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The significance of establishing China's hog futures market

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ABSTRACT

With the development and growth of China's agricultural product market, the market's regulation of production, circulation, and consumption has become more and more important, but there have also been some troublesome problems. Mainly due to the ups and downs of market prices, production is rampant in cyclical fluctuations. As far as the hog market is concerned, there is a vicious circle of almost one and a half cycles. The interests of producers and consumers are seriously damaged. In order to protect the interests of producers and consumers, the government has to pay huge sums of money from tight finances every year. In view of this, it is imperative to establish a hog futures market that is in line with China's national conditions. The development of hog futures trading will help stabilize production and consumption, slow down the unreasonable fluctuations in spot prices, and effectively avoid spot price risks. This paper gives a brief introduction to the situation in China's hog market and studies the impact of hog futures on China's hog market. At the end of the article, some suggestions and opinions on the launch of hog futures are put forward.

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Introduction

China is one of the largest pig breeding and consumption countries and pig breeding have great significance in China's agricultural production. Pork takes a huge account in China's meat consumption, thus can generally be regarded as a necessity. However, the cobweb phenomenon is very obvious in China's hog market. The supply and prices of pork are very unstable and are subject to cyclical changes. This phenomenon will cause serious damage to both consumers and farmers.

In recent years, the operation of China's agricultural futures market shows that the futures market can reduce the trade risks efficiently and play the role of price indicators. Moreover, in other foreigner countries, like the US, the futures markets of live pigs, live cattle and other livestock products are very active, providing a great demonstration for China to establish the hog futures market.

Based on the experience of the past market, the prices of products with futures are often more stable than the prices of products without futures. Therefore, it is reasonable to believe that the development of hog futures trading will help stabilize the production and consumption and reduce the unreasonable fluctuations in spot prices.

This essay will demonstrate the current situation of the hog industry in China and analyze the supply and demand of pork from the perspective of economics to find the factors which cause the unstable prices and to find what

the futures trading can do to reduce the impact of these factors. Because there are so many researches about the US hog futures market have prove the success of the US futures market in stabilizing the spot prices of pork. Then this essay will only analyze the Chinese soybean meals (the food of hogs) futures market to predict impact that hog futures will have in China. The reasons that cause the delayed listing of hog futures in China also will be discussed and some suggestions and opinions on the launch of the hog futures will be given in the end.

In conclusion, the essay will demonstrate the significance of hog futures in China. Hopefully, through hog futures trading, the market can avoid spot price risks effectively and farmers and consumers can get benefits as well.

Literature Review

China is one of the largest hog breeding countries. In 2018, the number of live pigs reached 693.82 million. Pork also takes the largest account of meat consumption in China. Among the 900 million farmers in China, 500 million are raising pigs. Pig farming is one of the main sources of income for farmers. Recently, the focus on the changes in pork prices is kept increasing. Chong Zhou (2016) has already pointed out two key factors that impact the pork price in his paper through an empirical analysis of pork prices between 2004 and 2014. One is the internal transmission mechanism of the market, including the cobweb phenomenon existing in the hog industry; Another factor is the impact of external shocks, like the African swine fever virus (ASFV). (ZHOU, 2016)

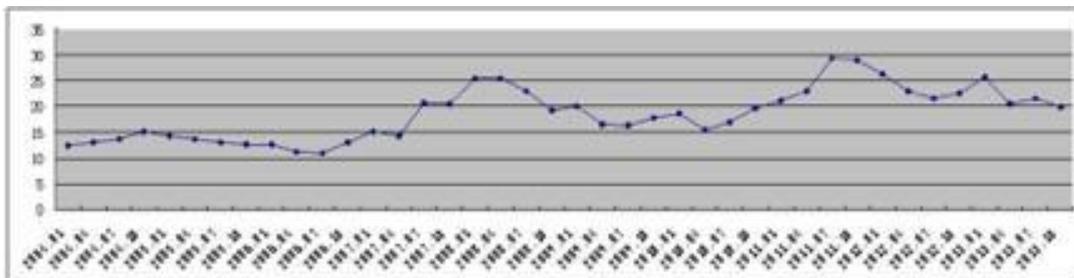


Figure 1: Pork Price Fluctuation during 2004-2013 (Zhou, 2016)

