# Has China's Domestic Food Price Become More Stable? An Investigation Based on a Structural Break Regime Switching Model

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## ABSTRACT

The stability of grain prices relates closely to the development of China's economy, social stability and quality of Chinese people's life. However, with the gradual openness of China's grain market and series of newly-issued China's grain policies, the volatility characteristics of China's grain price may experience some structural changes and whether it becomes more stable still remains controversial. In this paper, we investigate the fluctuation characteristics of some main grain prices during the past two decades by using Structural Break Regime Switching Model and the Structural Break Model. We find that China's grain price has become more stable since 2004 with narrowing low and high growth regimes. The implementation of Minimum Purchasing Price Policy and the semi-separation of domestic and international grain markets may explain part of the reasons for the stabilization.


***Key Words***：Food Price Volatility; Stabilizing Point; Structural Break Regime Switching


## INTRODUCTION

Determined by China's basic national condition, the balance of food supply and demand is always of strategic significance in China. And as the foundational price, food price can affect other commodities' price and even the national overall price level, and thus relates closely to the development of China's economy, social stability and the quality of Chinese people's life. Therefore, maintaining the stability of food price is an important issue of China's food security, and also a major aim for the Chinese government. However, with the gradual openness of the Chinese food market, the contributing factors of food price become more diverse and complicated. These new factors as well as Chinese government's new food policies may greatly affect the general pattern of food price volatility, and may lead to a structural break in the time series of China's domestic food price. Some literatures have already found that recently China's domestic food price shows some new characteristics of volatility (Leng C.Z., 2008; Cheng G.Q., 2011). This will cause greater challenges for Chinese government to maintain a stable food price and ensure the food security. Thus, it is a primary step to analyze the characteristics of China's domestic food price volatility and figure out whether China's food price has experienced a structural break. Such investigations will benefit the further researches on the effect of new contributing factors, and will help Chinese government to maintain China's food security and the stability of China's economy.

China's food market has long been driven by the dual system of market mechanism and government control. Due to China's special transition stage of development, the government has constantly been an important main body participating in food market. In the past twenty years, Chinese government has undertaken various means to intervene in the food market price, which directly leads to different fluctuation characteristics in the different stages. Yet, in recent years, Chinese government deregulates the food market and gradually adopts more market mechanisms, which makes the market itself a more and more significant role in determining food price. And the openness of China's food market also links China's domestic food price to the international food price more closely. Therefore, market supply and demand, international food price, and Chinese government intervention are the three main factors influencing China's food price. Since 2004, all these three factors have experienced some

new changes and at the same time act together to bring some new characteristics of volatility to China's food price, which challenges China's food security and the stability of China's economy. Thus recently, many literatures addressed the issue of the stability of China's food price.

Whether China's food price has become more stable these years still remains controversial. Some researches show that China's food price has jumped to a high level with more fluctuations, and will remain high in the future, (Cheng, 2011； Ke,1995; Xie,1996; Li and Ma, 1998; Jiang, 1999). China's sharply increasing food demand compared with the slowly increasing food production determines its food price to rise in the long term. Also, in the recent years, international food price has fluctuated more frequently, coupled with wider fluctuation range. Thus these researches argue that the international food price will cause China's domestic food price to fluctuate more severely and become more unstable due to the openness of China's domestic food market. However, some investigations suggest that China's food price volatility has been smoothed by a series of food policies carried out by Chinese government since 2004, like the Minimum Purchasing Price Policy (MPPP) and Temporary Purchasing and Storage Policy (TPSP), and international food price's impact on the domestic food price is moderate. Therefore China's food price has become more stable recently (Gui and Han, 2011; Yang, 2006; Wang, 2006; Huang, 2006).

Investigations on food price stability relates to important issues like the efficiency of Chinese food price policies, and the linkage between domestic and international food market. What's more, the stability of food price also affects farmers' expectation and thus further influences their producing behaviors. Increasing stability of food price acts as a guarantee for an equal or even better farming income in the next year, and thus motivates the farmers to maintain or expand their planting areas. Thus, food price stability has a significant impact on food supply and a far-reaching meaning for the food security. However, present literatures investigating the volatility of China's food price usually use the traditional filtering methods. Although these methods are relatively simple to calculate, they have shortcomings in that they all require the statistics be stationary and allow no structural breaks in the time series. Thus they may not be able to depict the food price precisely which fluctuates frequently and diversely.

In this paper, we will analyze food price fluctuation characteristics in the recent twenty years. Through the traditional Regime Switching Model and Structural Break Regime Switching Model, three major food prices will be analyzed. From the historical price fluctuation, this paper will extract the proper fluctuation range. With fluctuation variance of different growth regimes, this paper will also explore whether China's food price growth tends to be stable. Based on the empirical research, this paper will further discuss the possible reasons behind the transformation of fluctuation characteristics and explore how the government can perform properly to stabilize the food price.

## LITERATURE REVIEW

In general, agricultural cyclical fluctuation is a common phenomenon which surpasses the system and development stage. In order to conduct the effective macroeconomic regulation and control over agriculture, we must have the accurate warning analysis whose premise is correct understanding the agricultural cycle. Song Hongyuan (1995) analyzes the agricultural prices cycle from the perspective of food production cycle and the supply fluctuation of agricultural products. Luo Jianguo (1996) thinks that China's agricultural products market fluctuation mainly features leading fluctuations of production supply, frequent fluctuations, wide range, stronger cycle fluctuation, four years cycle presented by the main agricultural products. Wu Guoxing (1997) argues that the fluctuation of agricultural products market price manifest as the periodic fluctuation featured by the same step-by-step-jump ups and downs. The general price level showcases ascendant trend, and the rise and fall of

agricultural products price coincides with the overheated economy and economic adjustment in terms of time. Its fluctuation cycle agrees with the variation cycle of industrial growth speed against agricultural growth speed, and the two cycles have the same direction. The fluctuation of agricultural product price doesn't have a clear negative relation with the increase and decrease of total agricultural product. Cheng Guojiang (2010) thinks that there exist two kinds of situations of agricultural products price fluctuations: one kind is normal cyclical fluctuation determined by the relationship between agricultural product supply and demand. Another kind is abnormal fluctuations, which is not determined by the relation between market supply and demand, but other factors, such as sudden natural disasters, government regulation policy, speculative hype, improper public opinion adding fuel to the fire.

For a long time, it has been a strategic target for China's food security to maintain China's grain's balance between supply and demand and the stability of grain markets. Therefore, the balance between food supply and demand and food price fluctuation has already been intensely discussed by the academia. Food is an industry where natural reproduction and economic reproduction are twisted. As a consequence of the widespread layout of the producing space, intensity of time distribution and hysteresis of market signal influence, the cyclical fluctuation of grain prices and other agricultural products is an inevitable phenomenon. In the long run, food prices will present a cyclical fluctuation, with the overall rising. It will become an inevitable trend in the process of economic growth that grain and other agricultural prices continue to stay high(Cheng Guojiang, 2011; Li Guoxiang,2011).China's grain price fluctuation features pretty strong regularity and period (Leng Chongxin, 2008; Meng Fanxin et al., 2008), Liu Ximing(2009) finds that with respect to the grain price fluctuations of spot market and future market, price fluctuation rangesof basic food of are substantially consistent. And Gu Guoda, et al. (2010) believe that China's agricultural price fluctuation has the characteristics of obvious situation transfer. Its fluctuation is influenced by unobservable variables of situation transfer. This fluctuation is not only long-term and stable but asymmetrical to a certain degree.

