before we use our data in the co-integration test and error correction model. The guideline suggests that a co-integrated relationship may exist only if their time differences become the same.

The ADF model can be shown as,

$$\Delta \ln P_t = \alpha + \beta \ln P_{t-1} + \sum_{1}^{n} \delta_i \, \Delta \ln P_{t-1} + \varepsilon_t$$

Where, $\Delta \ln P_t = \ln P_t - LNP_{t-1}$, $\Delta \ln P_{t-i} = \ln P_{t-i} - \ln P_{t-i-1}$, P_t means the grain prices at time t, ε_t is called a white noise and n stands for the lag phase. We will choose the lag phase in order that there is no autocorrelation in the residuals ε_t.

Null hypothesis of ADF test is H0: $\beta = 0$, that is, the time series is non-stationary, while its alternative hypothesis is H1: $\beta \neq 0$. The result of ADF test aims to obtain the t-value of the estimated value of β. We will accept the null hypothesis if the ADF statistic is greater than the critical value, which indicates LNP_t is non-stationary. Otherwise, we will refuse the null hypothesis, which means that LNP_t is stationary and we can name it as I (0).

In our study, we can employ a Johansen Co-integration Test when all of the grain prices in both Chinese and the US markets become stationary after the first difference. A linear combination of two or more non-stationary series may be stationary. Engle and Granger (1987) pointed out that the stationary linear combination is called the co-integrating equation and may be interpreted as a long-run equilibrium relationship among the variables. Johansen (1991, 1995) developed a Johansen co-integration test is to determine whether non-stationary series are co-integrated or not, which followed a basis of the VAR (vector auto-regression) specification. Applying this methodology into our study, we established the VAR (1) model as,

$$\begin{bmatrix} \Delta \ln PC_t \\ \Delta \ln PU_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \pi_{11} - 1 & \pi_{12} \\ \pi_{22} & \pi_{22} - 1 \end{bmatrix} \begin{bmatrix} \ln PC_{t-1} \\ \ln PU_{t-1} \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \end{bmatrix}$$

Where, ln means the natural logarithmic form of our price data, PC and PU are grain prices in Chinese and the US markets, $\Delta PC_t = PC_t - PC_{t-1}$, $\Delta Pu_t = PU_t - PU_{t-1}$, α_1 and α_2 are constant term, $\pi_{11}, \pi_{12}, \pi_{22}$ and π_{22} indicate coefficients in each model, t stands for the weekly lag terms, and μ_{1t} and μ_{2t} means the random error terms. The model above can be converted when we generate some parameters, such as $Z_t = \begin{bmatrix} \ln PC_t \\ \ln PU_t \end{bmatrix}$, $\Delta Z_t = Z_t - Z_{t-1} = \begin{bmatrix} \Delta \ln PC_t \\ \Delta \ln PU_t \end{bmatrix}$, $\emptyset = \begin{bmatrix} \pi_{11} - 1 & \pi_{12} \\ \pi_{22} & \pi_{22} - 1 \end{bmatrix}$, $\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix}$ and $U_t = \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \end{bmatrix}$. Finally, our VAR (1) model becomes the following term,

$$\Delta Z_t = \rho + \emptyset Z_{t-1} + U_t$$

Where, ΔZ_t is first difference of the natural logarithmic form of grain prices in Chinese and the US markets, and Z_t follows I (1) because that both of LNPC and lnPU belong to time series data which are non-stationary and have the same unit roots. Therefore, $\Delta Z_t = Z_t - Z_{t-1}$ follows I (0). We generate γ as the metrical rank of ΔZ. As ρ and U_t are both stable. lnPC and lnPU will not be co-integrated when $\gamma = 0$. In addition, LNPC and lnPU will show co-integrated when $0 < \gamma < n$ (n is the number of vectors). Granger's representation theorem asserts that if the coefficient matrix has reduced rank to ($\gamma < k$), then there exist $\gamma \times k$ matrices α and β, each with rank γ such that $\emptyset = \alpha\beta$ and $\beta' Z_{t-1}$ is I(0). So γ is the number of co-integrating relations (the co-integrating rank), and the elements of α is known as the short-run adjustment parameters to the previous term in the VEC model, while each column of β is the co-integrating vector which shows the long-run equilibrium relationship of vector of Z_t. Johansen's method is to estimate the matrix $\emptyset$ from an VAR and to test whether we can reject the restrictions implied by the reduced rank of $\emptyset$.

We can run the VECM model when the variables are found co-intergraded, which reports the short-run equilibrium relationships between the vectors. The equation of VECM in this study can be write as,

$$\Delta \ln PC_t = \alpha_0 + \sum_1^m \alpha_k \Delta \ln PU_{t-k} + \sum_1^m \beta_k \Delta \ln PC_{t-k} + \sigma\left(LNPC_{t-1} + \omega LNPC_{t-1}\right) + \varepsilon$$

Where, $\sigma\left(\ln PC_{t-1} + \omega \ln PC_{t-1}\right)$ is called an error correction term whose value shows negative. And σ is the coefficient of this error correction term, which adjusts

the speed of a variable to go back to its equilibrium when some specific bias appears. The parameter of ε is the random error term. Therefore, when error correction term is positive, which means that $LNPC_{t-1} > \omega LNPC_{t-1}$, the previous value of Chinese grain prices are greater than the value of equilibrium, so the negative value of σ could pull the dependent variables back to its equilibrium value. Otherwise, a negative error correction term indicated that the previous value of Chinese grain prices are less than the value of equilibrium, so the role of σ is to provide a positive effect to the Chinese grain price back to equilibrium. In this study, the estimated value of σ shows the speed of the Chinese grain prices approaching to its equilibrium value in shot time. We regard a rapid equilibrium approach when the estimated value of σ is significantly close to -1, while a slow equilibrium approach is accepted when the estimated value of σ is significantly close to 0.

The Granger Causality Test developed by Granger (1969) will be used to the first difference grain prices between the two selected markets, only if these series are stationary. We shall test the short-run dynamic effects of the first difference of the grain prices between the two selected markets. A bivariate regressions form of the Granger approach in this study can be shown as,

$$\Delta \ln PC_t = \alpha_0 + \sum_1^p \alpha_i \Delta \ln PC_{t-i} + \sum_1^p b_j \Delta \ln PU_{t-j}$$

$$\Delta \ln PU_t = c_0 + \sum_1^p c_i \Delta \ln PU_{t-i} + \sum_1^p d_j \Delta \ln PC_{t-j}$$

Where, $\Delta \ln PU_t$ is said to be Granger-caused by $\Delta LNPC_t$ when $b_1 \neq b_2 \neq \ldots \neq b_p$, or equivalently the fluctuation of the international grain prices help statistically significantly in the prediction of the fluctuation of the Chinese domestic grain prices. Similarly, $\Delta \ln PC_t$ is said to be Granger-caused by $\Delta \ln PU_t$ when $d_1 \neq d_2 \neq \ldots \neq d_p$.

The impulse response function measures the effect of exogenous shocks on the domestic and international grain prices, which tests a standard random disturbance impact. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Accordingly, its model can be written as,

$$\Delta \ln PC_t = \alpha_{11}\Delta \ln PC_{t-1} + \ldots + \alpha_{1k}\Delta \ln PC_{t-k} + b_{11}\Delta \ln PU_{t-1} + \ldots + \alpha_{1k}\Delta \ln PU_{t-k} + \varepsilon_{1t}$$

$$\Delta \ln PU_t = \alpha_{21}\Delta \ln PU_{t-1} + \ldots + \alpha_{2k}\Delta \ln PU_{t-k} + b_{21}\Delta \ln PC_{t-1} + \ldots + \alpha_{2k}\Delta \ln PC_{t-k} + \varepsilon_{2t}$$

Where, changes in the parameter of ε stands for the exogenous shocks, and the impulse response function can graphically describe the influence of this shock on the grain prices.

6.3 Results of the research

In this study, we conduct our research for co-integration analysis only if both of the grain prices series in Chinese and US' markets are non-stationary, but both of them are required as I (1).

Table 6.3.1 shows the result of ADF test for grain prices in China and the US, which reports that all of the weekly grain prices in these two markets are non-stationary. However, our result also suggests that they are stationary at 1% significant level in their first differences, based on which we can conclude that all of our grain prices series belong to I (1), and there might be co-integrations exist between the same grain's prices.

Results of Johansen co-integration test in Table 6.3.2 show that there are long-run integration between the Chinese grain prices and the US grain prices. Our results of the trace statistics and the max-Eigen statistics for soybeans, wheat, corn, indica rice and japonica rice suggest that co-integration for the grain prices in those two markets exist at 5% significant level.

Table 6.3.1 Result of ADF test for weekly grain prices in China and the US

Variables	Test type (C, T, K)	ADF-test statistic	Prob.	Critical values (1% level)	Critical values (5% level)	Results
soybeans-CN	(C, T, 1)	-2.002	0.5974	-3.988	-3.424	Non-stationary
△soybeans-CN	(N, N, 0)	-24.01	0.0000	-2.572	-1.942	Stationary
corn-CN	(C, T, 4)	-2.414	0.3716	-3.988	-3.424	Non-stationary
△corn-CN	(N, N, 2)	-7.701	0.0000	-2.572	-1.942	Stationary
wheat-CN	(C, T, 1)	-1.858	0.6736	-3.988	-3.424	Non-stationary
△wheat-CN	(N, N, 1)	-10.91	0.0000	-2.572	-1.942	Stationary
indica rice-CN	(C, T, 1)	-1.976	0.6116	-3.988	-3.424	Non-stationary
△indica rice-CN	(N, N, 0)	-23.15	0.0000	-2.572	-1.942	Stationary
japonica rice-CN	(C, T, 1)	-2.187	0.4949	-3.988	-3.424	Non-stationary
△japonica rice-CN	(N, N, 0)	-26.37	0.0000	-2.572	-1.942	Stationary
soybeans-US	(C, T, 1)	-2.475	0.3405	-3.988	-3.424	Non-stationary
△soybeans-US	(N, N, 0)	-20.70	0.0000	-2.572	-1.942	Stationary
corn-US	(C, T, 0)	-2.286	0.4399	-3.988	-3.424	Non-stationary
△corn-US	(N, N, 0)	-17.84	0.0000	-2.572	-1.942	Stationary
wheat-US	(C, T, 0)	-2.290	0.4376	-3.988	-3.424	Non-stationary
△wheat-US	(N, N, 0)	-17.75	0.0000	-2.572	-1.942	Stationary
milled rice-US	(C, T, 0)	-2.418	0.3694	-3.988	-3.424	Non-stationary
△milled rice-US	(N, N, 0)	-16.95	0.0000	-2.572	-1.942	Stationary

Source: Authors' calculation.

Note 1: Time period: February 25, 2007 - February 24, 2013; All of the grain prices are in logarithmic form.

Note 2: (C, T, K) stands for the estimated equation for unit root test, in which C, T and K represent intercept, trend, and lag terms, respectively. N means that there is no intercept or trend;

Note 3: ∆ stands for the first difference of each variable.

