Causes of hiking price of global grain and
tendency prediction in 2014

Xuerui Chen¹, Wanlin Gao¹*, Ping Sun¹, Ganghong Zhang¹, Hui Hu¹

1.Key Laboratory of Agricultural Information Acquisition Technology, Ministry of Agriculture, China
Agriculture University, Beijing 100083, P.R.China

Abstract

The fluctuation of global grain price has been the focus of the global economy, and it is important for countries to catch the
dynamic change of grain price and take appropriate measures to regulate the grain market. This paper put forward that the global
 crude oil price changes were positively correlated with global grain price trends, and the global grain price fluctuations were
 impacted by global grain supply and demand changes. When supply exceeds demand, prices will rise; conversely, when supply is
 less than demand, price will decrease. While using multivariable linear regression model to research the relationship among
cereals, meat, vegetable oil, dairy and sugar of the food price index, we can infer that meat and vegetable oil have greater impact
on cereals. The world’s situation is relatively stable in 2014, on the basis of the tendency of global grain price in the first half,
using SPSS software to fit the curve of price changes over time, the paper predicted the prices of five major grains (maize, rice,
wheat, sorghum and soybeans) in August and September in 2014. And the predicted prices have been proved correct in tendency.

Keywords: Multiple linear regression model, Global grain price, Rise up, Price forecast, SPSS

1 Introduction

Global grain price changes have been the focus of the
global economy, and there is a close link between the
above two. The 2008 international financial crisis, made
a sudden increase in global grain and oil prices, and made
a huge hit to the emerging market of countries with a large
number of import foods. And if the import grain price is
higher than the export grain price, it may make trade
condition worse. In the first half of 2008, the high grain
price caused social unrest in many developing countries,
such as Haiti, Bangladesh, Mexico, Senegal, Mauritania,
Indonesia and Côte d'Ivoire and many other countries. If
these problems become more serious, it might endanger
global peace and security.

The grain price volatility is affected by a variety of
factors, so governments must accurately determine the
main reasons leading to price volatility in different periods,
in order to introduce reasonable policies to stabilize prices.
There are many references of factors affecting global grain
price, and scholars have also analyzed price changes from
multiple angles. The studies most about the global crude oil
prices [1] and the global grain supply and demand [2], also
to analyze. But these are mostly about the global grain
(mainly for maize, rice, wheat, soybeans, belong to cereals,
and sorghum belongs to whole grains) price-related factors
to analyze, while the research on the food price index, like
discussing the relationship among cereals, meat, dairy,
vegetable oil and sugar is really a little. Therefore, this
article is based on nearly 10 years’ changes of global crude
oil prices, global grain supply and demand and the
relationship among cereals, meat, dairy, vegetable oil and
sugar in food price index to analyze the changes in global
grain price, and predict grain price in August and
September in 2014.

There are many models for price predicting and price
volatility factors’ research, such as BP neural network
model [5], gray forecasting model [6] and so on, but taking
into account, the establishment of these models is
complicated, and the majority of models did not fully
consider the factors that affecting the grain price, thus
the results obtained inevitably is biased. This article does not
make model at certain factors, but according to the analysis
of global grain price situation in recent years, and
combined the data integrated in the first half of 2014 to
establish a linear regression model [7] to simple forecast the
grain prices in August and September in 2014.

2 Materials and method

2.1 Global grain price changes in 2000-2014

According to the analysis of Food and Agriculture
Organization (FAO) data, we can get the grain price
changes as shown in Figure 1.
We can analyze from the above chart that since the financial crisis broke out in 2008, countries have to take appropriate measures to stabilize the grain trade market, which makes global grain prices gradually decline. And the grain price is generally stable in 2009-2010. The price trends in 2011-2014 (the first half of 2014): first rise up slightly and then go down slightly, and there is a downward trend in the next period.

2.2 Global crude oil price changes
For people's daily life is closely related to food and crude oil, so we research the relationship between the two, as shown in Figure 2.

By comparison, we find the price trends of two graphs (Figure 1 and Figure 2) shows good consistency. So we can infer that the global crude oil prices have a positive impact on the global grain price changes.\(^8\)

2.3 Global grain supply and demand changes
Analysis at the global grain supply and demand from the Figure 3, we can know that although since 2003, grain supply and demand had increased dramatically, but both generally keep balance, so the grain price did not increase much. However, demand was greater than production since 2006, and until 2009 production was greater than demand. Meanwhile the financial crisis broke out and the grain price was soaring during this period, which means that there is some connection between the grain price and grain supply and demand. From 2009 to 2013, the grain supply and demand kept balance, and the corresponding trend in Figure 1 represented the grain price was relatively stable. And since 2014, the production was greater than the demand, and it could be inferred that grain price should decline, which was also verified in Figure 1. By inference, the next few months in 2014, global grain price should continue to decline until 2015 there may be an upward trend, as shown in Figure 3.
2.4 Food price index analysis

2.4.1 Establish multiple linear regression model
Multiple linear regression models are generally expressed as:

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \] (1)

Note: \( k \) is the number of explanatory variables;
\( \beta_j \) (\( j=1,2,\ldots,k \)) is regression coefficient.