Fundamentally, the food price stability depends on the balance between food supply and demand. Since the 1990's, Chinese scholars have begun to estimate and forecast the grain demand in the coming decades of China, and done some researches on the influence upon supply and demand of China's grain by international food market after China's entry into the WHO (Liu Jingyiet al., 1996; LvXinyeet al., 1997; Huang Peiminet al., 1997; Gao Guoqing et al., 2000).Research findings generally show that there still exists the food structural surplus and deficiency, but contents of surplus and deficiency will change. After the entry into WHO, China should adopt the following channels to keep the balance between supply and demand: control of food import and export, transformation of domestic food production layout, structural adjustment as the priority supplemented by grain reserve adjustment. The three channels should complement each other. After the 21st century, with China's entry to the WTO and further reform of domestic grain production and circulation system, researches of China's grain balance have spread from the deep research of production and supply system, reserve and stimulation system, market and circulation system to cohesion of food production and marketing, interregional grain circulation, regional grain balance of the national grain balance, domestic grain balance and the international grain market fluctuation and a lot of valuable research results have been reached.(Dong Quanhai, 2000; Yang Minghong, 2000; Xiao Guoan, 2002; Li Xinjianet al., 2005; Jiang Changyun, 2006; Ran Ruien, Deng Hao, 2007; 2009; Huang Jikunet al., Yang Lei, 2009).Most studies forecast a quite long period of time in the future where China's grain total demand is increasing. The tense situation of food supply and demand will continue in the coming years. (Liu Xiaomei, 2004; Chen Yongfu 2005; Li Bo, et al., 2008; Shao Lu, 2009; Yang Lei, 2009) Therefore, food prices overall will keep an upward trend in the long run. And in the process of rising food prices, how to deal with the relationship between the government regulation and market regulation has become a hot spot studied by many scholars(Wang Xiaolu, 2001; Wang Dewenet al., 2001; Wang Yisong, 2004; Wang Zhibin, 2007; Feng Yun, 2008; Yang Ju, 2008).

Comprehensively speaking, although there are a lot researches about China's grain price fluctuation and its

influence on economic social life, few study food prices fluctuation rules and the characteristics. In addition, several researches on characteristics of food price fluctuation are carried out mostly by the means of traditional filtering, or the method called “wave trough, wave crest” to differentiate fluctuation cycle. With China’s food fluctuation form and rule being more complicated, this kind of means has shown some limitations. The Structural Breaking Regime Switching Model adopted by this paper is based on the extension of Classical Hamilton (1989) Regime Switching Model. Classical Regime Switching Model has been widely developed and applied in recent twenty years. Hansen (1992) first put forward a testing theory of Hamilton Regime Switching Model. Albert and Chib (1993) used Gibbs Sampling Method to simplify the calculating process. Then, this method is widely used in researches on many countries’ economic growth and the business cycle by scholars of all countries (Albert,1993; McConnell, 2000; Krolzig,2001; Mills,2003; Lam,2004; Girardin,2005; Marmer, 2008; Sugita, 2008).Meanwhile, Chinese scholars also apply this method to China’s macro data analysis and research. Shi Zhuxian et al. (2007) apply multivariable dynamic Markov Transfer Factor Model to researches on China’s economic cyclical fluctuation since 1991.GuoQingwang, et al. (2007) used Gibbs sampling method to estimate the multivariable dynamic Markov switching factor model of Chinese economic cycle, identifying China’s economic cyclical inflection point and analyzing synchronous index. This paper will extract the characteristics of China’s grain price fluctuation by means of Nonlinear Regime Switching Model, with the focus on China’s twenty years’ grain price fluctuation rules and characteristics. Based on the new classification of fluctuation stages, this paper will analyze the policy mechanism before and after fluctuation point of China’s grain market.

## THEORETICAL MODEL

There still exist some flaws in terms of studying methods and perspectives in spite of a number of researches on grain price fluctuations emerging amongst the academics. Firstly, grain price fluctuations are not influenced by the short-term factors but the long-term structural factors with complicated fluctuation formalities. The fluctuations frequently appear in two different fluctuations or growth situations and switch between the both, with random switching probabilities instead of periodical or fixed ones. Therefore, the conventional method featuring “big cycle and small cycle” doesn’t fit the grain price fluctuations characterized by short term and intricate influencing factors. If the conventional method similar to “wave crest and wave trough” featuring classifications of grain price is used to describe the situation, the characteristics of short-term grain price fluctuation can’t be presented exactly due to the difficulty to find crest and trough resulting from complicated fluctuations and vague cycles of grain price fluctuations. As a consequence, the conventional cyclical methods are not desirable.

Owing to the dual influencing factors of short-term impact and long-term structural changes for grain price fluctuations, this paper will select Structural Break Regime Switching Model. Firstly, we will classify price growth into high-growth regime and low-growth regime, with different potential growth rates and fluctuation variances corresponding to different regimes. And grain prices will jump randomly between different regimes so that we can relatively precisely depict the fluctuations impacted by short-term factors. Secondly, in the long term, due to the possible changes of exterior macro-economy and overall operating mechanism of grain markets, macro-breaks may take place in fluctuation characteristics accordingly. Therefore, based on the Classical Regime Switching Model, we introduce the Structural Switching Mechanism (Fluctuation variances and potential growth rates of two regimes will break at some point). By those changes, we can find the structural breaking point of China’s grain price fluctuations in order to analyze the reasons before and after breakings and attain objective and scientific results entirely based on data rather than the conventional subjective way to detect still breaking point.

## Classical Regime Switching Model

According to the classical Markov Regime Switching Model theory, an economic index or price index growth can be divided into two kinds of regimes, namely high-growth regime and low-growth regime. The two regimes have different asymmetries. That is to say there exist various potential average growth rates and fluctuation variances in each regime, where the average duration lengths are different. Use state variables to describe two growth regimes, low-growth regime corresponding to St = 0, high- growth regime corresponding to St = 1.In each regime, time sequence obeys q order regression process,

$$y_t = \mu_{S_t} + \phi(L)(y_{t-1} - \mu_{S_{t-1}}) + u_t, \quad u_t \sim NID(0, \sigma^2_{S_t}) \quad (1)$$

$$\phi(L) = \phi_1 L + \phi_2 L^2 + \cdots + \phi_q L^q \quad (2)$$

L is lag operator. In this study, choices of the best lag order numbers comply with AIC (Akaike Info Criterion) Criterion（Simpson, 2001）.

The potential growth rates and fluctuation variances corresponding to respective every growth regimes can be presented:

$$\mu_{S_t} = \mu_0(1 - S_t) + \mu_1 S_t \quad (3)$$

$$\sigma_{S_t} = \sigma_0(1 - S_t) + \sigma_1 S_t \quad (4)$$

$$S_t = 0 \ or \ 1 \quad (5)$$

$\mu_0$ and $\mu_1$ represent two regimes' potential growth rates. $\sigma_0$and $\sigma_1$are fluctuation variances used to describe fluctuation range of every regime

Probabilities of transformations following time of economies in two regimes can be expressed as

$$\begin{pmatrix} P(S_t = 0) \\ P(S_t = 1) \end{pmatrix} = \begin{pmatrix} p_{00} & p_{10} \\ p_{01} & p_{11} \end{pmatrix} \begin{pmatrix} P(S_{t-1} = 0) \\ P(S_{t-1} = 1) \end{pmatrix} \quad (6)$$

And $\begin{pmatrix} p_{00} & p_{10} \\ p_{01} & p_{11} \end{pmatrix}$ is Conversion probability matrix, and every element of matrix is

$$\begin{cases} p_{00} = \Pr(S_t = 0 \mid S_{t-1} = 0) \\ p_{10} = \Pr(S_t = 0 \mid S_{t-1} = 1) \\ p_{01} = \Pr(S_t = 1 \mid S_{t-1} = 0) \\ p_{11} = \Pr(S_t = 1 \mid S_{t-1} = 1) \end{cases} \quad (7)$$

$p_{00}$and $p_{11}$representing duration probability of two regimes, and

$$p_{10} = (1 - p_{11}), \ p_{01} = (1 - p_{00}) \quad (8)$$

## Structural Break Regime Switching Model

In classical regime switching model, we assume that the switching mechanism, fluctuation variance and two regimes' potential growth rates are not changeable. But, in many cases, due to break of external economic operation mechanism, economic growth or price index fluctuation characteristics will change. The two regimes' potential growth rates and fluctuation ranges will also change accordingly（Kim and Nelson, 1999）. At this time,

we will introduce structural break mechanism. Use the setting structural break index Dt (0 or 1) to represent two fluctuation mechanisms before and after, 1 – d standing for break probability.