Table 6.3.2 Johansen co-integration test for the Chinese and the US grain prices

Grains	Soybeans		Wheat		Corn		Indica Rice		Japonica Rice	
Lag（s）	4		1		1		1		2	
No. of CE(s)	None *	At most 1 *	None *	At most 1 *	None *	At most 1 *	None *	At most 1 *	None *	At most 1 *
Eigenvalue	0.05646	0.005054	0.04268	0.02118	0.09013	0.005726	0.04541	0.006031	0.03938	0.003703
Trace Statistic	19.52	1.566	20.29	6.680	31.26	1.792	16.33	1.881	13.65	1.154
Critical Value	12.32	4.130	20.26	9.165	12.32	4.130	12.32	4.130	12.32	4.130
Probability	0.00270	0.2474	0.04960	0.1444	0.00000	0.2126	0.01010	0.2003	0.02980	0.3295
Max-Eigen Statistic	17.96	1.566	13.61	6.680	29.47	1.792	14.45	1.881	12.49	1.154
Critical Value	11.22	4.130	15.89	9.165	11.22	4.130	11.22	4.130	11.22	4.130
Probability	0.002900	0.2474	0.1106	0.1444	0.00000	0.2126	0.01310	0.2003	0.02980	0.3295
cointegrating eqn（s）	1		0		1		1		1	

Source: Authors' calculation.

Table 6.3.3 Long-run cointergrationships between the Chinese and US prices

Grains	Long-run equation
Soybeans	lnSC=1.509*+0.7941lnU*
Wheat	lnWC=5.936*-0.05523lnWU
Corn	lnCC=2.636*+0.5576lnCU*
Indica rice	lnIC=4.234*+0.3001lnRU*
Japonica rice	lnJC=5.474*+0.1273lnRU*

Source: Authors' calculation.

Note 1: SC, WC, CC, IC, and JC represent prices for Chinese soybeans, wheat, corn, indica rice and japonica rice. SU, WU, CU, and RU represent prices for US's soybeans, wheat, corn and rice.

Note 2: * denotes significance under 1% level.

In addition, we found the cointergrating equations for the individual grains, as shown in Table 6.3.3. The results indicate that the significant long-run cointergrationships between the Chinese and US grain prices except for the wheat prices, among which coefficient of soybeans, corn, indica rice and japonica rice are 0.7941, 0.5576, 0.3001 and 0.1273, respectively. All of these coefficients are less than 1, implying that the Chinese grain prices are less fluctuated than in the US grain markets. In addition, the US soybeans prices affect the Chinese domestic soybeans prices most, followed by corn, indica rice and japonica rice.

As all of the variables showed co-integrated, we can run the VECM model to examine the short-run relationship between the two grain markets. Table 6.3.4 provides the result.

Table 6.3.4 Result s of VECM models of the Chinese and US grain prices

Variable	△lnSC		△lnWC		△lnCC		△lnIC		△lnJC	
	coefficient	t-Stat.	coefficient	t-Stat.	coefficient	t-Stat.	coefficient	t-Stat.	coefficient	t-Stat.
ecm(-1)	-0.04749***	-3.134	-0.002187***	-5.531	-0.0009480***	-3.480	-0.005806***	-3.514	-0.004652***	-3.539
△lnPc(-1)	-0.2622***	-4.711	-0.1810***	-3.247	-0.1281**	-2.279	-0.2909***	-5.363	-0.449264***	-8.001
△lnPc(-2)	0.02949	0.5111	-0.003082	-0.3628	-0.007800	-0.5862	-0.01761	-0.8349	-0.09129	-1.624
△lnPc(-3)	-0.01558	-0.2711							0.02728	1.108
△lnPc(-4)	0.1102**	2.003							-0.03212	-1.301
△lnPu(-1)	0.02099	0.6265								
△lnPu(-2)	0.04644	1.386								
△lnPu(-3)	-0.04104	-1.217								
△lnPu(-4)	0.09622***	2.902								
R-squared	0.2115		0.03962		0.01745		0.09162		0.1920	
Log likelihood	706.3		1062		938.6		868.6		818.4	
AIC	-4.513		-6.791		-5.998		-5.549		-5.231	
DW	1.951		1.961		1.954		2.080		2.008	

Source: Authors' calculation.

Note 1: SC, WC, CC, IC, and JC represent prices for Chinese soybeans, wheat, corn, indica rice and japonica rice. SU, WU, CU, RU represent prices for US's soybeans, wheat, corn and milled rice.

Note 2: *, **, *** denotes significance under 1%, 5% and 10% level, respectively.

According to the Akaike Information Criterion (AIC), we selected lagged weeks as 4, 1, 1, 1 and 2 for soybeans, wheat, corn, indica rice and japonica rice, respectively. Our results suggest that the estimated error correction term coefficients are -0.04749, -0.002187, -0.0009480, -0.005806 and -0.004652 for soybeans, wheat, corn, indica rice and japonica rice, respectively, and all of them show significant at 1% significance level, based on which we can conclude that when the previous Chinese grain prices bias to its equilibrium value, a significant short-run adjustment can force it back to equilibrium. In addition, all of the estimated values of the error correction term coefficients are close to 0, indicating slow equilibrium approaches for each grain. However, the absolute values of the estimated coefficients provide us the information that the adjustment speed for Chinese soybeans prices located the fastest, followed by indica rice, japonica rice, wheat and corn.

Especially, we can also conclude from Table 6.3.5 that the US soybean prices show a significant influence on the Chinese soybean prices at 4 weeks lagged behind. As the first differences for the soybeans prices in the two markets show stationary, we use a Granger Causality Test to check the short-run dynamic effects between the two selected markets. We cannot reject the hypothesis that D (lnSC) does not Granger cause D (lnSU) but we do reject the hypothesis that D (lnSU) does not Granger cause D (lnSC). Therefore it appears that Granger causality runs one-way from D (lnSU) to D (lnSC) and not the other way, which indicates that the volatility for the US' soybeans prices can Granger-cause the Chinese soybeans prices fluctuated. The high dependence for Chinese soybean prices related to the CBOT soybean prices relayed on the less of the authority for pricing, although China is a large customer for soybean importing. Reasons include: First, Decentralized planting management raised procurement cost for companies. Second, Minimum procurement policy for soybean limited the competition for private companies. Third, Most of Chinese soybean processing enterprises are acquired or hold by large international oil processing enterprises, such as Kerry Oils, Bunge, ADM, Wilmar, Noble and Louis Dreyfus.

Table 6.3.5 Result s of Granger Causality test of soybean prices

Null Hypothesis	Obs	F-Statistic	Prob.
D(lnSU) does not Granger Cause D(lnSC)	309	5.952	0.0001000
D(lnSC) does not Granger Cause D(lnSU)	309	0.8063	0.5219

Source: Authors' calculation.

Note 1: SU and SC represent soybeans prices in COBT's and Chinese markets.

We also used the impulse response function to check the impact of one standard deviation innovation shock to the endogenous variables. Fig. 6.3.1 tells the result for soybeans and corn. Chinese soybean prices response immediately to its own standard deviation innovation, increasing by 0.025%, and the reducing to 0.017 in the following week, while its impact from the new information of the US soybean prices is steadily rising.

The US soybeans prices also increase rapidly by about 0.045% to its own standard deviation innovation, and then reduced by 0.01% in the following week. Response for Chinese corn prices shows smoother than soybeans. The result shows a 0.012% increase to its own innovation, and it reduces by about 0.02%, after which it gradually increases.

Influence from one standard deviation innovation from the international corn prices to the Chinese domestic corn prices increase slowly by about 0.001% since the fourth week. Response of the US's corn prices to its own innovation is a rapid 0.05% increase and decrease gradually, while the influence from the Chinese markets is negative until the fourth week.

Fig. 6.3.2 shows the impulse response for milled rice and wheat. The result indicates that Chinese indica rice and japonica rice response similarly to their innovations and the international prices. However, japonica rice is more influenced by its own price innovation, which increased by 0.017% and dropped by about 0.008% in the following week, comparing to a 0.004% reduce for indica rice. Response of the US's rice prices to its own innovation is around 0.04%, and both of the information from Chinese indica rice and japonica rice are small and negative.

Impulse response for wheat is similar to milled rice but for the slow and gradually influence of the US prices on the Chinese domestic wheat prices.

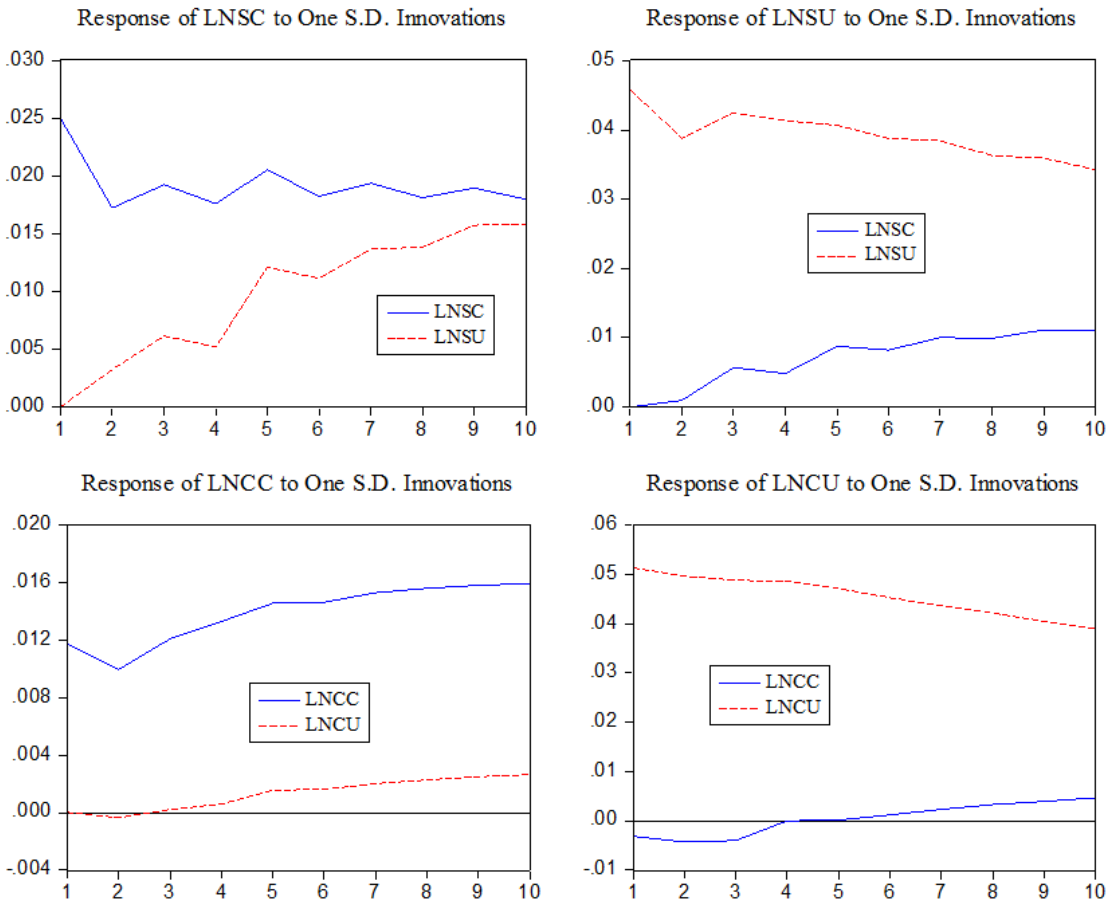

Fig. 6.3.1 Response of prices of soybeans and corn to one S.D. innovations

Source: Authors' calculation.

