Does biomass energy development affect the price fluctuation of international agricultural products?

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Abstract

The price fluctuation of international agricultural products, especially the continuous rising of that, slows down the global economic recovery. In case that measures to control the price of food are not taken in each country, food crisis like the one happened in 2007-2008 would burst out more and more frequently. Based on the related studies, this paper found by building an econometric model that: 1. the uppermost factor that affecting the price fluctuation of the international agricultural products is the change in structure of supply and demand in the global leading market of agricultural products which is caused by the development of the biomass energy; 2. the domestic economic changes in United States do not affect the price fluctuation of the international agricultural products.

Keywords: Price of international agricultural products; Fluctuation; Biomass energy

1 Introduction

International food price index had been relatively steady before 2007, however, from 2007 to 2008, the international food price went through a sharp fluctuation. The food price index had increased by 67.63% from Jan. 2007 to June 2008, while the rise in grain price had been more dramatic, for example, the global grain price index published by FAQ in Apr. 2007 was 141.2, however, it had increased to 267.8 by Mar. 2008, with a growth rate reaching up to 89.6%.After that, although the international food price index fell down a little, it still remained at a relatively high level. The food price index in May 2014 reached up to 207.8, with a rise of 92% compared to the one in Jan. 1990, as shown in Fig. 1. The fluctuation in global food price, especially the continuous increasing, results in sharp rise of agricultural price in poor population and imposes great threats upon food security in developing countries and worsens the global economic recovery at the same time. FAQ warns in case that measures that to control food price are not taken in each country, food crisis like the one happened in 2007-2008 would burst out more and more frequently. In addition, Fig. 1also shows that international food price fluctuation was relatively flat before 2005 and then became dramatic afterwards. This changing point of food price fluctuation is just in consistent with the large scale development of biomass energy in international from 2005, meanwhile, there are researches which show development of biomass energy boosts demands of agricultural products and leads to rise of price of agricultural products, which in turn leads to price fluctuation of international agricultural products.

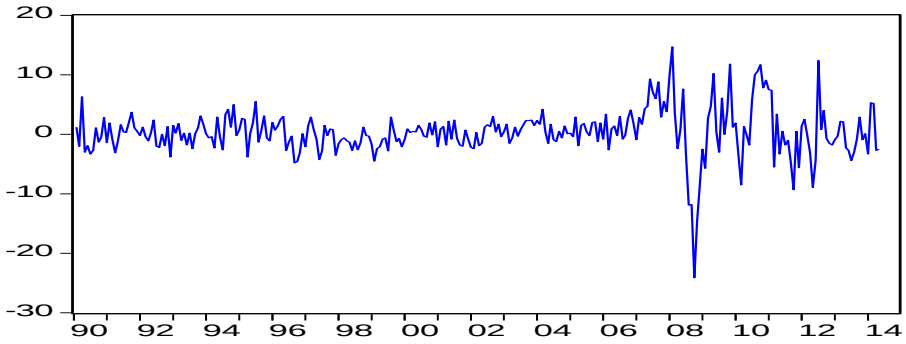

FIGURE 1 Fluctuation chart of international food price index

In China, confronted with the declination of domestic economic growth, economic transition and rigorous reform, Primer Li Keqiang has emphasized to encourage the modernized agricultural reform and to strengthen agricultural support and protection policy in his speeches many times. Furthermore, he stressed "solidifying and strengthening the foundational position of agriculture", "readjusting the agricultural structure based on market orientation" and "promoting the stable agricultural development and the sustainable increase in income of the

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farmers" in 2013 working report again and again. In such a context, it is very necessary to make an all-round analysis of the influencing factors of price fluctuation of international agricultural products.

2 Literature review

There has been some common conclusions that got by domestic scholars, which are: 1. The development of biomass energy has increased demand for international agricultural products to a large extent, resulting in great changes in basic pattern of supply and demand of the agricultural products [1-6]; 2. The rapid economic growth in developing countries such as China, Brazil and India stimulates increase in demand for global agricultural products [7-8]; 3. The rise in cost of agricultural production, which caused by the rise of oil price, directly results in rise of agricultural products price [3,9]; 4. Controllment over food market by the MNCs and participation and speculation in trade of agricultural products enlarge the demand for the agricultural products [4,10]; 5. Unique factors which affect agricultural products, such as the frequent natural hazards and the variation in production cycle, cut down the supply of the agricultural products in each country, thus leading to the international agricultural inventory falls down obviously [2,11].