From the food price index [9], we research the relationship among cereals, meat, vegetable oil, dairy and sugar.

From the Figure 4, the cereals price index [10], meat price index, vegetable oil price index and dairy price index show the same trend apart from sugar price index. So we use the multiple linear regression model to research which is the biggest factor affecting the price of cereals.

Make the meat, vegetable oil [11] and dairy as the independent variable, cereals as the dependent variable, using SPSS software for processing and analysis, we can get:

\[ y = -23.297 + 0.649x_1 - 0.051x_2 + 0.652x_3 \] (2)

Note: \( y \) express cereals, \( x_1 \) express meat, \( x_2 \) express dairy, \( x_3 \) express vegetable oil.

2.4.2 Model checking
The table 1 shows that the regression equation can pretty represent the relationship between the cereals and other three factors, and by observing, meat and vegetable oil have relatively large impact on the price index of cereals.
Table 1 Multiple linear regression equation coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>-23.297</td>
<td>17.597</td>
<td>-1.324</td>
</tr>
<tr>
<td></td>
<td>meat</td>
<td>.649</td>
<td>.285</td>
<td>.367</td>
</tr>
<tr>
<td></td>
<td>dairy</td>
<td>-.051</td>
<td>.150</td>
<td>-.048</td>
</tr>
<tr>
<td></td>
<td>vegetables</td>
<td>.652</td>
<td>.150</td>
<td>.679</td>
</tr>
</tbody>
</table>

a. Dependent Variable: cereals

2.5 Price forecast

2.5.1 Price - time equation

Seen from Figure 6, the global grain price remained stable in 2014, so we can analyze the relationship between grain prices and time to predict the price trends for next two months.

Using SPSS software to do various grain price and time curve fitting, and with maize as example, as shown in Figure 7.

By comparison (Figure 8), a cubic equation can pretty describe maize change over time.

Equation: $y = 173.226 + 27.05t - 3.68t^2$ (3)

Similarly, rice change over time equation:

Equation: $y = 452.500 + 20.604t - 13.068t^2 + 1.41t^3$ (4)

Wheat change over time equation:

Equation: $y = 240.293 + 47.976t - 5.767t^2$ (5)

Sorghum change over time equation:

Equation: $y = 204.811 + 13.189t - 1.869t^2$ (6)

Soybeans change over time equation:

Equation: $y = 507571 - 2.393 + 101.69t^2 - 1.41t^3$ (7)
Figure 7 Maize–month curve fitting diagram

<table>
<thead>
<tr>
<th>Equation</th>
<th>R Square</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
<th>Constant</th>
<th>b1</th>
<th>b2</th>
<th>b3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>.121</td>
<td>.681</td>
<td>1</td>
<td>5</td>
<td>.444</td>
<td>217.388</td>
<td>-2.392</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logarithmic</td>
<td>.011</td>
<td>.055</td>
<td>1</td>
<td>5</td>
<td>.824</td>
<td>210.571</td>
<td>-2.259</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inverse</td>
<td>.011</td>
<td>.056</td>
<td>1</td>
<td>5</td>
<td>.822</td>
<td>208.732</td>
<td>-6.161</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadratic</td>
<td>.984</td>
<td>119.362</td>
<td>2</td>
<td>4</td>
<td>.000</td>
<td>173.226</td>
<td>27.050</td>
<td>-3.680</td>
<td></td>
</tr>
<tr>
<td>Cubic</td>
<td>.985</td>
<td>177.922</td>
<td>3</td>
<td>3</td>
<td>.003</td>
<td>177.176</td>
<td>22.551</td>
<td>-3.984</td>
<td>-1.110</td>
</tr>
<tr>
<td>Compound</td>
<td>.132</td>
<td>.759</td>
<td>1</td>
<td>5</td>
<td>.423</td>
<td>217.788</td>
<td>.988</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>.014</td>
<td>.073</td>
<td>1</td>
<td>5</td>
<td>.787</td>
<td>210.614</td>
<td>-0.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>.008</td>
<td>.040</td>
<td>1</td>
<td>5</td>
<td>.849</td>
<td>5.342</td>
<td>-0.021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth</td>
<td>.132</td>
<td>.759</td>
<td>1</td>
<td>5</td>
<td>.423</td>
<td>5.383</td>
<td>-0.012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exponential</td>
<td>.132</td>
<td>.759</td>
<td>1</td>
<td>5</td>
<td>.423</td>
<td>217.768</td>
<td>-0.012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logistic</td>
<td>.132</td>
<td>.759</td>
<td>1</td>
<td>5</td>
<td>.423</td>
<td>0.015</td>
<td>1.012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent variable is month.