Note 1: SC and CC represent prices for Chinese soybeans and corn. SU and CU represent prices for US's soybeans and corn.

Note 2: Vertical axis calculates the level of the impulse response (%).

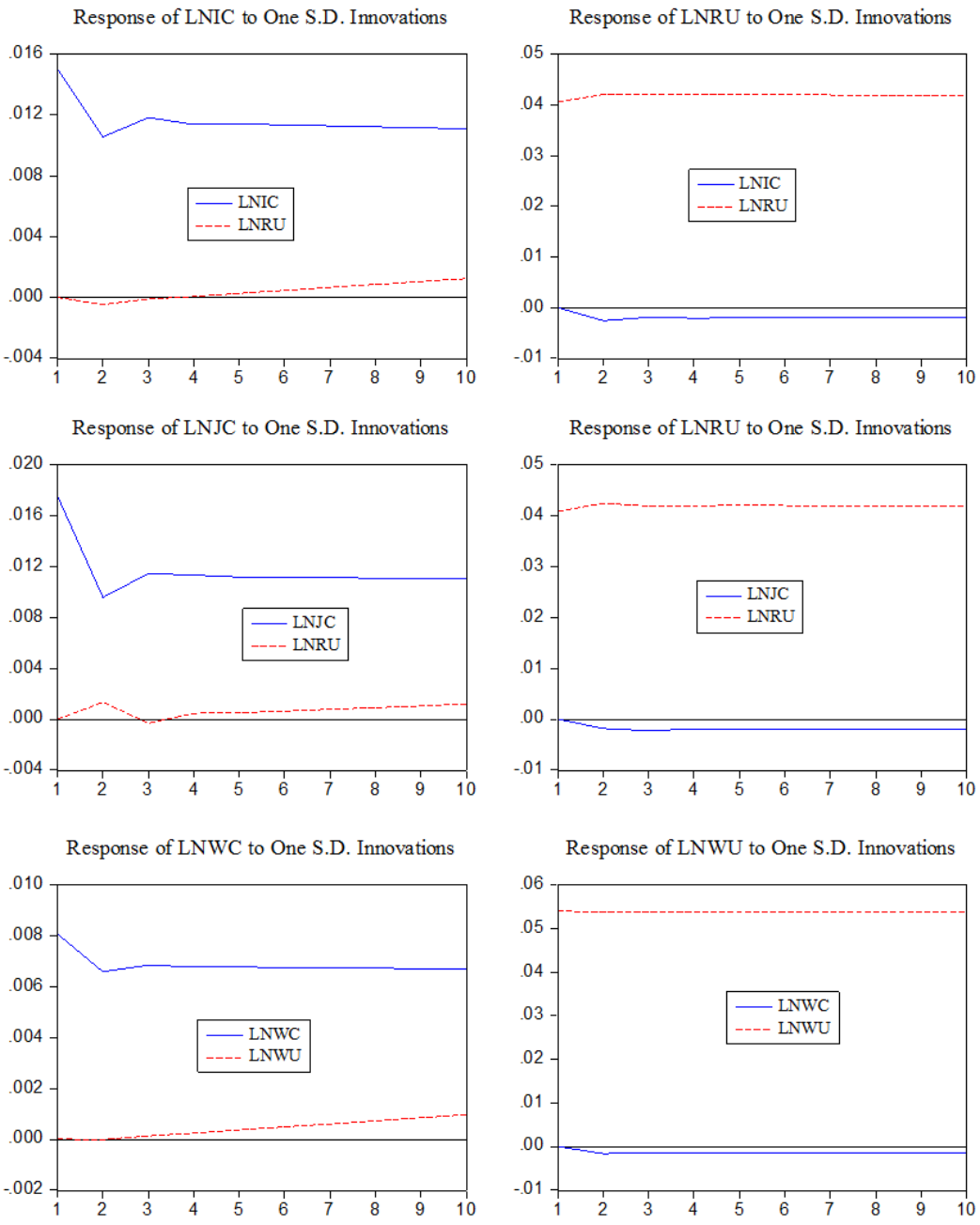

Fig. 6.3.2 Response of prices of milled rice and wheat to one S.D. innovations

Source: Authors' calculation.

Note 1: WC, IC, JC represent prices for Chinese wheat, indica rice and japonica rice. And WU, RU represent prices for US's wheat and milled rice.

Note 2: Vertical axis calculates the level of the impulse response (%).

6.4 Discussion

This study studied the grain price translation from the international grain markets to Chinese grain markets. The Johansen co-integration test and VECM model are employed to the weekly grain price data.

The result of ADF test for grain prices in China and the US, which reports that all of the weekly grain prices in these two markets belong to I (1), and there might be co-integrations exist between the same grain's prices. Furthermore, there are long-run integration between the Chinese grain prices and the US grain prices. Our results of the trace statistics and the max-Eigen statistics for soybeans, wheat, corn, indica rice and japonica rice suggest that co-integration for the grain prices in those two markets exist at 5% significant level. In addition, we found that the significant long-run cointergrationships between the Chinese and US grain prices except for the wheat prices, among which coefficient of soybeans, corn, indica rice and japonica rice are 0.7941, 0.5576, 0.3001 and 0.1273, respectively.

Our results from the VECM model also suggest that the estimated error correction coefficients are -0.04749, -0.002187, -0.0009480, -0.005806 and -0.004652 for soybeans, wheat, corn, indica rice and japonica rice, respectively, and all of them show significant at 1% significance level. In addition, the Granger Causality Test reports that the volatility for the US' soybeans prices can Granger-cause the Chinese soybeans prices fluctuated.

Finally, the impulse response function Chinese grain prices response immediately to its own standard deviation innovation and the impact from the international markets is more significant for soybeans. The US's soybeans and corn prices show significant effect to their own innovations.

Based on our analysis, we recommended that Chinese government should take some policy measures to face the new challenges to its domestic grain price stabilization.

Firstly, it is imperative to focus constantly on CBOT agricultural futures markets, whose prices will guide farmers to produce grains, and establish awareness for price

risk. Secondly, the soybean market, whose market regulation is much lower than other grain markets, has more robust price discovery function. Thirdly, domestic agricultural policies such as the grain subsidies and minimum grain procurement prices and trade policies can be help to stabilize the domestic grain prices to ensure the national food security, but China should care about the dependence for great volume of demand in the world grain markets in the future.

CHAPTER 7

CONCLUSIONS AND POLICY IMPLICATIONS

7.1 Summary of analysis

China has been motivated to find a way to face the grain price globalization during the recent years. Main findings of this research are as follows,

Firstly, the results of this entire study indicate that China's grain price reform has gone through a long process. Different historical periods of grain price policy has played a positive role to achieve the desired objectives on the protection of the grain market supply and stabilize prices, improve people's livelihood. On the other hand, we must consider that the government decisions have a lagged effect on the grain prices. However, with the macro-economic environment, food supply capacity and other factors change, the existing pricing mechanism gradually adapt to the new situation, such as the requirements of food policy objectives, the performance of the system costs, and system efficiency.

Secondly, we found in chapter 3 that nowadays, the high-risk high-return effect exists for corn maybe due to its insufficient supply. A clustering effect suggests that a larger price fluctuation follows a previous large one, while a smaller price fluctuation follows a previous small one. Therefore, farmers should take the most beneficial selling price, and feed-companies can avoid wasting money when prices are rising, while investors can enlarge their investments to gain more benefits from the market sentiment. Also indicated was that investors such as intermediaries and speculators showed risk aversion in wheat and corn before China’s joining WTO. After China joined the WTO, however, they have been risk avert for wheat and indica rice, risk appreciate for soybean. After the agricultural promotion policy introduced in 2004, investors are risk avert for staple food such as wheat, japonica rice and indica rice. During the global high grain prices in 2008, soybeans, corn and japonica rice showed

risk avert effects. While indica rice showed risk avert to intermediaries and speculators in the recent era, corn showed risk appreciate, which may bring a challenge for corn in the next few years.

Thirdly, conclusions in chapter 4 suggested that the effective but costly grains policy measures in China in 2008 cut off the relationship between the domestic and the international market, and thus helped stabilize the domestic prices. The Chinese government has great power to control the state-owned enterprises, because of which the state owned enterprises can reduced their export volume rapidly. We also conclude that NRA of soybeans and corn in China are basically positive, but rice and wheat show the negative sign in 2007 and 2008. NRA of rice and corn remarkably drops from late October, which means the cost for tax increase or export quota is issued. Also, according to our estimate, Stabilization index for wheat in China is the largest, followed by japonica rice, indica rice, and corn, with soybeans located at the lowest.

Fourthly, we draw from chapter 5 that wheat prices in China have been keeping gradually increasing since 2007. Corn wholesale prices and soybean wholesale prices in China have been higher than US price during the recent years. However, the US corn price had surpassed the China's corn price during the international price spike in 2008. Soybean prices in China shifted in the same direction as the US soybeans prices. Yet the China soybean prices remained above the world market price. The trade situations of main grains in 2008 were various in different countries.

Finally, results of the ADF test in chapter 6 for grain prices in China and the US indicated that co-integrations might exist between the same grain prices. The results of VECM models also indicated existence of causality among all grains at 1% significance level. Volatility for the US soybean prices may have caused the Chinese soybean prices to fluctuate. In impulse response functions, Chinese grain prices response immediately to their own standard deviation innovations and the impacts from the international markets are more significant for soybeans. Prices of US soybean and corn show significant effect to their own innovations.

7.2 Policy implications

Based on the results of this research, we recommended that Chinese government should take some policy measures to face the new challenges to grain price globalization.

Firstly, China will have to introduce some new the pricing systems to replace the old pricing mechanism. China has to find a way to face the grain globalization during the recent years. China holds the greatest number of population in the world, and it will be a difficult challenge for the government in the country to feed its population, by not only the traditional grain for food, but also the increasing demand for eggs, milk and meats, all of which will bring increasing demand for feed grains. In addition, the co-relationship between grains for food/feeding and for bio-energy provides big challenges on the rapid growth Chinese economies.

Secondly, China needs to be aware that excessive grain price volatilities may cause negative effects, not only on farmers' enthusiasm in cultivation, but also on grain demanders' consumption power. In addition, China can forecast the grain price fluctuations and take effective policy measures. Finally, it is necessary to reduce the speculators hoarding of large numbers of grains, which may lead to insufficient domestic grain supply.

Thirdly, government should help the farmers increase production in the future by increasing the financial and technical supports. It is necessary to strengthen the protection of arable land resources and build water conservancy facilities. Government can improve market in both facilities and management. By doing so, for example, improve the transportation can reduce the cost for grain transport. Also, the efficient market needs fast and exact information. Foreign food companies have been or are being entered markets of China's soybean, corn, wheat, rice and other staple foods. They have been entering the field of acquainting, processing and terminal selling. These companies bring advanced technology, management experience and capital but also bring the difficult that securing the supply, stabilizing the price and so

on. In long run, the rice stock may not sustain the price stabilization, and the Chinese government needs to prepare for face the higher price it and has its citizens to accept the main grains prices rise.