There are abundant studies on price fluctuation of international agricultural products. Rosen [12] pointed out that the price of agricultural products could not be predicted in a short term. USDA-ERS established a food security model and specifically analyzed the numerical values of food aid. Deressa & Hansan [13] and Zerihun G. Kelbore [14] held that the influence of climatic factor was more obvious and agricultural output was linearly related to temperature and precipitation. Robles et al [15] found in their study that speculation factor was another important factor that affecting the fluctuation. Aldona Zawojska [16] pointed out that it was just the capital transferred into the field of the agricultural products by the investors that brought about the fluctuation in price of agricultural products. Dawe [17] held that policy orientation significantly affected price tendency of agricultural products. Trostle [18] held that very great uncertainty would exist in international market of agricultural products in coming future, the price of agricultural products would fall down in some regions in a short term, however, it would continuously rise in a middle and long term. Westcott [19] held that the development of biomass energy would cut down the direct payment for agriculture by U.S. government and increase the price of the farm land in U.S.A; Coyle [20] held that the current biomass energy technology was of poor efficiency due to great waste in production; Tokgoz [21] discussed the effects of development of biomass energy on agriculture in Europe and found that the continuous development of the biomass energy with the continuous rise in oil price would affect the grain price in Europe. Ubilava & Holt [22] found that the price of agricultural products would be more and more linked up with the oil price while the fluctuation in energy price would be transferred to the market of the agricultural products.

In conclusion, in terms of the existed researches, most studies, based on the reason of price fluctuation, stressed the influence arising from the price fluctuation of agricultural products, then predicted the long-term tendency of agricultural products price in the future and put forward corresponding policy suggestions. However, there are differences of these studies, mainly lie in two aspects: 1. regarding scope of the studies, some studies focus on the effects of price fluctuation of agricultural products on global economy while others focus on the effects on regional economy; 2. with respect to specific technical details, research conclusions are different. The contribution of this paper is that we quantitatively analyzed the effects of various factors on price fluctuation of international agricultural products and laid stress on the effects of the biomass energy development on the fluctuation.

3 Main influencing factors of price fluctuation of international agricultural products

Based on the relevant literatures at home and abroad, it can be found that reasons for rise in international agricultural products price are basically consistent: the first one is the "structural" factor which affects price fluctuation of international agricultural products in a middle and long term, including population growth, economic development, biomass energy development and technical advance, especially the biomass energy development. The second one is factor which affects fluctuation in price of international agricultural products in short term. This paper will analyze the main influencing factors of price fluctuation of international agricultural products from these two aspects.

3.1 LONG-TERM FACTOR

Viewed from the middle and long-term influencing factors of price fluctuation of agricultural products, on one hand, the increase in food consumption and the upgrading of consumption structure bring about the increase in food demand; on the other hand, the rapid development of meatpacking industry with the primary agricultural products as the raw materials brings about rapid expansion of demand for related agricultural products. Among them, effects from the development of biomass energy are most far-reaching. In terms of the current conditions, the developed countries and regions (such as USA and EU) and the agricultural products exporting countries (such as Brazil) enthuse over the development of biomass energy because 1.In the context of given global energy inventory, the rise in oil price caused by the increase in global energy consumption trends to be extraordinary day by day; 2. Viewed from the trade, the developed countries are not obligated to export the food or "raise" the whole world; 3. Besides the economic considerations, in view of the politics and balancing the demands of the interest groups in developed countries, it becomes a good policy choice to develop biomass energy.

It can be seen that the main structural factors (P_{argi}) affecting the agricultural products include population growth (P_{op}), economic development (E_{co}) and biomass energy development (B_{io}), among which the foremost influencing factor is the development of biomass energy while an important influencing factor of the biomass energy development is oil price (P_{oil}). In like manner, oil price is affected by population growth and economic development. Therefore, this paper adopts oil price as a proxy variable of population growth and economic development, together with the factor of biomass energy development.

Then, hypothesis I of this study is: due to the development of biomass energy, the relationship between the agricultural department and the energy department is becoming more and more close, as a result, the energy price will more significantly affect the price of agricultural products.