$$\mu_{S_t}=\begin{cases}\mu_0(1-S_t)+\mu_1 S_t, & if\ \ D_t=0\\ \mu_0^*(1-S_t)+\mu_1^* S_t, & if\ \ D_t=1\end{cases}, \quad (9)$$

$$\begin{cases}\Pr[D_t=1\,|\,D_{t-1}=1]=1\\ \Pr[D_t=0\,|\,D_{t-1}=1]=0\\ \Pr[D_t=0\,|\,D_{t-1}=0]=d\\ \Pr[D_t=1\,|\,D_{t-1}=0]=1-d\end{cases} \text{ and } \begin{cases}D_0=0\\ D_T=1\end{cases} \quad (10)$$

Due to the large numerous of undetermined coefficients and computational complexity, we adopt Gibbs sampling method in the concrete operation process. First of all we set joint probability density as:

$$g(S_1,...,S_T,D_1,...,D_T,\varphi,\mu_0,\mu_1,\mu_0^*,\mu_1^*,\sigma_0,\sigma_1,p,q,d\,|\,Y_1,...,Y_T) \quad (11)$$

Concrete sampling method process are shown as :①

1) Based on $S_{\neq t}$, $D_1,\ldots, D_T,\theta$to $S_t$ sampling:

Posterior probability density of $S_t$ can be shown as

$$g(S_t\,|\,Y_T,S_{\neq t},D_1,...,D_T,\theta)\propto g(S_t\,|\,S_{t-1})g(S_{t+1}\,|\,S_t)g(y_t\,|\,S_t,S_{t-1},D_1,...,D_T,\theta)g(y_{t+1}\,|\,S_{t+1},S_t,D_1,...,D_T,\theta) \quad (12)$$

2) Based on D≠t, $S_1,\ldots, S_T$, θto $D_t$ sampling:

Posterior probability density can be shown as

$$\Pr\left[D_t=j\,|\,Y_T,D_{\neq t},S_1,...,S_T,\theta\right]=\frac{g(D_t=j\,|\,Y_T,D_{\neq t},S_1,...,S_T,\theta)}{\sum_{j=0}^{1}g(D_t=j\,|\,Y_T,D_{\neq t},S_1,...,S_T,\theta)} \quad (13)$$

3) Based on $D_1,\ldots, D_T$, $S_1,\ldots, S_T$, $\theta_{(-\varphi)}$to φ sampling:

Posterior probability density can be shown as

$$g(\varphi\,|\,S_1,...,S_T,D_1,...,D_T,\theta_{(-\varphi)})\propto\prod_{t=2}^{T}\frac{1}{\sigma_{D_t}}\exp\left[-\frac{(y_t-\mu_{S_t,D_t}-\varphi(y_{t-1}-\mu_{S_{t-1},D_{t-1}}))^2}{2\sigma_{D_t}^2}\right]. \quad (14)$$

4) Based on $D_1,\ldots, D_T$, $S_1,\ldots, S_T$, $\theta_{(-\mu)}$:to$\mu_0,\mu_1,\mu_0^*,\mu_1^*$sampling:

5) Based on $D_1,\ldots, D_T$, $S_1,\ldots, S_T$, $\theta_{(-\sigma)}$to$\sigma_0,\sigma_1$sampling:

$$g(\sigma_0^2\,|\,S_1,...,S_T,D_1,...,D_T,\theta_{(-\sigma_0)})\propto(\frac{1}{\sigma_0^2})^{\frac{u}{2}}\prod_{t(D_t=0)}\exp\left(-\frac{[y_t-\mu_{S_t,0}-\phi(y_{t-1}-\mu_{S_{t-1},D_t})]^2}{2\sigma_0^2}\right). \quad (15)$$

6) Based on $D_1,\ldots, D_T$, $S_1,\ldots, S_T$, $\theta_{(-p,-q)}$to p,q sampling:

$$g(p,q\,|\,S_1,...,S_T,D_1,...,D_T,\theta_{(-p,q)})\propto p^{(u_{00}+1)-1}(1-p)^{(u_{01}+1)-1}q^{(u_{11}+1)-1}(1-q)^{(u_{10}+1)-1} \quad (16)$$

and $u_{00},u_{11},u_{10},u_{01}$are observable switching times

$$g(p\,|\,S_1,...,S_T,D_1,...,D_T,\theta_{(-p)})\sim beta(u_{00}+1,u_{01}+1)$$
$$g(q\,|\,S_1,...,S_T,D_1,...,D_T,\theta_{(-q)})\sim beta(u_{11}+1,u_{10}+1) \quad (17)$$

7) Based on $D_1,\ldots, D_T$, $S_1,\ldots, S_T$, $\theta_{(-d)}$ to dsampling

①the sampling process has circulated for 20000 times in which 5000 times before are discarded.

# EMPIRICAL ANALYSIS

Data used in this research are derived from market and economic information department of the agricultural ministry of the People's Republic of China, as well as national bureau of statistics calendar year *China Statistical Yearbook*. Selected representatives are wheat, rice, corn. All data are monthly data time series, spanning from 1987 to 2010.Before the measurement test, all the time sequences go through the seasonal adjustment by X - 12 Adjustment Method, then monthly price sequences are transformed into link growth rate.

In the empirical analysis, we first use classical regime switching to analyze three grain prices separately in order to extract fluctuation characteristics as well as the growth cyclical stages of different periods in the past twenty years. Second, through Structural Break Regime Switching Model, we classify different fluctuation stages of average prices so as to discover inflection point of fluctuation characteristic switching.

## The Analysis of Fluctuation Characteristics of Three Crops' Prices Based On the Classical Regime Switching Model

The empirical results are as shown in figure 2, 3, 4, 5, and table 1, 2, 3, 4. Take rice for example. The curve below the left of figure 2 represents its monthly growth rate, while the blue curve above the left shows the probability when prices belong to the high-growth regime. We can see in the year of 1988, 1993 -1994, 2000, 2003-2004, the price of wheat belongs to high-growth regime. From table 1, we can come to the conclusion that the monthly average growth rate of rice belonging to the low-growth regime is 0.16%, with 1.32% to high-growth regime, but the fluctuation variance of high-growth regime is bigger than that of low-growth regime, showing the characteristics of "high growth, high fluctuation".

The analysis of the two remaining grain prices is similar. In addition, from overall average price fluctuations of the three kinds of grain, in the year of 1988, 1994, 1997, 2000, 2003-2004, the high-growth regime belongs to high-growth regime. Potential growth rates of low and high growth regime are 0.05% and 2.7%, and fluctuation variances are 1.36%, 3.82%.

Between 1987 and 2010, China's grain price has undergone several rising fluctuations (similar to Table 1). That is to say, price fluctuations stay in the high-growth regime. As regards the results of three main grain crops, the high-growth regime took place in the second half of 1988, in 1994, in the second half of 1997, in 2000 and from the end of 2003 to the beginning of 2004, with each rising period spanning from six months to a year. During the 24 years, high-growth regime took up 13% of the total time span. Therefore, despite several big fluctuations occurring in the past two decades, low-growth regime has occupied 85% and above of time span. Moreover, the three crops all present features of "high growth, high fluctuation", namely, higher growth rate, bigger fluctuation variance leading to more volatile market. We can see that the potential growth rate of wheat, rice and corn is below 0.5% in the low-growth regime and between 1%-3% in high-growth regime, among which wheat's potential growth rate can top 3.4% and corn's can reach the lowest 0.4%. After the analysis of the average price of the three crops, we can see that potential growth rates of two growth regimes are 0.05% and 2.7% respectively with respective fluctuation variances of 1.36% and 3.8%.