Finally, it is imperative for the Chinese government to focus on CBOT agricultural futures markets and find out immediately any new symptoms of the CBOT prices so that any negative influence to the Chinese markets can be harnessed, whose prices will guide farmers to produce grains, and establish awareness for price risk. Although the Chinese domestic agricultural policies such as the grain subsidies, the minimum grain procurement prices and trade policies can help to stabilize the domestic grain prices to ensure the national food security, but China should care about the dependence for great volume of demand in the world grain markets in the future.

7.3 Suggestions for further study

This study solved issues about Chinese grain prices and its related policies. It also brings some experiences for developing countries to face the grain price globalization.

However, there were some limitations for this study. First, it is necessary to identify the causalities about Chinese grain prices and the world grain prices by more detailed grain prices, such as the daily grain prices, which can explain more information about the grain transmission from the CBOT grain prices to Chinese prices. Second, new situations such as whether China decides to illustrate its grain prices or not, formulation of Chinese grain prices and trends for Chinese grain demands, are also needs to be analyzed in the future study.

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APPENDIX

Appendix Table 7.3.1 Chinese grain polices and its policy purpose (1949-1952)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
	Dec. 19, 1949	*Instructions about production relief on the disaster*	Fight against natural disaster; encourage mutual savings.
	Feb. 5, 1950	*Instructions on regional food surplus and deficiency*	Fight against food shortage caused by natural disaster.
	Mar. 3, 1950	*Decisions on the national finance and economic*	Ministry of Finance unified to use the state-owned grains.
1949 -	Mar. 14, 1950	*Decisions on the harmonization of the state trading*	Set 12 state-owned corporations.
1952	Mar. 26, 1950	*National income, expenses, custody and scheduling in grains*	Manage the grain market by the central government.
	Aug. 5, 1950	*Establishment of national grain management system*	Enhance the system of grain management in China.
	Nov. 24, 1951	*State-owned corporations to acquire local surplus grains*	Increase the participation of the state-owned corporations.
	Mar. 20, 1952	*Preliminary views about the nationwide trade organization*	Found Ministry of Chinese Grain on Sep. 1, 1952.

Source: China Statistical Yearbook, China Agricultural Statistics Yearbook, China Development and Reform Commission, Ministry of Agriculture of China.

Note: sources for Appendix Table 7.3.2 to Appendix Table 7.3.9 are the same as this table.

Appendix Table 7.3.3 Chinese grain polices and its policy purpose (1953-1957)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1953 - 1977	Feb. 27, 1953	*Instructions about the current grain problems*	Solve some regional grain shortage, stabilize grain prices and ensure grain supply.
	Apr. 1, 1953	*Adjustment of prices of cotton and grain prices in 1953*	Adjust Chinese seasonal price differences for grain.
	Apr. 11, 1953	*Instructions on grain issues*	Guarantee fully the market supply.
	May 16, 1953	*Strengthening grain production and helping the stricken area*	Stop hoarding and speculation in grains in the stricken area and ensure dispatch for enough grains supply.
	May 25, 1953	*A thorough job to levy agricultural tax*	Encourage grain producers.
	Oct. 23, 1953	*Order on planned procurement and planned supply in grains*	Control grain and unify the grain supply.
	Mar. 23, 1954	*Instructions on pre-agricultural procurement in 1954*	Introduce pre-order with grain procurement contract with farmers through the commissioned Cooperatives.
	Mar. 28, 1954	*Report on purchase and sale on edible oil from 1953 to 1954*	Introduce a planned supply on edible oil in big cities.
	May 3, 1954	*Notification on the adjustment of the procurement grain prices*	Adjust the monopolized procurement for edible oil.
	Jul. 16, 1954	*Report on the planned supply of edible oil*	Expand the planned supply of edible oil in urban areas.
	Mar. 3, 1955	*Grain marketing arrangement and stable grain production*	Implement "quotas, planned order, planned sale" for grains.
	Apr. 28, 1955	*Instructions on rectifying the grain marketing system*	Reduce the local unreasonable grain supply.
	May 16, 1955	*Instructions on rectifying urban planned grain supply*	Implementation a nationwide people-quantitative and rationing supply plan in various industries.

Appendix Table 7.3.2 Chinese grain polices and its policy purpose (1953-1957) –continued 1-

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1953 - 1977	Aug. 18, 1955	*Interim measures on national general grain coupons*	Promote rationing system for grain coupons.
	Sep. 29, 1956	*Instructions on improving the procurement prices*	Increase the procurement prices for rapeseed.
	Mar. 27,1957	*Instructions on the current work*	Increases the procurement volume and prices for edible oil.
	Aug. 9, 1957	*Regulations on banning planned agricultural products from entering the free market*	Require that planned grain not to open to the free market, instead to acquire by the government.
	Oct. 11, 1957	*Supplementary provisions on unified purchase and sale*	Control grain sales volume.
	Oct. 18, 1958	*Regulations on hierarchical management for market prices*	Post the procurement prices and the market sales price.
	Apr. 21, 1959	*Instructions on compressing the grain sales volume*	Reduce grain in urban by 10% to face the natural disaster.
	May 26, 1959	*Solving the current problems of edible oil supply*	Stop supply for edible oil in rural from Jun. to Sep. in 1959.
	Sep. 23, 1959	*Instructions on organizing the rural village fair trade*	Encourage farmers to sell their surplus grains.
	Oct. 10, 1959	*Report on the adjustment of purchase and sale prices for several commodities*	Raise the purchase prices for soybeans and peanuts, and the selling price for soybean, soybean oil and peanut oil.
	Sep. 7, 1960	*Instructions on depressing grains' rations standards*	Reduce grain rations volume to overcome the food shortage.
	Jan. 15, 1961	*Report on raising the grain purchasing prices*	Increase the national average grain purchase prices by 25%.
	Jan. 2, 1963	*Instructions on purchasing unplanned grain, etc.*	Increase the surplus grains supply.
	Mar. 19, 1963	*Increasing the rural grain sales prices to the same level as the purchase prices*	Reduce the difference between the purchase and sale prices.

Appendix Table 7.3.2 Chinese grain polices and its policy purpose (1953-1957) –continued 2 -

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1953 - 1977	Jun. 30, 1963	*Report on the current acquisitions for agricultural and industrial products*	Stress that the planned grain, unplanned grain and edible oil should be unified by the government.
	Nov. 12, 1963	*Interim measures on exchange industrial products for food*	Redeem industrial products with farmers' surplus grain at an equivalent value.
	Jan. 19, 1965	*Decisions on adjusting the current market prices*	Increase the unified grain selling prices in urban, equals to the unified purchase grain prices.
	Jun. 8, 1966	*Report on the increasing the unified grain selling prices and the unified purchase grain prices*	Increase the unified grain selling prices by 13.07% and the unified purchase grain prices by 17.1%.
	Aug. 14, 1971	*Price adjustment in 1971*	Raise the procurement prices for soybean by 9%.
	Aug. 31, 1972	*Provisions to prices of the excessive purchased oilseeds*	Increase prices of the excessive purchased oilseeds by 30%.
	Mar. 22, 1974	*Notification on the grain work in 1974*	Prescribe that the grains bargain purchase prices cannot exceed the allowable limits.

Appendix Table 7.3.4 Chinese grain polices and its policy purpose (1978-1984)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1978 - 1984	Dec. 18, 1978	*Report of the Third Plenary Session of 11th central committee of CCP*	Increase the grain procurement prices by 20% and 30% more for over purchased volume, but fix the selling prices.
	Mar. 1, 1979	*Implements of the grain policies of the Third Plenary Session*	Increase 30% to 50% prices for the over purchased volume.
	May 20, 1981	*Increasing the procurement prices and cancelling the ultra-purchase prices for soybeans*	Meet the domestic demands for soybeans.
	May 26, 1982	*Report on improving method of the rapeseeds' acquisition*	Set grain procurement prices as 40%, and 60% for the over purchased volume for rapeseeds.
	Jan. 1, 1983	*The current rural economic policy issues*	Allow multi-channel sales after finishing the unified procurement task.
	Feb. 5, 1983	*Fair trade measures in urban and rural areas*	Promote the development of grain's fair trade markets.
	May. 23, 1984	*Grain and oil purchase and sales in the summer of 1984*	Open up the grain market and implement multi-channels for sales, but keep the national procurement.
	Jul. 19, 1984	*Report of improving the commodity circulation in rural areas*	Reduce the national grain unified procurement varieties to paddy, wheat, and maize.

Appendix Table 7.3.3 Chinese grain polices and its policy purpose (1985-1992) –continued -

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1985 - 1992	Jan. 1, 1985	*Ten policies to further active rural economy*	Introduce contract procurement for grains (30% at the procurement prices and 70% at the over purchased prices).
	Jan. 18, 1985	*Investigating illegal arbitrage in grain purchase prices*	Rectify the order of the grain markets.
	Mar. 13, 1985	*Notification on adjusting the prices of hogs and grains*	Promote the contract procurement.
	May 17, 1985	*Changing grains into currency to pay agricultural taxes*	Translate the method of paying the agricultural taxes.
	Nov. 15, 1985	*Notification on grasping the grains' work*	Expand the range of bargain prices for grains.
	Jan. 17, 1986	*Notification on grain contract in 1986*	Determine the national grain procurement by contract.
	Apr. 15, 1986	*Adjustment for the purchase prices of soybean*	Raise purchase prices of soybean and soybean oil.
	Ma. 30, 1986	*Provisions on improving the management of prices of agricultural products*	Point out that grain prices subject to the government prices, the national guidance prices and the market prices.
	Oct. 16, 1986	*Notification on improving grain contract system*	Implement market bargain prices to farmers' surplus grains after the contract procurement.
	Feb. 2, 1987	*Notification on price arrangements in 1987*	Increase the procurement price for maize and rice.
	Apr. 1, 1987	*Financial issues after adjusting purchase price for oilseeds*	Increase the prices for the inventory of grain and oil.
	Apr. 15, 1987	*Several problems in the current grain issues*	Announce that the government subsidizes the gap between the contract prices and the market prices.

Appendix Table 7.3.5 Chinese grain polices and its policy purpose (1985-1992)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1985 - 1992	Jan. 3, 1988	*Improving contracts ordered policies for grains*	Introduce of a combination policy for the grain contract, cheap fertilizer, diesel and pre-deposit.
	Jul. 25, 1988	*Regulating bargaining prices for grain and edible oil*	Regulate bargaining prices for grain and edible oil.
	Sep. 27, 1988	*Decision on strengthening grain management*	Stabilize the grain market.
	Dec. 22, 1988	*Notification on grasping regulation in grain purchase work*	Set grain prices.
	Mar. 9, 1989	*Adjustment of purchase prices of grain in 1989*	Increase purchase prices of paddy, corn and wheat.
	Jul. 18, 1989	*Notification on subsidizing grain loss*	Stop reselling cheap grain and edible oil.
	Mar. 21, 1990	*Notification on strengthening grain market regulation*	Manage the grain market.
	Jul.24, 1990	*Decision on s strengthening the grain marketing*	Meet the requirements of farmers to sell surplus grain.
	Sep. 16, 1990	*Decision on establishing national grain reserve system*	Ensure market supply and prices stable.
	Jan. 12, 1991	*Notification on the adjustment of grain procurement policy*	Compress sales on cheap grain and edible oil.
	Apr. 4, 1991	*Decision on adjustment of grain prices*	Increase the unified grain selling prices.
	Oct. 28, 1991	*Notification on invigorating the circulation of grains*	Cancel the unified procurement system
	Feb. 14, 1992	*Notification on increasing the order prices for grains*	Increase selling prices to equal to the purchase prices.
	Apr. 1, 1992	*Notification on improving the import and export grain prices*	Raise grain prices.