"Cobweb phenomenon" means that the realization of the supply decision-making process takes a certain period time, which leads to a lag in the response of the supply to the price. This phenomenon is particularly evident in the hog market in China. Take the pork prices in 2006 as an example. From 2005 to the first half of 2006, feed prices skyrocketed and pork prices were low. Pig farmers lost nearly 80-100 yuan for each pig they sold. Many pig

farmers had to endure the number of sows, which led to a rapid decline in stocks and triggered the shortage of live pigs and soaring pork prices from 2006 to 2007. In May 2007, in just half a month, Qingdao pork prices climbed from 15 yuan/kg to 21 yuan/kg with an increase of 40%.

Why the pork price obtains so much attention? The fact that the changes in pork price significantly affect China's consumer price index (CPI), which eventually influences the national macroeconomic policy, can explain it.

(ZHAO & WU, 2015) It has been documented that more than 60% of meat consumption is pork, therefore, pork can take account of more than 6% in the calculation of the CPI (YU & Abler, 2014). The correlation coefficient between CPI and pork price is 0.82 which is quite high.

The spot price of live pigs has such strong volatility, and there is a serious shortage of hedging instruments. In recent years, the listing of hog futures has been widely concerned and supported by all sectors of society. In the futures market, producers can transfer price risk and investment arbitrageurs accept price risk. It is reasonable to assume that the development of hog futures trading will help stabilize the pork prices and promote the overall healthy development of the hog industry.

The United States is also a large country for live cattle and pig breeding. From 1995 to 2003, the stock of live cattle and live pigs remained at 100 million and 0.5 to 600 million heads. The Chicago Mercantile Exchange (CME) launched live cattle and hog futures contracts between 1964 and 1966. For more than

40 years, the futures of livestock products have developed rapidly and become an important part of the commodity futures market. Velmurugan P. Shanmugam and Paul W. Armah (2016) used ARCH/GARCH Volatility Tests to predict the volatilities of many financial and economic returns and prices especially those that relate to the impact of futures prices on spot price volatility. (Shanmugam & Armah, 2016) The authors successfully proved the effectiveness of the US live stocks futures market.

In 1990, the first agricultural market in China, the Zhengzhou Grain Wholesale Market (ZGWM) was introduced because of the help from the Chicago Board of Trade (CBOT). At present, China's other agricultural products futures market is relatively mature, and the market has the abundant experience of successfully carrying out futures trading. However, there are not so many studies on futures markets in China. H. Holly Wang and Bingfan Ke (2005) used the Johansen approach to test the efficiency of Chinese agricultural commodity futures and concluded that the soybean futures market is efficient and wheat futures prices are not cointegrated with any wheat cash prices. (Wang & Ke, 2005)

The approaches to test the efficiency of commodities futures markets are varied. Timmermann and Granger (2004) studied the efficiency of the efficient market hypothesis (EMH). Fortenbery and Zapata (1993), Peroni and McNown (1998) and McKenzie and Holt (2002) focused on the theoretical perspective by using the relative model. Consuegra and Garcia-Verdugo (2016) used a sample of futures contracts with different maturities. And this

article will take advantage of ADL Model and Granger Test to see the significance of the soybean meals futures market in China and predict the significance of hog futures market.

Research Design

3.1 Data Resources

Because China has not yet launched pork futures, this article will use the data of other agricultural products with corresponding futures to demonstrate the relationship between futures prices and spot prices.

Like the pork market in China, the agricultural product market also has a certain production cycle, and farmers' decisions on the supply of agricultural products in the current period often depend on the price level of agricultural products in the previous period, while the demand for agricultural products is determined by the current price. At the same time, the agricultural products have the characteristics that the supply elasticity is greater than the elasticity of demand. This method of determining supply and demand, which is affected by the previous and current prices, is a typical divergent cobweb model. Therefore, the pork market and the agricultural product market are quite comparable. Verifying the effectiveness of the operation of the agricultural futures market and the relationship between its futures and spot prices has great significance for the study of hog futures.