## The Stage Classification of Food Price Fluctuation Based on the Structural Break Model

In order to further analyze the overall transformation of fluctuation characteristics, we have discussed the structural break on the average price growth rates of three kinds of grain. Results of parameters sampling for potential growth rate and fluctuation variance are shown in figure 6 from which we can see that the parameter sampling process tends to be stable after 2000 times.

The empirical results are shown in figure 7 and table 5.The empirical results show that the price experiences

a break in early 2004 and the potential growth rates of its two regimes shrink. The potential growth range shrinks from (0.01%, 7.71%) to (0.36%, 3.37%), with fluctuation variance dropping dramatically, from 1.7% to 0.98%.It shows that after 2004, China's grain price market has entered a period of "low growth, low volatility", which is closely linked to China's continuous grain harvest and the food price protection policy undertaken by government.

Moreover, in order to test the stability of the model in our study, we have altered the conditions on variable before and after the structural breaking point. For one thing, the potential growth rate will not change before and after break point; for another, the fluctuation variance will not change before and after break point (Kim and Nelson,1999). The testing results are shows in Table 7 and Table 8, in which the potential growth rate and fluctuation variance are in consistent with the original model presenting sound stability.

## Reasons for the Stabilization of China's Grain Price

As shown by the empirical analysis above, China's grain price has experienced a structural change around early 2004. China's grain price follows an overall increasing tendency, and the high and low growth regimes are narrowing substantially with fewer fluctuations. China's grain market is relatively stable compared with the international grain market in the same period. Food price volatilities can be divided into short-term fluctuations and long-term structural transformation. The former mainly results from all kinds of random and non-controllable shocks, while the latter is usually determined by some macro-factors discussed above, including China's food price policies and the international shock. In this part, we will discuss the possible reasons for the stabilization of China's grain price.

### China's Food Price Policies

Since the reform and opening up, China's food marketing circulation system has gradually transformed from a government-leading one to a market-leading one. In general, the food pricing system has experienced five major periods since 1953: 1) the free price system; 2) the state monopoly for purchasing and marketing system; 3) the coexistence of the contract price and market price; 4) the coexistence of protective purchasing price and selling price; 5) the coexistence of minimum purchasing price and the selling price (Leng Chongzong, 2009). In every period, Chinese government acts as an important participant in the food market and its interventions directly leads to different volatility characteristics of China's domestic food price. Thus the change of China's grain price volatility in 2004 may result from some food price policies carried out by Chinese government around that time.

After 2000, the liberalization of food markets took off in parts of China, and many areas in China have loosened the control over food prices completely. Getting rid of the government's control, the grain prices experienced fierce fluctuations as the results of unbalanced supply and demand. This causes greater risk for farmers and deepens the farmers' enthusiasm for production. In order to promote grain production, the Chinese government has employed Minimum Purchasing Price Policy (MPPP) successively for rice and wheat since 2004, which marks that China's food market has changed from the state monopoly for purchase and marketing system to food market mechanism based on minimum purchase price of grain for basic guarantee. From 2004 to 2007, rice minimum purchase price plan is implemented in Jilin, Heilongjiang, Anhui, Jiangxi, Hubei, Hunan, Sichuan. In 2008, it expands to 11 provinces (area), including Liaoning, Jiangsu, Henan, Guangxi. Since 2006, the wheat execution areas of minimum purchase price are not changed, including Hebei, Jiangsu, Anhui, Shandong, Henan and Hubei. Our empirical results show that the grain price has become more stable after 2004 when these food policies began to take effect, so the MPPP may be a possible reason for the stabilization of China's grain price.

MPPP may stabilize China's grain price through two ways: Firstly, the downward range through the limit of food prices (namely "TuoDi") stops food price from falling. In addition, more importantly, the minimum purchase

price policy can greatly improve the production income expectation. MPPP makes the coexistence of rising grain output and rising food prices possible, which elevate famers' enthusiasm for production. Even without financial subsidies, if the market prices are rising and farmers believe that the price is getting higher in the future, the farmers will plant more grain to increase the supply (Lu Feng, 2008). Thus the stable rising grain price ensures a stable grain production through the farmers' expectation for a stable income, while a stable grain production in turn ensures a following stable grain price. Thus, the stability of food production and food prices complement each other and lead to the structural change from high volatility to stabilization of the China's grain price. Until 2013, China has kept the growth in food production consecutively for 10 years. At the same time, food price market also experiences stable development.

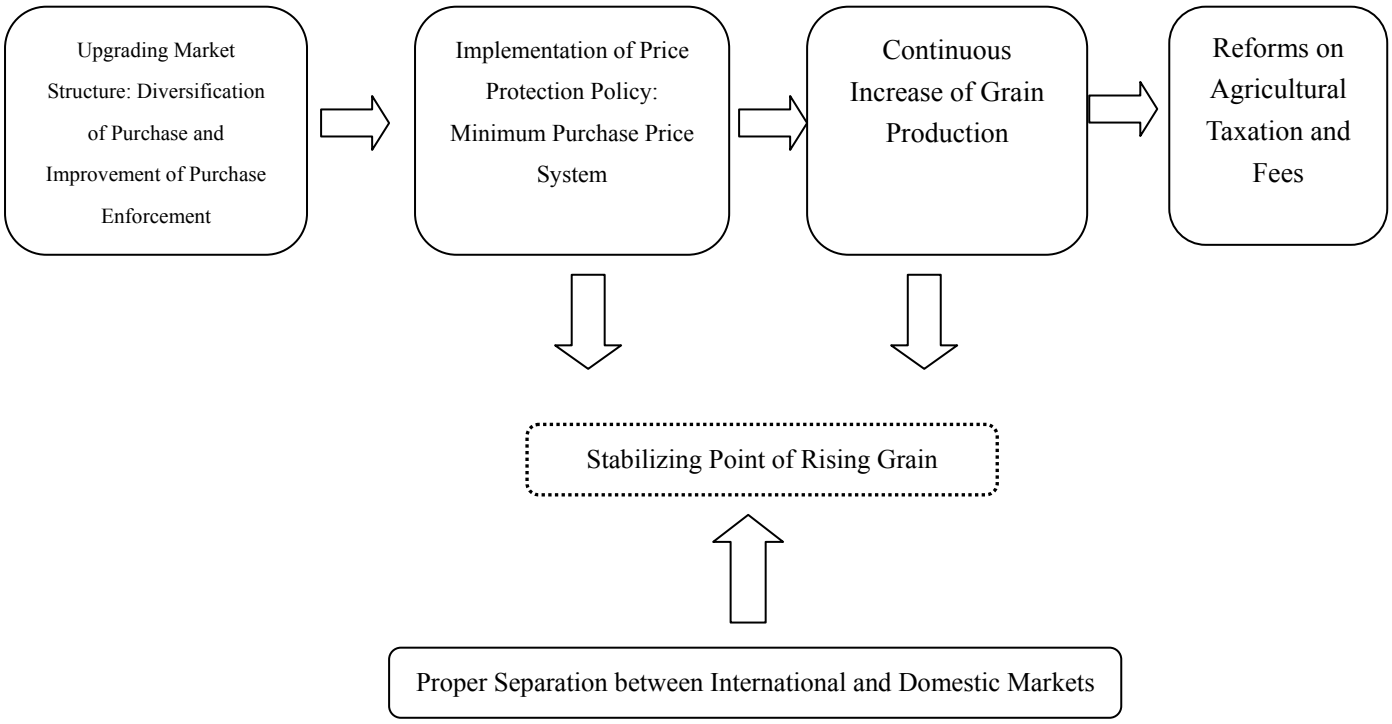


**Figure 8 Driving Forces behind Stabilizing Point of Grain Prices**

Although before MPPP, China has gradually improved the food price regulation mechanism and carried out a series of protection policies, these policies and mechanisms do not act as efficiently as MPPP. Before MPPP issued, the food price system has already included market price, price protection, contract price, the maximum price, leveling price, and so on, which cooperate with each other in order to ensure the smooth running of grain market. Among all, the protective price is similar to the minimum price. However, in the long term, the effect of protective price is not satisfactory, "fertility dilemma" happening from time to time. The protective price policy implemented before 2004 is still working within the framework of food prices double-track system, with limited function of the market regulation mechanism. Even if the protective price is higher than the market price, it only guarantees the revenue of grains within the contract, and it has no guarantee for the revenues of grains exceeding the contract's requirement (namely the part which is free to enter the market part). Farmers focus more on the market price rather than contract price, and determine the future production investment according to market prices. Therefore, income expectation of whole grain of producers is unstable in the long run. This is the main reason for the flowing of China's grain output before 2004. Therefore, though the protective price and the minimum purchasing price seem similar to each other on the surface, they are distinct in essence because the protective price is still working within the double-track system, while minimum purchasing price functions based on the power of market itself.