Appendix Table 7.3.6 Chinese grain polices and its policy purpose (1993-1995)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1993 - 1995	Feb. 15, 1993	*Accelerating the grain circulation system*	Reduce financial burden and improve commercialization.
	Feb. 20, 1993	*Establishing protective grain purchasing prices system*	Promote the steady growth of grain production.
	Apr. 4, 1994	*Stabilizing grain and oil prices*	Reduce the impact of rising prices on consumer.
	May 13, 1994	*Scheduling grain purchasing prices in 1994*	Complement the gap between purchase and market prices.
	May 30, 1994	*Principles and methods of grain sale prices*	Maintain price differences of the quality and variety; provide prices of acquisition, process, wholesale and retail.
	Jun. 2, 1994	*Notification on strengthening sale prices for grains*	Stabilize grain prices and food markets.
	Jun. 16, 1994	*Strengthening the grain market management system*	Maintain market stability for grains.
	Sep. 29, 1994	*Stopping futures markets of japonica rice and rapeseed oil*	Reduce excessive speculation in futures market.
	Dec. 6, 1994	*Regulations of Chinese wholesale market management*	Regulate wholesale trading activities.
	Apr. 2, 1995	*Notification on deepening purchase and sale reform*	Manage the local grain markets and prices.
	May 18, 1995	*Using of stored corn to stabilize hog production*	Reduce the price drop of the feed materials.
	Jun. 10, 1995	*Notification on deepening grain reforms*	Stabilize the grain procurement policy.

Appendix Table 7.3.7 Chinese grain polices and its policy purpose (1996-2000)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
1996 - 2000	Jan. 7,1996	*Arrangements for the ordered grain prices in 1996*	Increase grains' order prices.
	May 9, 1996	*Notification on adjusting grain sales prices*	Increase grains' sales prices.
	Aug. 6, 1997	*Notification on opening to purchase grains at protective price*	Ensure that farmers to increase production and protect Farmers' enthusiasm for production.
	May 10, 1998	*Decision on further Deeping the grain circulation system*	Convert national grain enterprise management.
	May 29, 1998	*Improving the management of grain market and prices*	Open to purchase farmers' surplus grain at protective prices.
	May 26, 1999	*Notification on grain purchase prices in 1999*	Reduce procurement price up down to protective prices.
	Jul. 20, 1999	*Notification on good quality and competitive prices policy*	Adjust structure of grain planting.
	May 9, 1999	*Provincial interface approaches for grain purchasing prices*	Maintain grain order prices among the adjacent provinces.

Appendix Table 7.3.8 Chinese grain polices and its policy purpose (2001-2003)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
2001 - 2003	Apr. 29, 2001	*Notification for summer grain purchase prices in 2001*	Protect farmers' benefits when the market price below the protective prices.
	Aug. 3, 2001	*Notification on purchase prices of paddy in 2001*	Maintain the PPP for paddy unchanged, compared to 2000.
	Aug. 6, 2001	*Advice for further managing the grain circulation system*	Develop market mechanism.
	May 28, 2002	*Notification on summer grain purchase prices in 2002*	Ensure PPP not only cover farmers' costs and benefits.
	Jan. 27, 2003	*Suggestions on improving China's agricultural support policy*	Prove the international competitiveness of Chinese agricultural products and increase farmers' income.
	May 9, 2003	*Notification on purchase prices of grains in 2003*	Prevent the farmers to be hard to sell their grains.

Note: PPP is the abbreviation of protective purchase price.

Appendix Table 7.3.9 Chinese grain polices and its policy purpose (2004-2008)

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
	Apr. 15, 2004	*Announcing MPP for indica and japonica paddy*	Guide farmers to grow grains.
	May 19, 2004	*Regulations on grains management*	Enhance the regulatory capacity to the grain market.
	May 23, 2004	*Advices on further deepening the grain circulation system*	Release grain markets and subsidize farmers directly.
	Mar. 1, 2005	*Announcing MPP for early indica paddy in 2005*	Mobilize the enthusiasm for farmers to grow grain.
	Jun. 1, 2005	*Announcing MPP for late indica paddy in 2005*	Increase MPP for rice.
	May 13, 2006	*Policy measures to improve the grain system reform*	Improve the grain direct subsidies and MPP policy.
	May 18, 2006	*Implementation plan of MPP for wheat in 2006*	Stabilize the price for wheat and protect farmers' benefits.
	May 29, 2007	*Implementation plan of MPP for wheat in 2007*	Improve MPP for varieties of wheat in different areas.
	Aug. 28, 2007	*Eleventh Five-Year Plan in the national grain market system*	Ensure grain supply, stabilize prices and ensure security.
2004 -	Jan. 1, 2008	*Receive temporary export tariff and export quota license*	Reduce grain exports from the grain enterprises.
2008	Feb. 8, 2008	*Notification on announcing MPP for wheat and paddy in 2008*	Increase MPP for rice and wheat.
	Mar. 28, 2008	*Notification on increasing MPP for wheat and paddy in 2008*	Reduce the influence from the rising producing costs.
	May 20, 2008	*Implementation plan of MPP for wheat in 2008*	Strengthen the supervision to MPP in main produce area.
	Aug. 1, 2008	*Regulations reporting and information dissemination*	Limit grain export to ensure the domestic food security.
	Aug. 11, 2008	*Interim measures on import tariff and quotas*	Determine grain volumes that enter the domestic market.
	Aug. 11, 2008	*Redistribution of import tariff and quotas*	Make full use of quota.
	Oct. 15, 2008	*Notification on promoting rural reform and development*	Ensure that national food security is the top priority
	Oct. 28, 2008	*Notification on increasing MPP for wheat in 2009*	Increase MPP for wheat.
	Nov. 12, 2008	*Four measures to expand domestic demand in China*	Cancel or reduce export tariffs.
	Dec. 1, 2008	*Preferential policies to grain processing companies*	Improve the domestic grain demand.

Appendix Table 7.3.10 Chinese grain polices and its policy purpose (2009-2013)

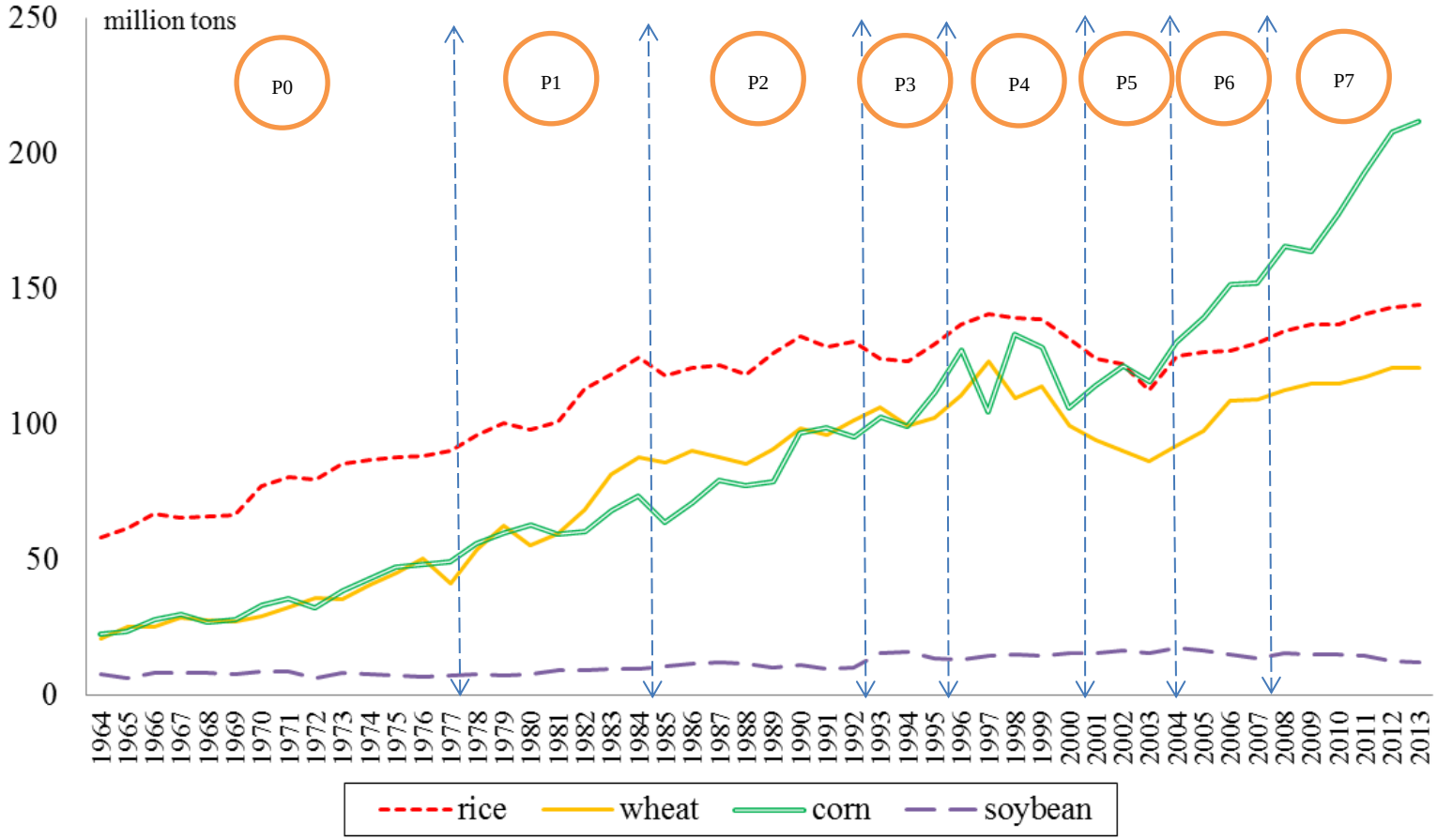
Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
2009 - 2013	Jan. 24, 2009	*Notification on increasing MPP for paddy in 2009*	Increase MPP for paddy.
	Feb. 1, 2009	*Several Opinions on promoting agricultural development*	Increase agricultural subsidies.
	Feb. 5, 2009	*Drought assistance funds and disaster relief fund*	Support agricultural production.
	Feb. 11, 2009	*Raise auction prices for the reserve wheat*	Protect farmers' benefits.
	May 21, 2009	*Implementation plan of MPP for wheat in 2009*	Protect farmers' benefits.
	Jul. 1, 2009	*Notification on adjusting export tariffs for some products*	Cancel export provisional tariffs for grains
	Jul. 16, 2009	*Implementation plan of MPP for early indica paddy in 2009*	Protect farmers' benefits in 5 provinces.
	Sep. 16, 2009	*Implementation plan of MPP for late indica paddy in 2009*	Protect farmers' benefits in 5 provinces.
	Oct. 12, 2009	*Decision on raising MPP for high quality paddy*	Stabilize market prices and protect the interests of farmers.
	Feb. 20, 2010	*Notification on increasing MPP for paddy in 2010*	Increase MPP for early and late indica and japonica paddy.
	Apr. 9, 2010	*Advice for reducing the burden of farmers in 2010*	Reduce famers' burden and increase their benefits.
	Apr. 19, 2010	*Policy measures to support agricultural production*	Reduce the loss from the natural disaster.
	Apr. 27, 2010	*Seven measures to support agricultural production*	Ensure the effective supply of grain.
	May 27, 2010	*Implementation plan of MPP for wheat and rapeseed in 2010*	Increase MPP for wheat and rapeseed.
	May 27, 2010	*Cracking down driving up agricultural commodity prices*	Promote the grain prices stable.
	Jun. 28, 2010	*Carrying out inspection on MMP*	Regulate behaviors of the grain purchase enterprises.
	Feb. 10, 2011	*Notification on increasing MPP for paddy in 2011*	Increase MPP for paddy.