This essay takes the soybean meal futures as an example and selects the relevant data from 2009 to 2019 for analysis. In actual futures trading, the same variety has several futures prices on one trading day. According to the needs of the research, the futures price data used must be a sequence of continuity. Therefore, this paper selects the futures contract closest to the

trading day and month. According to the period studied in this paper, it can select a group of consecutive representative futures contracts. And then select the weekly closing price of these sequences as the index value of the soybean meal futures price, the futures price series can be obtained. The relevant data of futures prices are compiled according to the actual trading conditions of the Dalian Commodity Exchange (DCE), while the data of spot prices mainly adopts the statistics of the spot price of agricultural products by the Wande database. Before the data is analyzed, the logarithm is taken to reduce the volatility of the data.

3.2 Research Model

i. Correlation test: The correlation test between the spot price and futures price, calculate the correlation coefficient. The specific formula is as follows:

$$r = \frac{n \sum_{i=1}^n X_i Y_i - \sum_{i=1}^n X_i \sum_{i=1}^n Y_i}{\sqrt{[n \sum_{i=1}^n X_i^2 - (\sum_{i=1}^n X_i)^2][n \sum_{i=1}^n Y_i^2 - (\sum_{i=1}^n Y_i)^2]}}$$

r represents the correlation coefficient;

n represents the number of groups of variables.

ii. Autoregressive Distributed Lag Model (ADL): From the perspective of the economy, to prove that there is indeed a long-term relationship between the two economic variables. This essay needs to examine the long-term dynamic changes of the two indicators of futures and spot prices. In order to examine the relationship between variables as they extend over time intervals, it is necessary to introduce the ADL model.

In order to reduce the volatility of the data in the sequence and ensure the validity of the analysis results in the process of empirical research, it is necessary to convert the data in the original sequence into a logarithmic form so that the data in the sequence appears to be as smooth as possible in the long run.

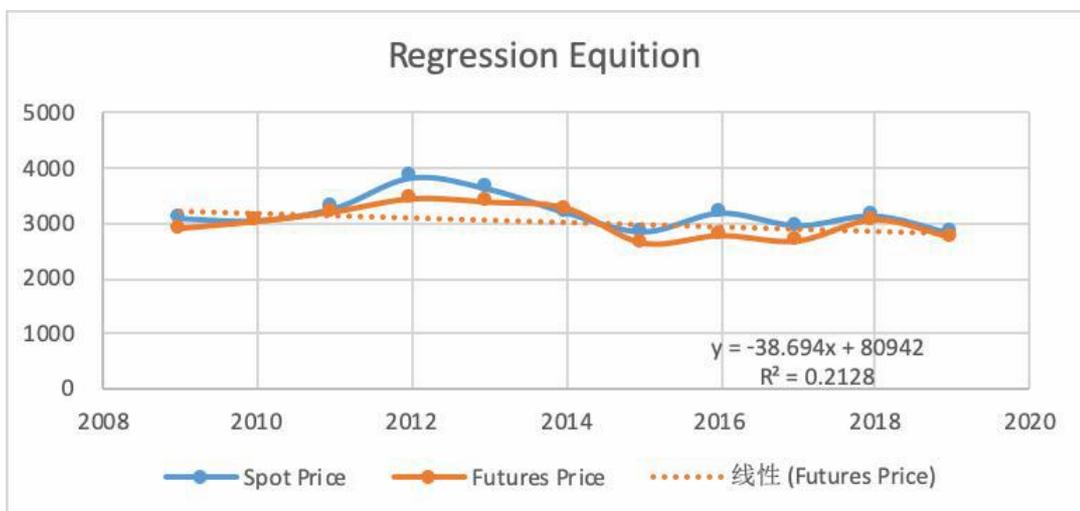
iii. Granger Causal Relation Test: This paper firstly examines whether there is a specific long-term relationship between variables. The method chosen is the co-integration analysis. Since only stable variables are used as the result of the co-integration analysis, it is necessary to perform unit root tests on each variable (ADF Model). To judge the stability of the variable. After analyzing the long-term correlations between the variables, the Granger test further examines the causal relationship between the variables to determine whether the correlation in the long-term relationship is unidirectional or bidirectional.

Analysis And Findings

4.1 Correlation Test

According to the selected Zhengzhou Commodity Exchange, the mainstay of soybean meal futures Continuous price and national average soybean meal spot price, analyzed by exercises. The price of soybean meals is positively correlated with the price of the current goods, and the correlation is relatively high.