## The International Shock

As the empirical results show, China's food price transformed from a "high volatility, low level" stage to a "low volatility, high level" stage in early 2004. However, compared with China's more stable grain price, the international grain price fluctuates more severely on a higher level. We use the classical regime switching model to analyze the fluctuation characteristics of the international prices of three main types of grains, wheat, rice, and maize. And we find that all these three types of grains have transformed from a "low level, low volatility" stage to a "high level, high volatility" stage, shown by their higher means and larger standard variances (Table 10). This forms a sharp contrast with the result of China's domestic grain price. Although the international grain prices also have experienced structural breaks, the times of structural break are quite different from those of China's domestic grain prices. International prices for wheat, rice and maize experienced a structural break respectively at the year 2007, 2008, and 2006, which may be results of the international food crisis. Since the structural breaks of China's domestic grain prices happened earlier than 2006, the structural break of international grain prices cannot explain that of China's domestic grain prices.

Thus, the divergence of volatility characteristics between the international and domestic grain prices may suggests that the effective separation of the two markets, which is an important guarantee for China's grain prices to avert the impact from international market. According to the literature, there are mainly two ways for the international grain prices to affect domestic grain prices: the grain trade and the information transmission. However, China's grain import accounts for a very small part of the overall international import, and thus the import price won't have a significant impact on the domestic price. On the other hand, since the commodities futures markets are not mature, the linkage between the domestic and international grain market is not sound. Thus the international information cannot be transmitted to China completely and instantly. Thus, the semi-separation mechanism provides a vital exterior guarantee for China's grain price stability.

## Suggestions to Maintain the Stability of China's Grain Price and the Balance of Grain Supply and Demand

The raise of China's grain prices in the past few years maintains a relatively stable trend. However, we must also see that the considerable uncertainty and instability hides below the surface. Behind the stable grain market are China's years of production's increase and increasing reserves investment. Grain prices in China market have a considerable potential fluctuation. Some problems exist in China's grain purchase and reserve system, such as unbalance of grain reserve structure. Conflicts of interest of decision-making bodies of different levels may easily pop up due to different goals. There is lack of transparency in information of aggregate grain reserve and supervision and inspection mechanism for grain purchase and reserve needs implementation. All factors mentioned above will lead to instability in future China's grain market operations. Despite China's grain market reform advancing step by step, with the complete opening of the grain purchasing market since 2004, because of the excessive political intervention formed under the traditional planned purchase system, the inertia is difficult to be eliminated in a short time. The deformed cycle of the grain market cannot be resolved in a short time. Once in the future, China is impacted by internal and external environments (such as the impact of disasters, international food fluctuation), it is more likely that larger crisis will take place. Therefore, China can't lower our ground for the short-term food prices stability, and besides speeding marketization, improving mechanism of grain purchase and reserved as well as price mechanism, the government should make full use of social forces tailored to national grain purchase and reserve enterprises, enlarge purchase and reserve channels, accelerate and improve the market-oriented grain reserve mechanism capable of dealing with all kinds of internal and external impact, form complementary multi-level security system, realize compatibility and consistency of policy goal and means.

In the future, China's grain total demand is increasing for a long period of time. The stability of the grain supply and demand will directly determine the stability of grain markets. Many studies show that in the future

national food demand will experience a rigid growth, with the overall in tight state of equilibrium. By 2020, China's grain total demand will increase from 530 million tons in 2007 to 570-600 million tons. Therefore, in terms of the long-term growth of demand for food or inflationary pressure confronting China, China's grain prices in quite long period of time will keep a rising trend. As a consequence, China's macroeconomic regulation and control goal should be the stable moderate growth of food prices, avoiding dramatic ups and downs. Despite the current stability of China's food prices and small fluctuation, the price guarantee system should be improved, without too much dependence on the state and the government's administrative power. Food, as national strategic resource products, shall be addressed by different means from other agricultural special policy in certain conditions, for example, regulating the total supply by specific grain reserve policies and import and export adjustment. (KeBingsheng, 1998). But the government macro-control cannot simply be understood as government intervention in market. We shouldn't try to intervene in market when it comes to agricultural macroeconomic regulation and control. We should control the government's improper intervention, because frequent government interventions lead to further amplification of market fluctuation. In the area of macroeconomic regulation and control, we should distinguish grain control from that of other kinds of agricultural products, namely the policy that corresponding price intervention and price guide policy should be taken according to the specific species. In the past, the classification of China's agricultural products is made only according to the natural attributes, not economic attributes. Therefore, when some agricultural prices are fluctuating, frequent price control escalates the fluctuation to some extent. The governments' measures or intervention policy don't fundamentally level the fluctuation, causing the market "fluctuation expectation", attracting more social idle funds to hype, thus leaving the market more unstable

## SUMMERY AND CONCLUSION

The issue of the stability of China's grain prices has been of interest for years. Recently, the three main influencing factors of China's grain prices—the grain supply and demand, the international shock and Chinese government's intervention all experience some new changes, which may bring some structural changes for the volatility characteristics of China's grain prices. In this paper, we use the classical regime switching models and the structural break model to analyze the volatility of China's grain prices more precisely. We find that China's domestic grain prices have been stabilized and been transformed from a stage of "low level, high volatility" stage to a "high level, low volatility" stage in early 2004. In the long run, prices of rice, wheat, corn will long belong to low-growth regime, with the time span less than 15% in high-growth regime. The minimum price system may play a crucial role in smoothing the grain price fluctuations. On the one hand, it directly influences the grain fluctuation range through limiting price downward range; on the other hand, the government can expand the grain purchasing body and change market structure to influence farmers' production expectation and improve the food production, thus fundamentally increasing the food supply, stabilizing grain market. Also the semi-separation of domestic and international grain market offset part of the international shock, which contributes to the stabilization of grain price. But in recent years, with tendency of rising food prices stabilized, the unsustainability of regulation and control is also very significant. Therefore, the government should further speed up the reform of grain circulation system, expand the range for grain purchasing, speed up the legislation of grain circulation and market, finally ensure healthy steady development through the institutionalization, marketization, coupled with the government's moderate supervision and control.