Note: MPP is the abbreviation of the minimum procurement prices.

Appendix Table 7.3.9 Chinese grain polices and its policy purpose (2009-2013) –continued -

Period	Dates of issue	Government's documents related to grain prices	Purpose of the policy
2009 - 2013	Mar. 28, 2011	*Outline for supporting grain production and farmers' income*	Maintain farmers' income grow by more than 7%.
	Jun. 8, 2011	*Implementation plan of MPP for wheat in 2011*	Protect farmers' benefits.
	Feb. 2, 2012	*Notification on increasing MPP for paddy in 2012*	Increase MPP for early indica paddy.
	Mar. 28, 2012	*Support food production and farmers' income in 2012*	Increase the subsidies to farmers.
	May 21, 2012	*Implementation plan of MPP for wheat in 2012*	Increase MPP for wheat.
	Aug. 7, 2012	*Accelerate the development grain industry*	Improve the market efficiency to ensure grain supply.
	Aug. 28, 2012	*Notification on increasing MPP for late paddy in 2012*	Increase MPP for late indica paddy.
	Nov. 17, 2012	*Acquisition of temporary storage for soybean in 2012*	Protect farmers’ production in Northeast China.
	Jan. 30, 2013	*Notification on increasing MPP for paddy in 2013*	Promote the development of grain production.
	Mar. 20, 2013	*Support food production and farmers' income in 2013*	Continue subsidizing farmers and train professional farmers.
	May 30, 2013	*Notification on increasing MPP for wheat in 2013*	Protect farmers' benefits.

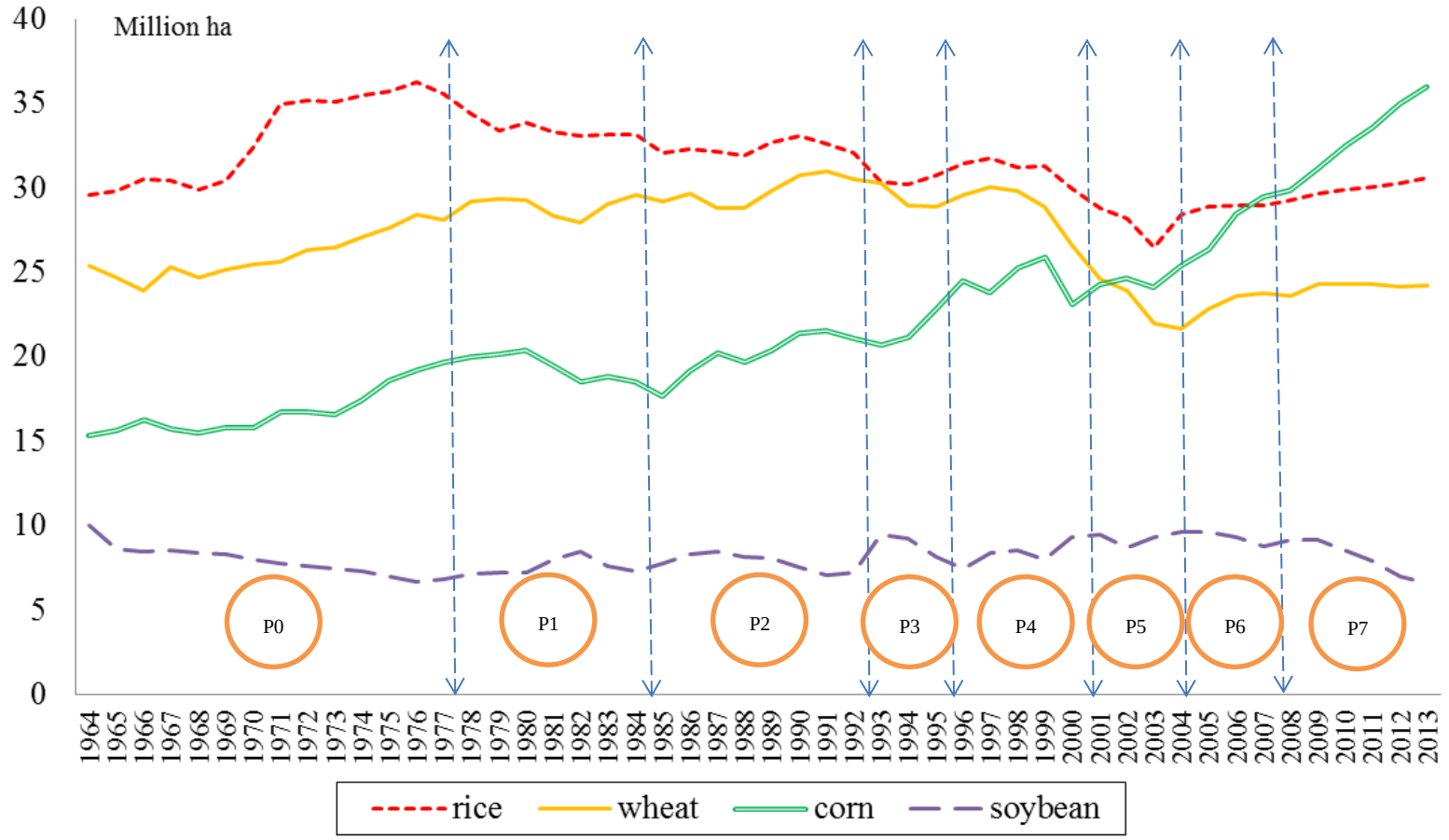
Note: MPP is the abbreviation of the minimum procurement prices.



Appendix Fig. 7.3.1 Development of Chinese grain production (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

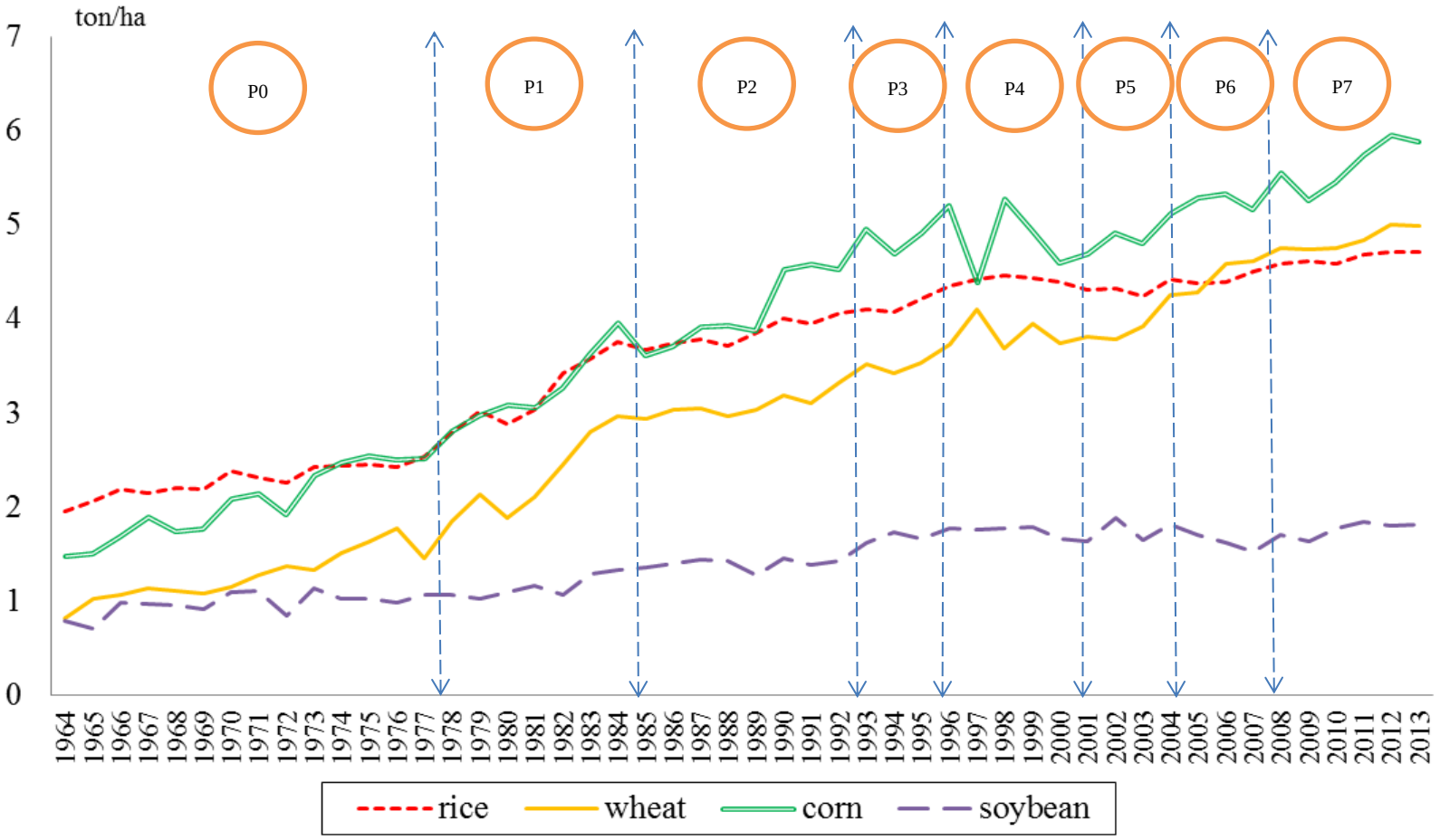
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.2 Development of Chinese grain harvest area (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