	Spot Price	Futures Price
2019	2814	2749
2018	3136	3059
2017	2962	2689
2016	3190	2781
2015	2847	2651
2014	3200	3264
2013	3633	3372
2012	3843	3429
2011	3280	3202
2010	3051	3033
2009	3090	2909
Correl	0.867050681	
R ²	0.2128	



4.2 Regression Analysis

Regression analysis is to measure and describe the quantitative change relationship between two variables with a correlation relationship, to explore the general mathematical expression of the quantitative change between the independent variable and the dependent variable. The model obtained on the basis of regression analysis does not have constraints. The general formula of the regression model is:

$$Y=C+\beta_1X_1+\beta_2X_2+\beta_3X_3+\dots+\beta_iX_i+\mu$$

Where (C is a constant term, β_i is a regression coefficient, and μ is a random error term)

The logarithm of the data does not change the co-integration relationship of the original variables, and it can linearize its trend, eliminating the effects of heteroscedasticity and enhancing the comparability of the time series. Therefore, the variables are logarithmic processed, and the data is processed by eviews analyzed.

Stationarity is a statistical characteristic of time series. Therefore, before establishing a VAR model for a time series, we should test the stability of the time series. Only time series that have passed the stationarity test can be modeled.

4.3 Data Stationarity Test

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4.4 ADF Model

It can be seen from the original sequence of logarithmic variables that they are not stable. After the first-order difference processing of the variables, the ADF value of each variable is less than the 5% level value at the significance level of 5%. The test results show that the first-order difference processing of the variable sequence is stable, and on this basis, the model can be modeled.

变量	ADF 值	P值	1%水平值	5%水水平值	10%水平值	平稳性
Lnsort price	-1.552124	0.4684	-4.297073	-3.212696	-2.747676	不平稳
LnFutures Price	-1.554027	0.4675	-4.297073	-3.212696	-2.747676	不平稳
dLnsort price	-2.933016	0.0085	-2.84725	-1.988198	-1.60014	平稳
dLnFutures Price	-3.374786	0.0038	-2.84725	-1.988198	-1.60014	平稳

4.5 VAR Analysis

In general, the more lag models of VAR models, the smaller the residuals will be, and the better the model's prediction effect, but the unnecessary increase in order will sacrifice the degree of freedom, so that the estimated variance becomes larger and the stability of the model becomes worse. If the number of lags is too small, the integrity of the dynamic relationship between variables is affected. This article mainly refers to the AIC and SC criteria to determine the optimal lag time. The selection of the model lag order is as follows, which is comprehensively considered as the lag first order:

Lag	AIC	SC
0	-1.643442	-1.60727
1	-1.667367	-1.576592
2	-1.101822	-0.992253

4.6 Cointegration Test

According to the ADF unit root test of the data, the unit root test after the first-order difference of related variables is stable, so as long as there is a long-term cointegration relationship between the variables, a model can be established for regression analysis. Based on this theory, a cointegration test was performed on the variables.

Unrestricted				
Cointegration				
Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.907996	23.13108	15.49471	0.0029
At most 1	0.16823	1.657795	3.841466	0.1979

From the above cointegration test of variables, it can be known that for the null hypothesis that there is no cointegration relationship between the variables, the tested P value 0.0029 is less than 0.05, that is, the null hypothesis is rejected, indicating that at least one cointegration relationship exists between the variables.

4.7 Cointegration Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSPOTPRICE	0.843357	0.162689	5.183865	0.0006
C	1.207229	1.311738	0.920328	0.3814
R-squared	0.749111	Mean dependent var		8.006674
Adjusted R-squared	0.721235	S.D. dependent var		0.092189
S.E. of regression	0.048674	Akaike info criterion		-3.044369
Sum squared resid	0.021323	Schwarz criterion		-2.972024
Log likelihood	18.74403	Hannan-Quinn criter.		-3.089972
F-statistic	26.87246	Durbin-Watson stat		1.660594
Prob(F-statistic)	0.000576			

It can be seen from the above equation that the R-squared of the model is 0.749, which is greater than 0.05, indicating that the model fits well. From the above regression results, we can see that the variable equation is

$$\text{LnFutures Price} = 1.207229 + 0.843357 * \text{LNSPOTPRICE}$$

It can be seen that there is a positive correlation between the variables, and the significance is significant at the level of 1%, indicating that there is a significant positive relationship between the variables, that is, the spot price has not increased by 1%, and the futures price will increase by 0.84%.