3.2 SHORT-TERM FACTOR

As to the short-term influencing factor, this paper mainly takes into account the effects of exchange rate of USD on the price of agricultural products because: 1. in the global products trade, the price is in USD. 2. USA is the largest exporting country of agricultural products in the world, so the variation in domestic supply and demand will affect the price of international agricultural products to a certain extent. Further, in case that the effects of the exchange rate of USD on the price of global agricultural products are analyzed just based on the change in exchange rate of USD to the main trading countries, the deviation may appear because:1.the effects of the change in exchange rate caused by the change in terms of trade on the price of agricultural products cannot be taken into account; meanwhile, due to great differences in change of exchange rate of USD to the currencies in other countries, it is difficult to quantize the effects.2.the change in exchange rate is not simply determined by the trade. In addition, due to engagement of the trade contract on international agricultural products, the change in exchange rate has a relatively limited effect on the trade of agricultural products in a short term. In order to consider the effects of the exchange rate of USD in an all-round way, it is necessary to analyze the influencing factors of the exchange rate of USD. Generally, the exchange rate of USD is mainly affected by the domestic supply of money, international balance of payments and national debt of USA.

In a short term, the price of international agricultural products is affected by the exchange rate of USD (Exusd) while the exchange rate of USD is affected by domestic supply of money (M2) and international balance of payments (BOP) of USA. Meanwhile, as to the short-term price fluctuation of agricultural products, it is necessary to take into account the effects of domestic consumer price index (CPI) in USA.

Based on the above-mentioned analysis, hypothesis II of this study is: viewed from the short-term, the global commodity price is in USD, so the economic change in USA will affect the international commodity price.

4 Variables, data and model results

4.1 VARIABLES

In order to verify the above mentioned hypothesis I and II, this study, with the price of international agricultural price as the dependent variable, the international oil price, international biomass energy development, balance of international trade of USA, domestic supply of money of USA and domestic consumer price index of USA as the independent variables, establish the model for the above-mentioned variables to affirm the relationship between the price of international agricultural products and the related influencing factors, among which, the price of international agricultural products is the logarithm of the international food price index of IMF, international oil price is the logarithm of the international oil price index of IMF and the development of international biomass energy is indicated by the pseudo-variable. Based on the global development of biomass energy, this study selects the time pseudo-variables by the end of Jan. 2005. In addition, these three variables, including domestic supply of money in USA, balance of international trade in USA and domestic consumer price index in USA, are used to reflect the effects on the economic changes in USA on the price of international agricultural products. Among them, the data about domestic supply of money in USA are from the Federal Reserve Board; the difference of first order of the logarithm of domestic supply of money in USA indicates the speed of growth of the supply of money in USA, which is used to examine the effects of the monetary policy of USA on the price of international agricultural price. The data about the balance of trade in USA are from the U.S. Census Bureau and the processing method of the data about the balance of trade after taking the absolute value is consistent with the one of the supply of money, which is used to validate the effects of the trade policy of USA on the price of international agricultural products. The data about domestic consumer price index in USA are from the United States Department of The Treasury, which is used to test the effects of the overall economy in USA on the price of the international agricultural products.

4.2 DATA

The foregoing variables are the monthly data from Jan. 1990 to May 2015, totaling 293 observation samples. Before modeling, it is necessary to make the stationarity test on the time series data. With ADF testing method in this paper, the results indicate that each variable series is the stationary series (see Table 1).

TABLE 1 Variable declaration and inspection

Variable	Meaning of variable	Unit	ADF test
Ln(P_{argi})	International food price index	100 on average in 2005	Stationary
Ln(P_{oil})	International oil price index	100 on average in 2005	Stationary
D1	Time pseudo-variable	1 after Jan. 2005 and 0 before Jan. 2005	—
D(Ln(M2))	Domestic supply of money in USA	USD 1 billion	Stationary
D(Ln(ABS(BOP)))	Balance of international trade in USA	USD 1 billion	Stationary
CPI	Domestic consumer price index in USA	%	Stationary

Note: Ln denotes the natural logarithm of the variable, D denotes the difference of first order and ABS refers to the absolute value.

4.3 MODEL RESULTS

This paper established the linear regression model with the ordinary least square method (OLS), among which Scheme I just considered the effects of change in international oil price on price fluctuation of agricultural products; Scheme II, based on Scheme I, considered the effects of biomass energy development since 2005 and analyzed the different effects before and after the boundary point with the interaction between the pseudo-variable and the oil price; Scheme III, based on Scheme I, considered the effects of two factors including the domestic supply of money in USA and the change in adverse trade balance; Scheme IV, based on Scheme III, considers the effects of the price variation in USA on the fluctuation in price of the international agricultural products again; Scheme V is an entire variable scheme. See Table 2 for the estimated result of the specific model.

Since the variables adopted in this paper are the stationary data of time series, the Engle-Granger two-step procedure was applied to carry out the stationarity test on each regression residual. Scheme III and IV do not pass the stationarity test at the significance level of 10% while Scheme I, II and V pass the stationarity test. According to the judgment of Engle-Granger two-step procedure, it represents the long-term stable relationship among the variables.