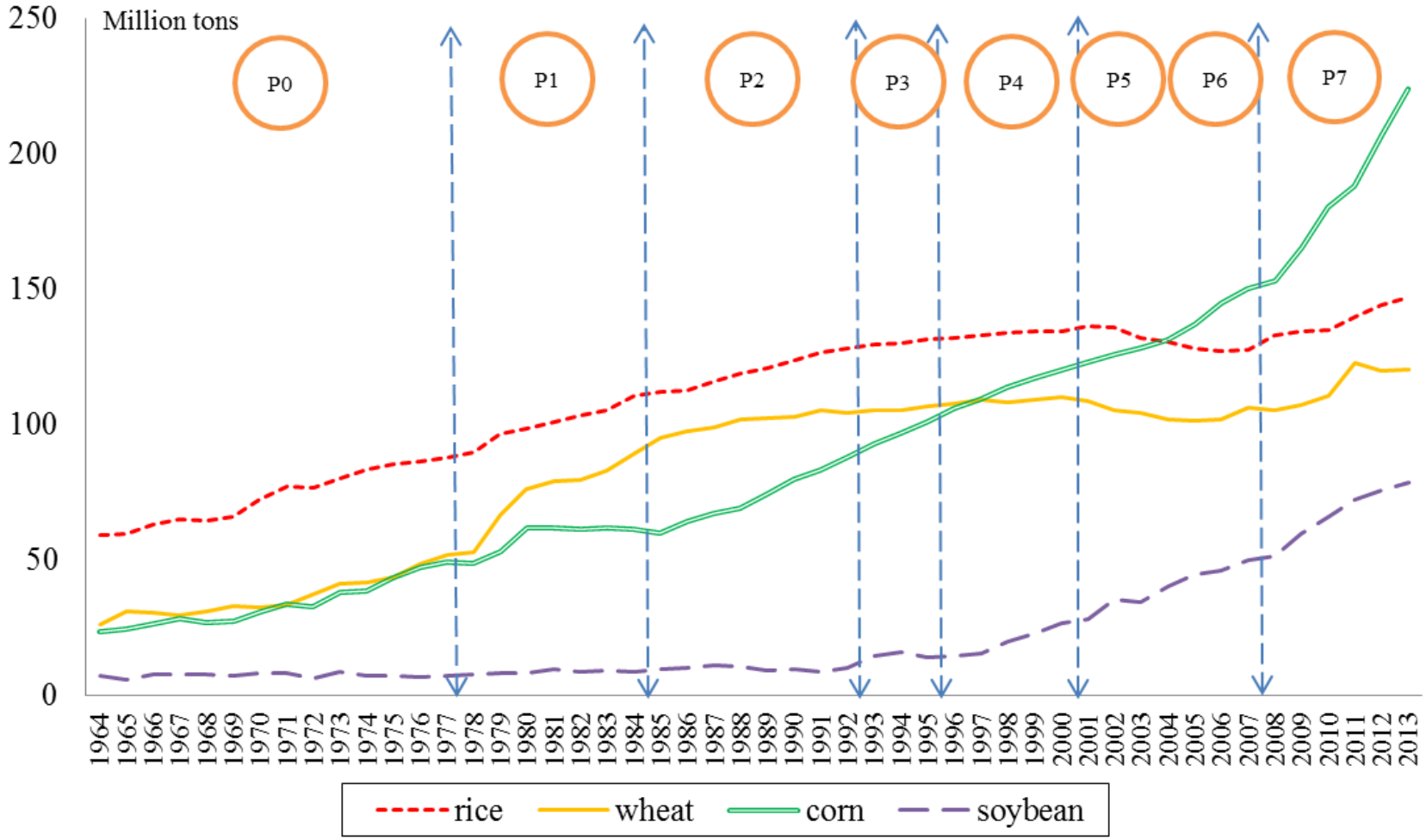
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.3 Development of Chinese grain yield (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

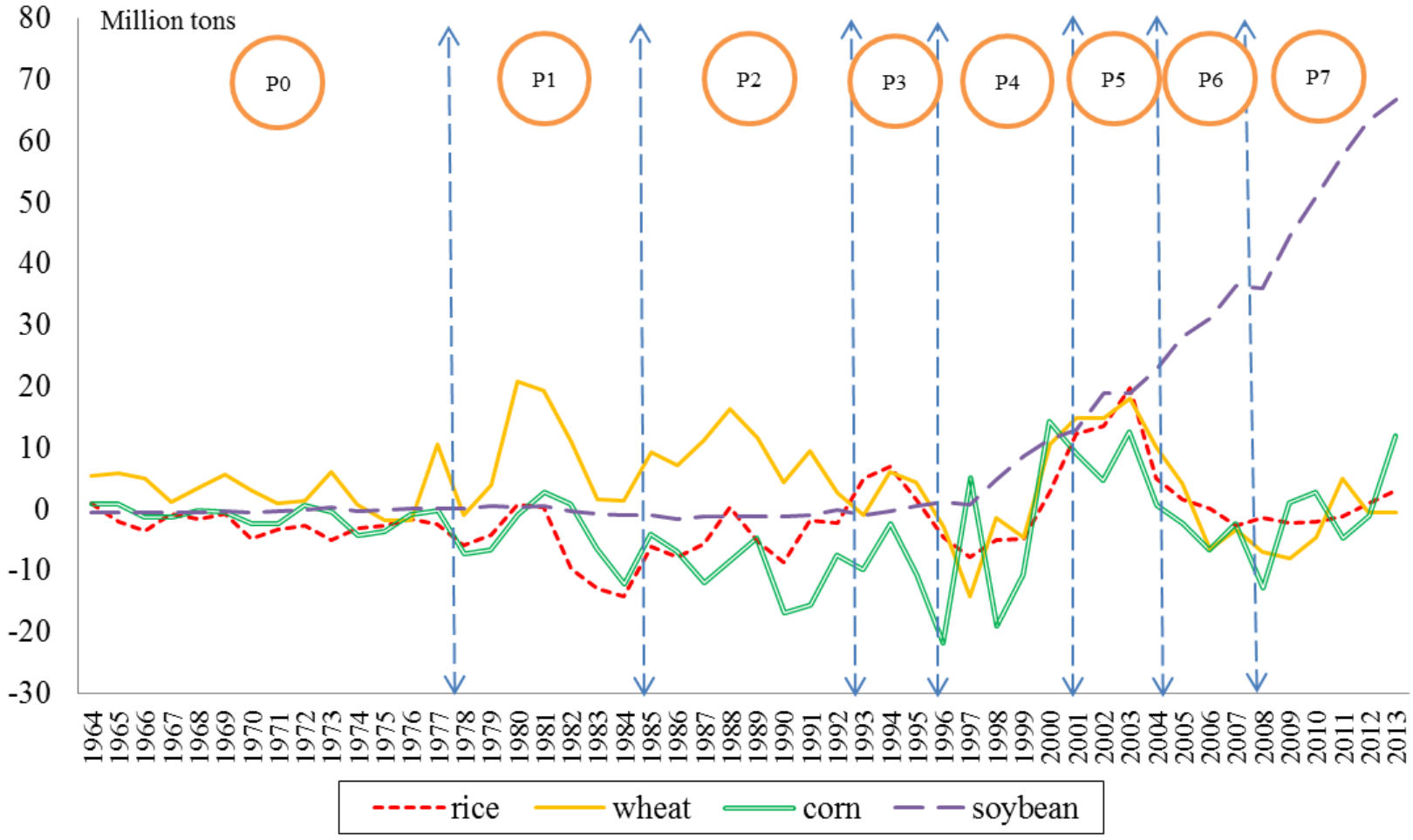
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.4 Development of Chinese grain comsumption (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

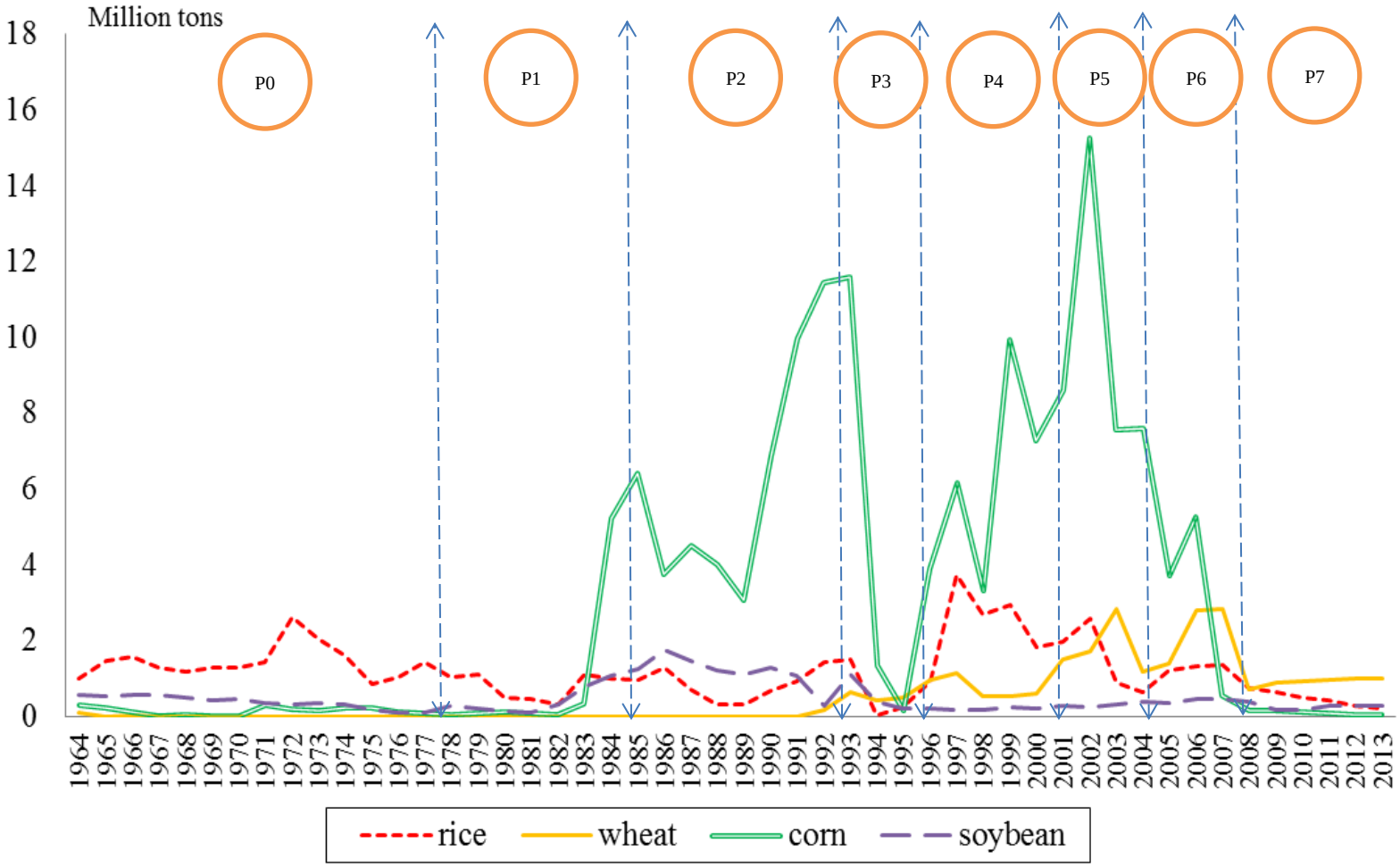
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.5 Grain supply gap in China (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