4.8 Granger Test

Null Hypothesis:	Obs	F-Statistic
LNSPOTPRICE does not Granger Cause LNFUTURESPRICE	10	0.54695
LNFUTURESPRICE does not Granger Cause LNSPOTPRICE		0.01093

According to the Granger test lagging one period of the variable, it is seen that the spot price is not the cause of the change in the futures price, but the future price does cause the change in the spot price.

Because the soybean meal has the similar demand and supply cycle with pork price, it is reasonable to predict that the hog futures price can have the similar positive effect.

Conclusion

There are also a lot of difficulties needed to be taken into consideration during the launch of hog futures.

5.1 Limitation&Suggestion

5.1.1 Design of hog futures contract

A futures contract is a standardized contract that is uniformly defined by exchange and provides for the delivery of a certain quantity and quality target at a specific time and place in the future. Through delivery, the two markets of futures and spot can be linked to each other, and the futures price and spot price will eventually become consistent so that the futures market will truly play the role of price barometer. Therefore, the key to the success of futures contract design is delivery.

However, reviewing the varieties of China's futures market, such as soybeans, copper, aluminum, etc., such goods are conducive to storage and to deliver. Hogs are live animals, which brings difficulties for storage and delivery. The Chicago Mercantile Exchange began the hog futures trading in 1997 with cash: All long contracts can be settled by the CME on all short-selling contracts after the last trading day, using the CME's lean hog index as the settlement price. This innovative delivery method makes delivery and trading more convenient.

The reason why the United States can adopt cash delivery is mainly based on the following three points: First, the requirements for technological conditions are particularly high. The second is the need for modern refrigeration equipment. The third is to have large-scale pig farms and slaughter processing plants with higher technical conditions. Because of the current hog market in China, there is still a certain gap between China and the United States. Therefore, I believe that China's futures contracts should be traded in a live delivery manner. Since pigs are different from traditional storage products, they cannot be registered as warehouses. In order to reduce the delivery cost and solve the problem of non-storage, the delivery can be carried out in the form of a pig farm and a slaughterhouse, and the futures exchange will issue a warehouse receipt for it.

5.1.2 Unfavorable factors for the listing of hog futures

In China, the domestic pig breeding industry is small in scale, and there are few large companies with strength, and the pig slaughtering enterprises already have strong strength. Therefore, similar to other domestic agricultural product futures, the futures trading entity of the hog futures will still not be a pig raiser, but the demand side.

From the perspective of industry comparison, there is a tendency for hog futures to suppress the price of live pigs. China has implemented a slaughter system for pigs, and most large and medium-sized cities have restricted the number of local slaughter enterprises. These designated enterprises have become the only legal pig demanders. The state has been cracking down on

the slaughter of pigs and further strengthening the status of designated enterprises as monopoly buyers. That is to say, the strength of the demand side of pigs will continue to enhance the influence of domestic pig producers on the financial strength and cultural level, and producers are unable to enter the futures trading market for trading. The price of pigs has always been determined by the demand side of the pigs, and the farmers can only be forced to accept or only make small adjustments. The listing of hog futures will further strengthen the bargaining power of the demand side.

5.1.3 The disadvantages of the futures market

Futures can indeed make price volatility smaller, but there is a basic premise here, that there is no huge fluctuation in the supply of the spot market.

Because futures only can find future prices without accidents, if the stock supply has problems for some reason, the impact of futures on market prices is extremely limited. Also, if futures speculation is excessive or excessive reaction to unexpected events, it will lead to huge fluctuations in the spot market and a chain reaction of related products, and the result will be disastrous.

The large-scale breeding is a major premise for the development of hog futures. The development of hog futures requires more concentrated pig breeding. From the current point of view, the concentration of pig farming is faster than expected. However, it should be emphasized that pig farming cannot be concentrated in the hands of individual enterprises and needs to be multi-directionally concentrated under the support and guidance of national

policies. After the concentration of pig breeding, it will be conducive to the statistics of the number of breeding and the standardization of breeding standards, laying a good foundation for the development of pig futures.