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# Figures and Tables

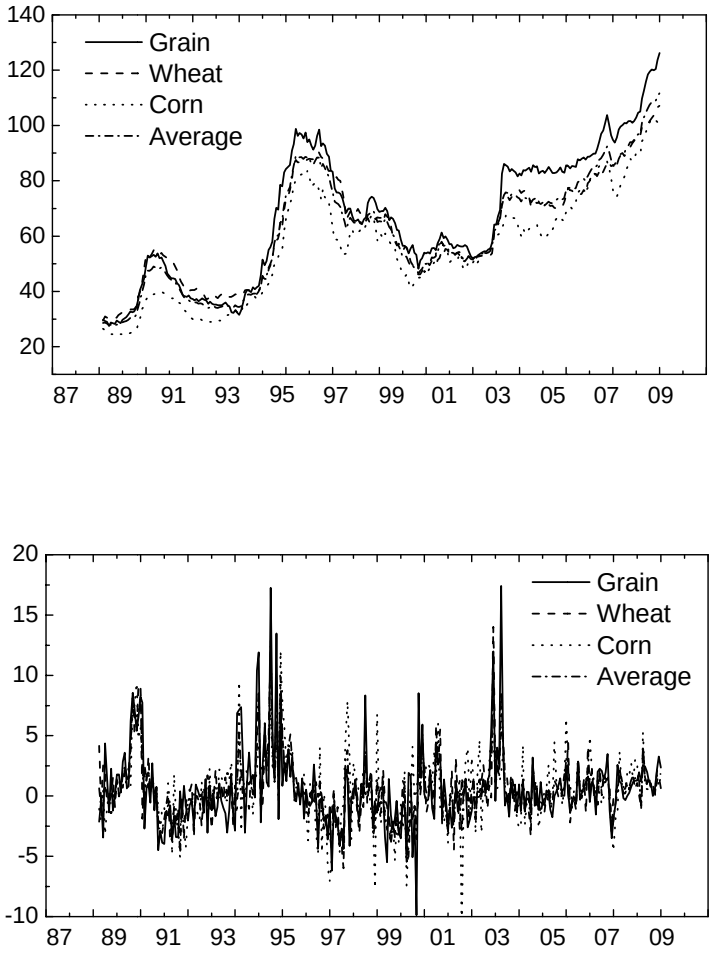



**Figure 1 Monthly Price and Growth Rate of Three Kinds of Grain**

**Note**: 1. The above figure shows the average price for rice, wheat, corn ,unit RMB/50kg;

2. The below figure shows monthly quarter-on-quarter growth rate after seasonal adjustment.

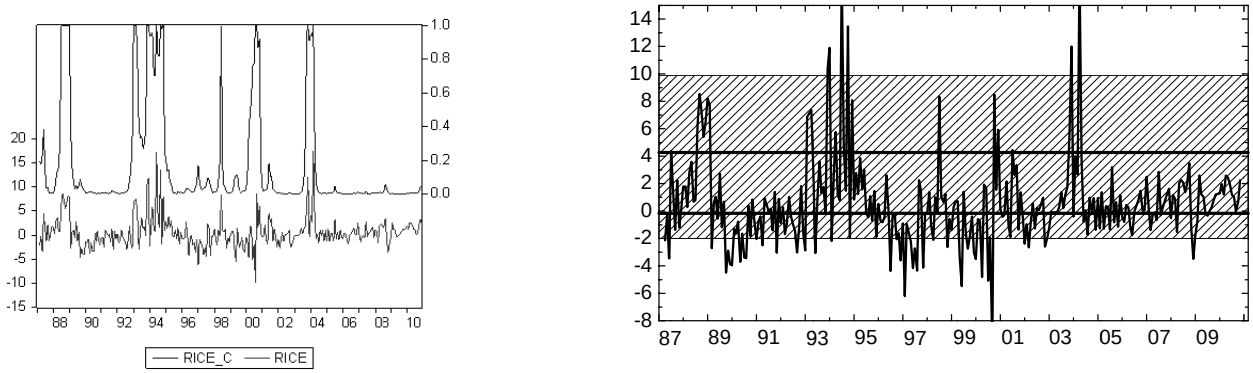



**Figure 2 Rice's Traditional Model**

**Note**: 1.The curve below the left figure shows the monthly growth rate while the curve above the figure shows the probability of the

high-growth regime;

2.Two solid lines of the right figure shows the potential growth rate of low and high regime with the shade representing the range of fluctuation variance.

3.Figure 3,figure 4,figure 5 are similar.