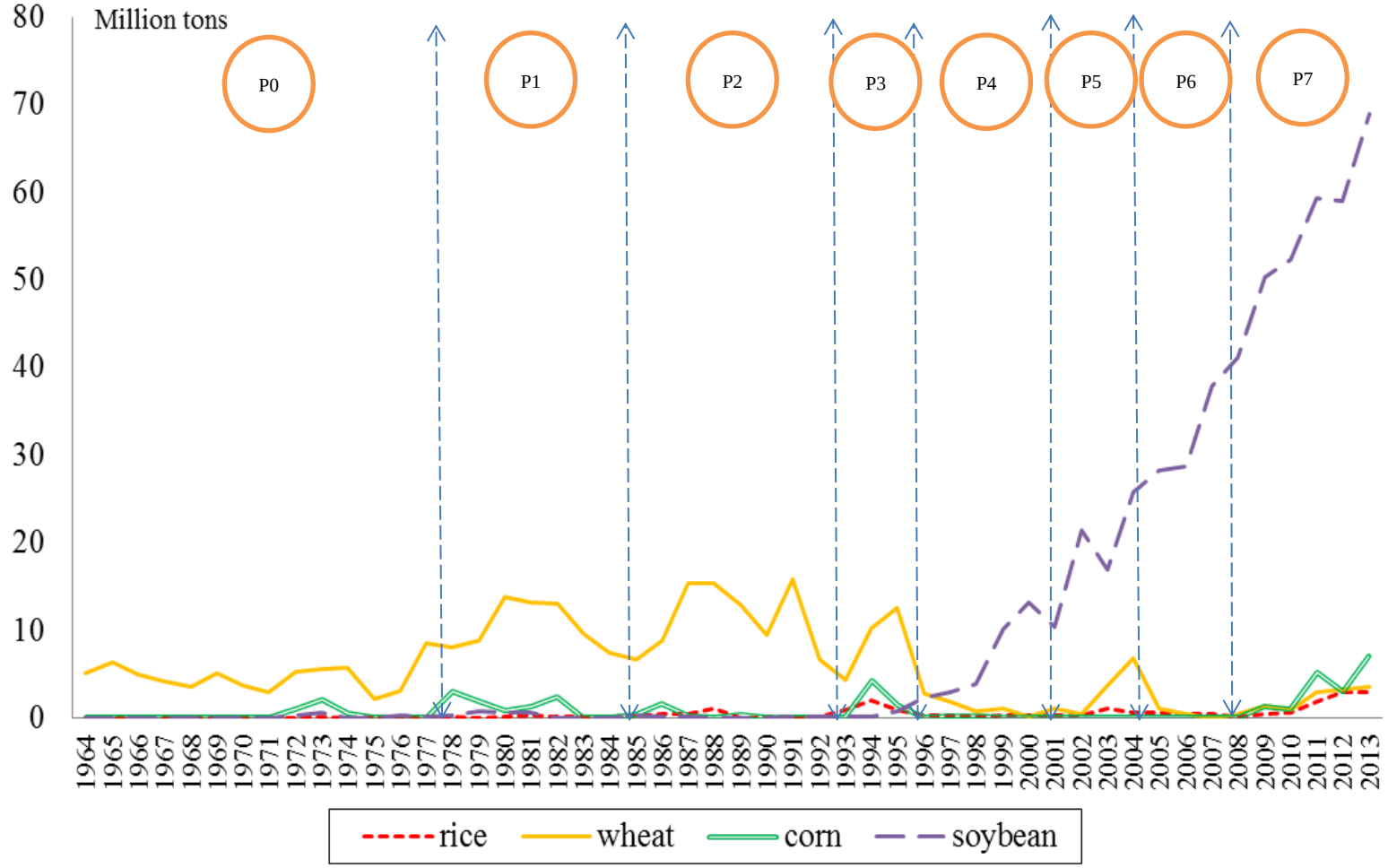
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.6 Development of Chinese grain exports (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

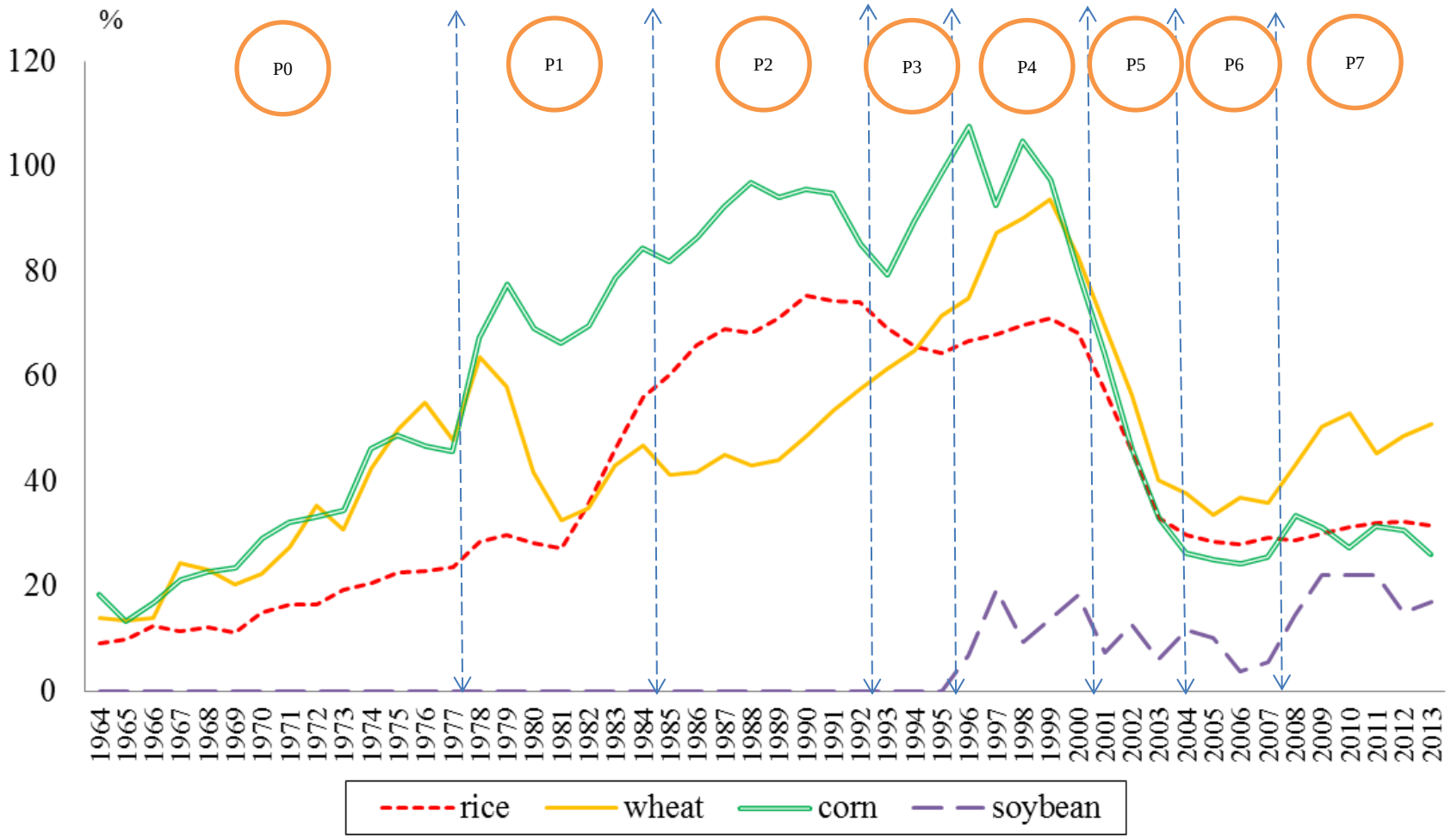
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.7 Development of Chinese grain imports (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

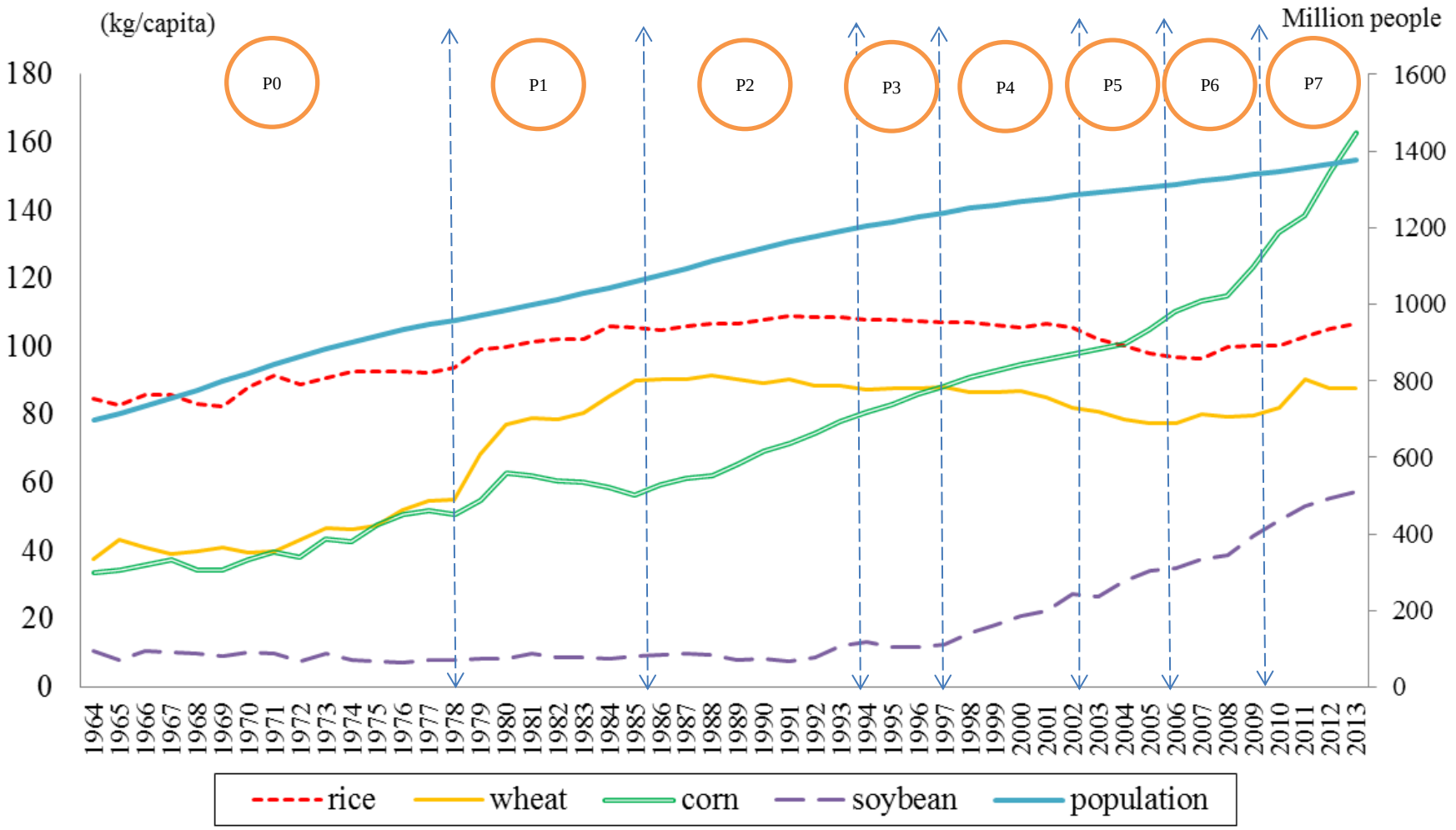
Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.8 Chinese grain Stocks-to-use ratio (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.



Appendix Fig. 7.3.9 Per capical grain consumption and population (1964-2013)

Source: S. Ito; World Food Statistics and Graphics (http://worldfood.apionet.or.jp), (Original sources are from ERS/USDA; PSD Online).

Period: P0:1964-1977; P1: 1978-1984; P2: 1985-1992; P3: 1993-1996; P4: 1996-2000; P5: 2001-2003; P6: 2004-2008; P7: 2009-2013.A