5.2. Conclusion

In the current Chinese pork market, spot prices have a lag in the guidance of supply and demand, and cannot overcome the cyclical fluctuations in pig production and prices. Futures have the function of predicting prices and avoiding risks. After the introduction of the pigs futures trading, farmers can use the futures market to lock the profit of raising pigs, preventing the ups and downs of prices from adversely affecting the profit of pigs, so as to ensure that farmers have reasonable and stable farming profits, and truly improve their enthusiasm for breeding, making the market have a long-term stable supply of pork.

So it can be concluded that the price level depends on a variety of factors. After the introduction of the hog futures trading, although the price level of pork cannot be determined, it can prevent the price from huge rising and falling and guarantee the long-term stable supply of hogs in the market. We have reason to believe that the launch of the hog futures will bring a win-win situation for all parties in the hog market and the stability of the industrial chain.

Reference

- Watanabe, M., & Wang, J. (2016). Does Market Upgrading Benefit Farmers?: Market Differentiation, Contract Farming, and Professional Cooperatives in China's Pork Processing Industry. *SSRN Electronic Journal*. doi: 10.2139/ssrn.2820916
- Chen, Y., & Yu, X. (2018). Does the centralized slaughtering policy create market power for pork industry in China?. *China Economic Review*, 50. doi: 10.1016/j.chieco.2018.03.005
- ZHAO, G., & WU, Q. (2015). Nonlinear dynamics of pork price in China. *Journal Of Integrative Agriculture*, 14(6), 1115-1121. doi: 10.1016/s2095-3119(14)60994-1
- Zhou, C. (2016). An Improved Quantitative Model for Evaluating Pork Price Fluctuation Trend and the Impaction in China: an Empirical Analysis between 2004-2014. *International Journal Of Future Generation Communication And Networking*, 9(2), 199-210. doi: 10.14257/ijfgcn.2016.9.2.21
- Xu, B., Zhang, C., & Qi, H. (2019). International Trades of Pigs and Pork Products Accelerate the Global Spread of African Swine Fever. *The Lancet*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3433899
- Dai, J., Li, X., & Wang, X. (2017). Food scares and asymmetric price transmission: the case of the pork market in China. *Studies In Agricultural Economics*, 119(2). doi: 10.7896/j.1620
- Alexakis, Christos., Bagnarosa, Guillaume., & Dowling, Michael M. (2017). Do Cointegrated Commodities Bubble Together? The Case of Hog, Corn, and Soybean. *Finance Research Letters, Forthcoming*. Retrieved from: <http://dx.doi.org/10.2139/ssrn.2914152>
- Mo, Di., & Gupta, Rakesh. (2015). The Information Transmission between China and the US Agricultural Commodity Markets. Retrieved from: <http://dx.doi.org/10.2139/ssrn.2647773>
- US livestock futures market Karali, B., Isengildina-Massa, O., Irwin, S., Adjemian, M., & Johansson, R. (2019). Are USDA reports still news to changing crop markets?. *Food Policy*, 84, 66-76. doi:10.1016/j.foodpol.2019.02.005
- Velmurugan, P. Shanmugam., & Paul, W. Armah.(2017). Volatility Spillovers between Spot and Futures Markets: An Empirical Study on U.S. Agricultural Commodities. Retrieved from: <http://dx.doi.org/10.2139/ssrn.2975263>

Mo, Di., & Gupta, Rakesh. (2015). The Information Transmission between China and the US Agricultural Commodity Markets. Retrieved from: <http://dx.doi.org/10.2139/ssrn.2647773>

Consuegra, M., & Garcia-Verdugo, J. (2016). Measuring the functional efficiency of agricultural futures markets. *Australian Journal Of Agricultural And Resource Economics*, 61(2), 232-246. doi: 10.1111/1467-8489.12196

Jinbo, Pang., Lingfei, Deng., Gangyi, Wang. (2017). An evolutionarily stable strategy and the critical point of hog futures trading entities based on replicator dynamic theory: 2006–2015 data for China's 22 provinces. Retrieved from: <https://doi.org/10.1371/journal.pone.0172009>