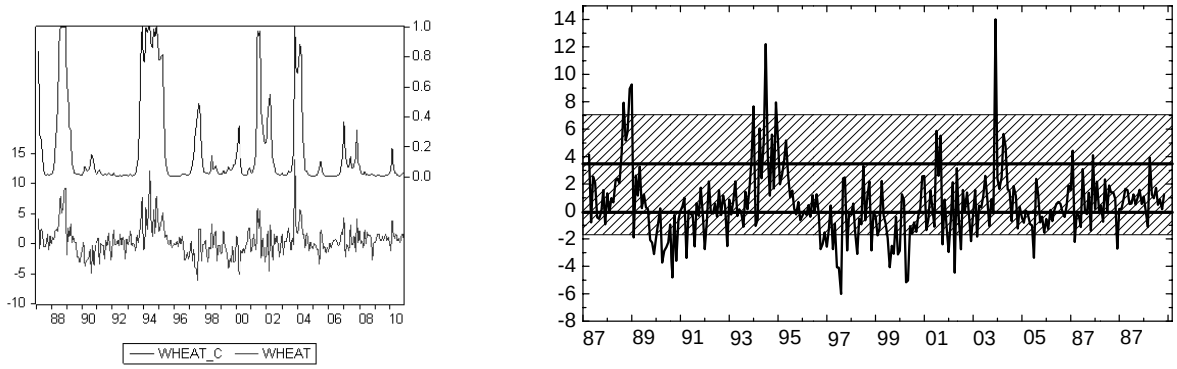



**Figure 3 Wheat's Traditional Model**

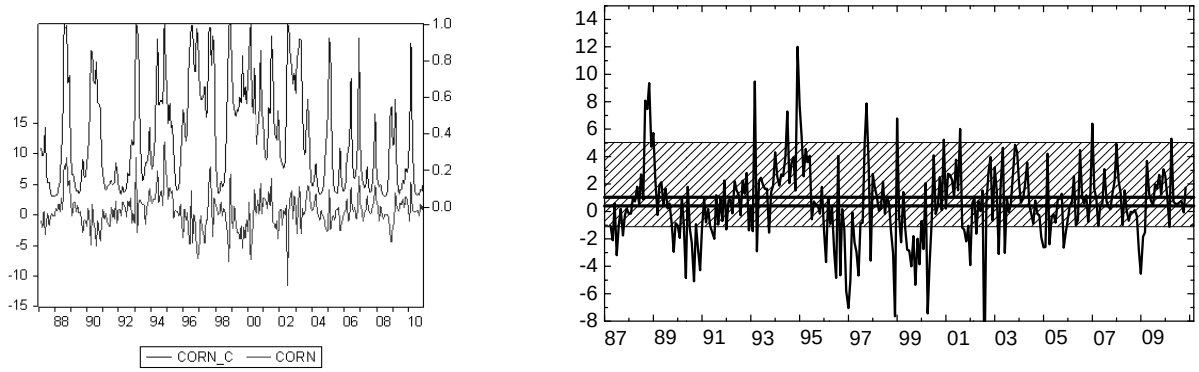



**Figure 4 Corn's Traditional Model**

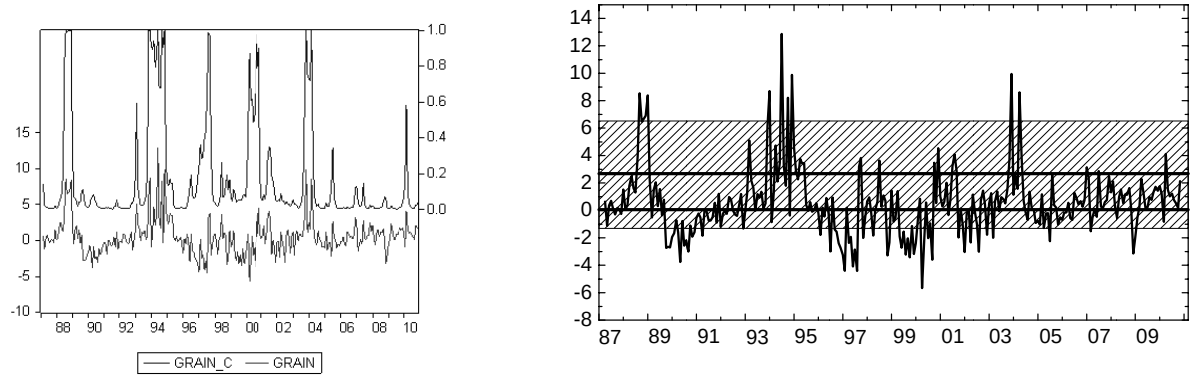



**Figure 5 Average Traditional Model of the Three Kinds of Grain**

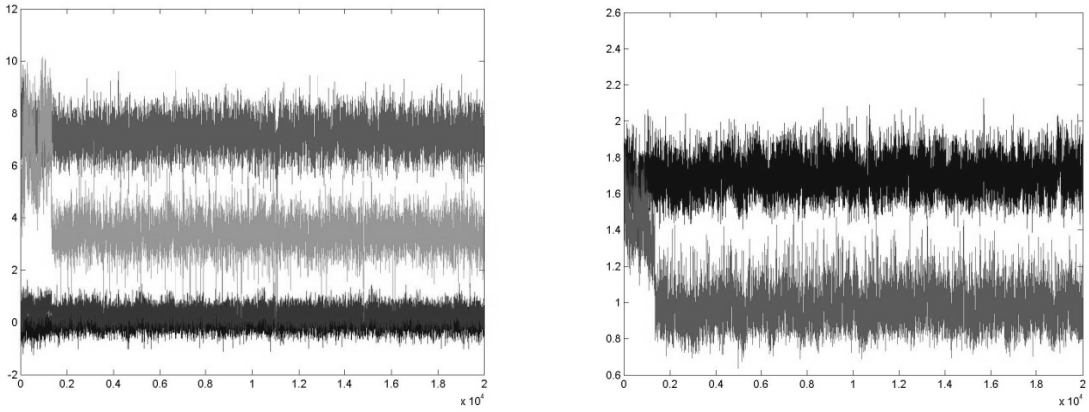
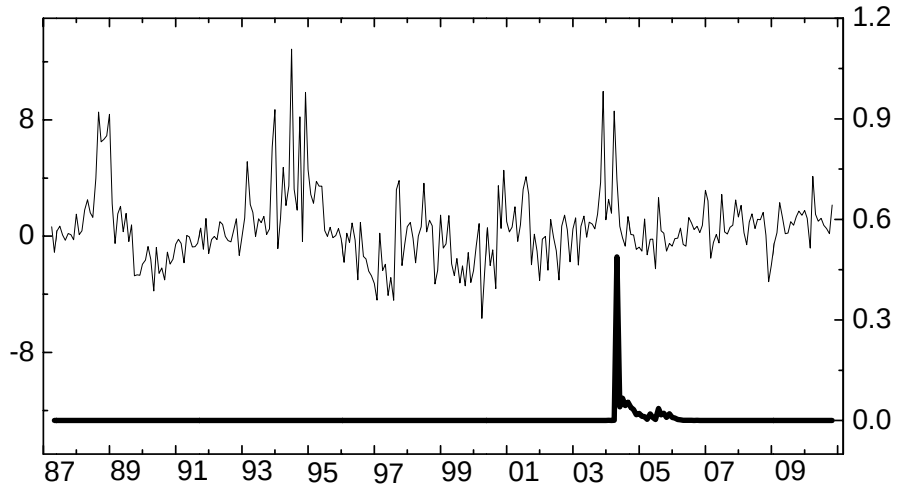


**Figure 6 The Parameter Sampling Process of Structural Breaking Model**

**Note:** The sampling process of the potential growth rate parameters $\mu_0$, $\mu_1$, $\mu_0$*, $\mu_1$* are on the left; the sampling process of the fluctuation variance $\sigma_0$, $\sigma_1$ are on the right; the sampling process has lasted for 20000 times and 5000 times before are discarded in parameter statistics to ensure the stability of the results.



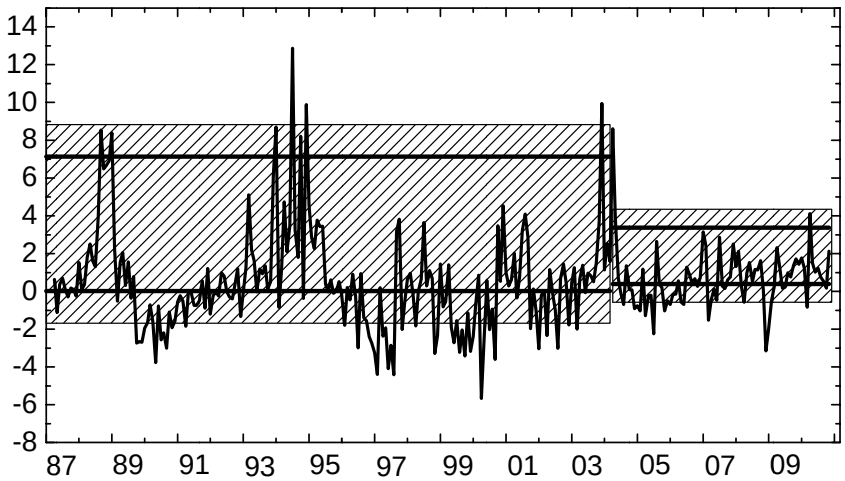



**Figure 7 The Structural Breaking Model of the Kinds Of Grain**

**Note:** The above figure shows the probability of stabilizing breaking. The following figure shows that the solid lines stand for the potential growth rate of high and low growth regime in different fluctuation stages. The shady represents the fluctuation variance range.

**Table 1 The Analysis Result of Classic Markov Regime Switching Model of Rice Price (1987-2010）**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quntile |
|---|---|---|---|---|---|---|
| φ | 0.059 | 0.243 | 0.144 | 0.167 | 0.337 | 0.059 |
| $\mu_0$ | 0.163 | 0.156 | 0.421 | -0.362 | -0.107 | 0.163 |
| $\mu_1$ | 1.317 | 4.230 | 2.167 | 2.615 | 6.496 | 1.317 |
| $\sigma_0$ | 0.098 | 1.792 | 1.627 | 1.662 | 1.952 | 0.098 |
| $\sigma_1$ | 0.656 | 5.582 | 4.675 | 4.862 | 6.806 | 0.656 |
| p | 0.017 | 0.962 | 0.927 | 0.936 | 0.982 | 0.017 |
| q | 0.082 | 0.804 | 0.637 | 0.679 | 0.906 | 0.082 |

**Note:** 1.$\mu_0$ and $\mu_1$stand stand for potential growth rates of high and low growth regimes.

2.$\sigma_0$ and $\sigma_1$ stand for the fluctuation variance of high and low growth regimes. Table 2, table3 and table 4 are similar.

**Table 2 The Analysis Result of Classic Markov Regime Switching Model of Wheat Price（1987-2010）**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|
| φ | 0.243 | 0.084 | 0.244 | 0.108 | 0.136 | 0.382 |
| μ0 | 0.064 | 0.163 | 0.069 | -0.323 | -0.269 | 0.225 |
| μ1 | 3.478 | 1.337 | 3.548 | 1.189 | 1.576 | 5.570 |
| σ0 | 1.643 | 0.142 | 1.658 | 1.361 | 1.430 | 1.851 |
| σ1 | 3.585 | 0.490 | 3.555 | 2.824 | 2.978 | 4.427 |
| p | 0.956 | 0.028 | 0.963 | 0.892 | 0.914 | 0.986 |
| q | 0.789 | 0.093 | 0.804 | 0.613 | 0.663 | 0.911 |

Note：similar to table 1

**Table 3 The Analysis Result of Classic Markov Regime Switching Model of Corn Price（1987-2010）**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|
| φ | 0.383 | 0.073 | 0.383 | 0.264 | 0.290 | 0.498 |
| $\mu_0$ | 0.401 | 0.227 | 0.406 | 0.017 | 0.112 | 0.773 |
| $\mu_1$ | 1.039 | 0.523 | 0.926 | 0.386 | 0.493 | 2.038 |
| $\sigma_0$ | 1.523 | 0.233 | 1.520 | 1.156 | 1.226 | 1.910 |
| $\sigma_1$ | 3.980 | 0.556 | 3.869 | 3.290 | 3.385 | 5.010 |
| p | 0.832 | 0.071 | 0.841 | 0.698 | 0.734 | 0.928 |
| q | 0.724 | 0.123 | 0.746 | 0.508 | 0.566 | 0.888 |