Figure 8 Models and parameter estimates

2.5.2 Price–time formula tests and the grain price forecast

The forecast showed by table 2 also can be represented by the graph as follows, as shown in Figure 9–Figure 13.

These figures show that the five equations can pretty characterize the relationship of price change over time, so we can predict grain price in the next two months in this situation, as shown in table 3.
### Table 2  Global grain price's actual values and calculated values comparative analysis of seven months in 2014

<table>
<thead>
<tr>
<th>Month</th>
<th>Maize</th>
<th>Rice</th>
<th>Wheat</th>
<th>Sorghum</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Calculated</td>
<td>Actual</td>
<td>Calculated</td>
<td>Actual</td>
</tr>
<tr>
<td>1</td>
<td>198.42</td>
<td>196.596</td>
<td>456.5</td>
<td>461.453</td>
<td>288</td>
</tr>
<tr>
<td>2</td>
<td>208.85</td>
<td>212.606</td>
<td>465.5</td>
<td>452.772</td>
<td>303.25</td>
</tr>
<tr>
<td></td>
<td>222.14</td>
<td>221.256</td>
<td>430</td>
<td>434.959</td>
<td>333.75</td>
</tr>
<tr>
<td>4</td>
<td>223.99</td>
<td>222.546</td>
<td>408</td>
<td>416.516</td>
<td>339.6</td>
</tr>
<tr>
<td>5</td>
<td>216.97</td>
<td>216.476</td>
<td>408</td>
<td>405.945</td>
<td>345.25</td>
</tr>
<tr>
<td>6</td>
<td>201.96</td>
<td>203.046</td>
<td>418.75</td>
<td>411.748</td>
<td>314</td>
</tr>
<tr>
<td>7</td>
<td>182.41</td>
<td>182.256</td>
<td>438.75</td>
<td>442.427</td>
<td>294.2</td>
</tr>
</tbody>
</table>

![Figure 9 Maize actual and calculated values comparison chart](image1)

![Figure 10 Rice actual and calculated values comparison chart](image2)
Table 3  August and September grain price forecast in 2014 (USD/ton)

<table>
<thead>
<tr>
<th></th>
<th>August</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>154.106</td>
<td>118.596</td>
</tr>
<tr>
<td>Rice</td>
<td>506.484</td>
<td>612.421</td>
</tr>
<tr>
<td>Wheat</td>
<td>255.013</td>
<td>204.95</td>
</tr>
<tr>
<td>Sorghum</td>
<td>190.707</td>
<td>172.123</td>
</tr>
<tr>
<td>Soybeans</td>
<td>416.795</td>
<td>281.086</td>
</tr>
</tbody>
</table>
3 Results and discussion

In this paper, using graphs and multiple linear regression models, intuitively analyzed the global grain price changes and researched the grain price affecting factors. Throughout the analysis process, there are advantages and disadvantages as follows:

Advantages:
(1) With the previous experience, from the global crude oil price changes and the global grain supply and demand changes to analyze, verified that these two factors had a significant impact on the global grain price changes.
(2) Cereals, meat, dairy, vegetable oil and sugar belong to food, so there must be some connections, but scientists rarely studied about it. This paper, using multivariate linear regression model, visually depicted various factors have various impact on cereals.
(3) Using SPSS software [13] to do curve fitting, got price - time expressions, and predicted grain price in August and September in 2014 for reference, avoided the bias of price analysis models that build on certain price impact factors.

Disadvantages:
(1) Due to the limited data collection, this paper is only based on the global crude oil price changes and the global grain supply and demand changes to analyze, there is no specific investigation of other factors’ effects.
(2) Using the curve fitting expressions by SPSS only can predict the grain price in August and September as a reference, because there are many factors that affect the global grain trade market, and the introduction of regulatory policies [14] by different countries, the grain price will fluctuate in the future.

Improvements:
Due to the grain price over several years is undulating and the trend of price change is different in different years, while one year of global grain price generally stable, so we can focus on one year grain price changes to analyze. Combined with the important factors that affected the global grain price changes, to establish a pluralistic model to depict global grain price trends in a year and forecast the price trends in the next months in the year.

4 Conclusion

This paper analyzed the link between global crude oil price changes and the global grain price changes, researched the relationship between global grain price changes and grain supply and demand, and concluded that the global crude oil price changes were positively correlated with global grain prices trends. If supply exceeds demand, prices will rise. And based on the food price index of meat, dairy, vegetable oil and cereals, established multiple linear regression model to analyze, obtained that meat and vegetable oil had a greater impact on cereals price index. And after analysis, we found that the trend in grain price relatively stable in the first half of 2014, so with curve fitting by SPSS and used simple expressions to predict the prices of maize, rice, wheat, sorghum and soybeans in August and September in 2014. And the price trend has been proved correct, which can be found at the latest data of FAO. And the predicted grain price can provide for the relevant departments as reference, to formulate policies and measures to stabilize the global grain price to avoid serious regional hunger and panic by a sharp rise in the price.

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