TABLE 2 Estimated results of the model

	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Ln(P_{oil})	0.057^{***}	0.081^{***}	0.146^{***}	0.145^{***}	0.044^{***}
D_1	—	-2.059^{***}	—	—	-2.011^{***}
D_1* Ln(P_{oil})	—	0.467^{***}	—	—	0.438^{***}
D(Ln(M2))	—	—	-1.837	-1.565	0.817
D(Ln(ABS(BOP)))	—	—	-0.021	-0.029	—
CPI	—	—	—	0.031	0.079^{***}
Intercept	4.391^{***}	4.327^{***}	4.031^{***}	4.021^{***}	4.401^{***}
Residual test with ADF	-13.307^{***}	-2.681^{*}	-2.182	-1.933	-3.025^{**}
F	5146.475^{***}	14000.560^{***}	34.802^{***}	26.578^{***}	14600.320^{***}

Note: * denotes the significance at the significance level of 10%, ** denotes the significance at the significance level of 5% and *** denotes the significance at the significance level of 1%. The one in the bracket refers to the test value of t.

It is shown by the results in Scheme I, II and V that coefficient of international oil price as a variable is significant positive, however, with the biomass energy development and economic growth in USA, significant changes in the coefficient between the international oil price and agricultural products price has taken place. Among them, based on the results in Scheme I, since that the effects of the time pseudo-variable is not taken into account, that is to say, the effect of the biomass energy development on the price of agricultural products is not taken into account, although the oil price is closely related to the price of agricultural products, the effects of the oil price on the agricultural products are relatively limited, specifically speaking, every time when the oil price rises by 100%, the price of agricultural products rises by 6.3%.

Further, based on Scheme II, Year 2005 is regarded as a boundary of biomass energy development, that is to say, considering the development of biomass energy changes the basic structure of the market supply and demand of the international agricultural products, results in the effects of the variation in the global oil price on price fluctuation of agricultural products, obviously, development of biomass energy drives the fluctuation in price of the international agricultural products to a large extent. Specifically speaking, the elasticity of the fluctuation in oil price to the one in price of the agricultural products was 0.07 before

2005, which implied every time when the international oil price rose by 100%, the price of agricultural products rose by 7%; however, the elasticity of the fluctuation in oil price to the one in price of the agricultural products has been 0.07 plus 0.46, namely the coefficient of interaction item since 2005, at this moment, the elasticity of the fluctuation in international oil price to the one in price of the international agricultural products has been 0.53, implying that every time when the oil price rises by 100%, the price of the international agricultural products will rise by 53%. This conclusion explains the dynamic mechanism for the sudden and sharp rise in price of the global agricultural products before June 2008, and relatively reasonably explains the sharp drop in price of global agricultural products since June 2008 as well. Therefore, Proposition I is proofed.

According to the results in Scheme V, viewed from a short term, the domestic supply of money and adverse balance of trade in USA have no significant effects on the price of international agricultural price and the conclusion that the fluctuation in price of international agricultural products is affected by the economic changes in USA cannot be drawn. Actually, the change in domestic supply of money in USA tends to stably increase, same as the adverse trade balance. Theoretically, if US government increases the supply of money to sedulously reduce the debt burdens, it will inevitably bring on the rise in price of all products including the agricultural products. Therefore, the hypothesis that the price of international agricultural product is affected by the economic change in USA cannot be supported, that is to say, hypothesis II cannot be proofed. In addition, the domestic consumer price index in USA has relatively small effects on the price of the international agricultural products indeed. Every time when the domestic consumer price index in USA rises by 1%, the price of global agricultural products rises by 0.08%, meanwhile, the domestic consumer price index in USA basically fluctuates at 1%, therefore, technically speaking, the effects are not sufficient to bring about price fluctuation of agricultural products to a large extent.

5 Main conclusions and further study direction

Based on the above-mentioned results, the following conclusions can be drawn: 1. The foremost factor affecting the fluctuation in price of the international agricultural products is the change in market supply and demand of the global primary agricultural products caused by the biomass energy development; 2. The domestic economic changes in USA does not affect the fluctuation in price of the international agricultural products. Finally, viewed from the study conclusions, there are some issues for further study: 1. in the condition of open trade, whether the price of international agricultural products is convergent or not in a long term; **2.** Whether the short term price fluctuation of international agricultural products is magnified or not. In like manner, the population and income factors regarding the price fluctuation of the agricultural products are included in one variable in this paper, namely the oil price, however, the delicate analysis has not been made, all of these should be further analyzed.

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