**Note:** similar to table 1

**Table 4 The Analysis Result of Classic Markov Regime Switching Model of Average Price（1987-2010）**

| | Average | Standard variance | Median | 5% quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|
| φ | 0.475 | 0.057 | 0.476 | 0.386 | 0.405 | 0.572 |
| $\mu_0$ | 0.046 | 0.182 | 0.041 | -0.248 | -0.185 | 0.355 |
| $\mu_1$ | 2.694 | 1.227 | 2.575 | 1.004 | 1.303 | 5.882 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $\sigma_0$ | 1.356 | 0.096 | 1.357 | 1.183 | 1.226 | 1.524 |
| σ1 | 3.824 | 0.565 | 3.819 | 2.681 | 3.123 | 4.684 |
| p | 0.943 | 0.027 | 0.948 | 0.885 | 0.901 | 0.978 |
| q | 0.725 | 0.123 | 0.748 | 0.442 | 0.534 | 0.882 |

**Note**：similar to table 1

**Table 5 Fluctuation Range of China'S Grain Prices (1987-2000)**

| Kind | Potential Growth Rates of Low Growth (%) | Potential Growth Rates of High Growth(%) | Fluctuation Variance of Low Growth (%) | Fluctuation Variance of High Growth (%) |
|---|---|---|---|---|
| Rice | 0.16 | 1.32 | 0.10 | 0.66 |
| Wheat | 0.06 | 3.48 | 1.64 | 3.59 |
| Corn | 0.40 | 1.04 | 1.52 | 3.98 |
| Average | 0.05 | 2.69 | 1.36 | 3.82 |

**Table 6 The Analysis Result of Classic Markov Regime Switching Model of Average Price（1987-2010）**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|
| φ | 0.551 | 0.058 | 0.552 | 0.450 | 0.473 | 0.647 |
| $\mu_0$ | 0.008 | 0.274 | 0.006 | -0.452 | -0.350 | 0.447 |
| $\mu_1$ | 7.173 | 0.597 | 7.171 | 6.186 | 6.406 | 8.161 |
| $\mu_0$* | 0.361 | 0.268 | 0.358 | -0.068 | 0.032 | 0.834 |
| $\mu_1$* | 3.365 | 0.590 | 3.376 | 2.474 | 2.701 | 5.829 |
| $\sigma_0$ | 1.700 | 0.094 | 1.695 | 1.546 | 1.575 | 1.860 |
| $\sigma_1$ | 0.976 | 0.107 | 0.965 | 0.823 | 0.851 | 1.345 |
| p | 0.947 | 0.015 | 0.948 | 0.921 | 0.928 | 0.971 |
| q | 0.385 | 0.108 | 0.381 | 0.213 | 0.246 | 0.571 |
| d | 0.991 | 0.007 | 0.992 | 0.977 | 0.981 | 0.998 |

**Note**：1.$\mu_0$ and $\mu_1$ stand for potential growth rates of high and low growth regimes before the breaking point

2.$\mu^*_0$ and $\mu^*_1$ stand for potential growth rates of high and low growth regimes after breaking point

**Table 7. Testing Results of Stability (Same Potential Growth Rate and Different Fluctuation Variances)**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|
| φ | 0.515 | 0.058 | 0.516 | 0.418 | 0.441 | 0.609 |
| μ0 | 0.248 | 0.196 | 0.250 | -0.071 | 0.000 | 0.567 |
| μ1 | 7.219 | 0.634 | 7.251 | 6.146 | 6.404 | 8.227 |
| μ0*（=μ0） | 0.248 | 0.196 | 0.250 | -0.071 | 0.000 | 0.567 |
| μ1*（=μ1） | 7.219 | 0.634 | 7.251 | 6.146 | 6.404 | 8.227 |
| σ0 | 1.672 | 0.093 | 1.667 | 1.530 | 1.559 | 1.837 |
| σ1 | 1.255 | 0.133 | 1.249 | 1.053 | 1.096 | 1.482 |
| p | 0.964 | 0.012 | 0.965 | 0.941 | 0.947 | 0.981 |
| q | 0.420 | 0.121 | 0.416 | 0.224 | 0.263 | 0.625 |
| d | 0.991 | 0.007 | 0.992 | 0.977 | 0.981 | 0.998 |

**Table 8 . Testing Results of Stability (Different Growth Rates and Same Fluctuation Variance)**

| | Average | Standard variance | Median | 5%quantile | 10%quantile | 95%quantile |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| φ | 0.522 | 0.086 | 0.522 | 0.385 | 0.416 | 0.676 |
| μ0 | 0.224 | 0.516 | 0.185 | -0.552 | -0.389 | 1.232 |
| μ1 | 6.770 | 2.812 | 7.493 | 0.934 | 1.773 | 10.616 |
| μ0* | 0.466 | 0.528 | 0.466 | -0.405 | -0.187 | 1.386 |
| μ1* | 3.987 | 3.170 | 3.193 | 0.101 | 0.431 | 9.731 |
| σ0 | 2.579 | 0.417 | 2.495 | 2.060 | 2.133 | 3.405 |
| σ1（=σ0） | 2.579 | 0.417 | 2.495 | 2.060 | 2.133 | 3.405 |
| p | 0.960 | 0.066 | 0.972 | 0.916 | 0.943 | 0.994 |
| q | 0.333 | 0.205 | 0.322 | 0.034 | 0.063 | 0.692 |
| d | 0.987 | 0.009 | 0.989 | 0.969 | 0.975 | 0.998 |

**Table 9 The Contrast Between Grain Minimum Purchase Price and Traditional Protective Price**

| | Grain Minimum Purchase Price | Grain Protective Price |
|---|---|---|
| the essence of price | free purchasing price, diversifying purchasing bodies, perfectly competitive purchasing market | government setting prices and monopoly of state-own purchasing enterprises |
| main executive body of price implementation | According to price executive plans, governments ask state-own purchasing enterprises that exert the influence of main channels | All state-own enterprises and other grain enterprises with the purchase qualification |
| the scope and time of implementation | When the price of rice in main producing areas is lower than the minimum purchase price issued by government, several enterprises entrusted by government purchase grain in markets | Without the limit of time and place, purchasing must be free in the protective ranges |
| the efficiency of price supporting policy | Grain price mechanism is formed by market. Use markets to allocate grain resource. Guide farmers to plant grain by price and subside farmers directly | Extreme asymmetry between government subsidies and farmers' rising income, serious losses of government efficiency |

**Material Source**: Zhou Xuezhong (2005), The difference between grain minimum purchase price and protective price, *Grain Issues Research*, Vol.1

**Table 10 International Grain Price Volatility**

| | **wheat** | | **rice** | | **corn** | |
|---|---|---|---|---|---|---|
| | Average | Standard Variance | Average | Standard Variance | Average | Standard Variance |
| φ | 0.214 | 0.078 | 0.153 | 0.042 | -0.012 | 0.04 |
| μ0 | -0.156 | 0.477 | 0.062 | 0.074 | 0.096 | 0.129 |
| μ1 | 1.632 | 1.119 | 1.422 | 0.687 | 0.48 | 0.228 |
| σ0 | 3.319 | 0.402 | 1.348 | 0.077 | 2.443 | 0.138 |
| σ1 | 8.612 | 0.916 | 5.668 | 0.584 | 4.706 | 0.249 |
| p | 0.886 | 0.058 | 0.95 | 0.017 | 0.978 | 0.012 |
| q | 0.854 | 0.072 | 0.705 | 0.073 | 0.975 | 0.017 |
| year of the structural break | 2007 | | 2008 | | 2006 | |