SAINT MARY'S UNVERSITY

The Relationship between Chinese copper futures prices and relevant listed company stock price

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Abstract

The Relationship between Chinese copper futures prices and relevant listed company stock price

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The core point of the paper is test the relationship between Chinese copper futures prices and relevant listed company stock price. The paper selected a data sample to include stock price, future price and the Shang Hai composite index for the period from 04, January 2011 to 31, December 2013. The testing methodology of the paper is the VAR model and basic data analysis, From the results, I can determine the high correlation between the stock price of a related copper listed company and futures copper prices. For the VAR model, it is more difficult to determine the relationship.

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Chapter 1

Introduction

1.1 Background

In a healthy financial market, futures and stock markets are two core areas. A stock market focuses on the micro-economic level resource allocation and pricing the unique risk of the company. Whereas futures markets will focus on the macro-economic level social and economic risk management and commodity price discovery.

The Chinese stock market started with two stock exchanges named the Shen Zhen stock exchange and Shang Hai stock exchange in 1990. 14 companies were listed on both A and B stock markets, and around 257,000 accounts opened. The total equity market value was around 10.918 billion yuan in the inception phase. In the following decades, the Chinese market has grown rapidly to be the second largest world stock market. More than 2,535 companies are listed, and around 165 million accounts exist. Furthermore, aggregate equity market value jumped to exceed 4.6 trillion yuan.

Although the Chinese stock market has grown with an unbelievable speed, many economists found serious flaws over many years, such as large market makers manipulating share price, listed companies making false accounts for to pass the government examination, and the absence of foreign listings.

Additionally it has shown high share price volatility, share market bubbles, and many share prices have been far in excess of their intrinsic value caused by those flaws. To improve the stock market environment, the central government introduced different rules and established the CSRC (China Securities Regulatory Commission)

For the Chinese futures market, the Zheng Zhou, Da Lian, and Shang Hai commodity exchanges are the three legal exchanges in the Chinese futures market. In the early period, futures prices were manipulated frequently, because they lacked a market regulatory system and supervisory experience. Copper futures, one of the earliest futures contracts began in 1991, and did not have the experience to operate efficiently carrying huge pricing risks and a chaotic market environment.

As a result, attempts were made to solve these problems and copper futures listed on the Shang Hai community exchange were back on track by 1998. So now the Shang Hai Futures Exchange (SHFE) in respect to copper has seen continuous improvements and not only has attracted a large number of domestic speculative traders, but also promoted copper production and consumer companies have begun to take part in futures trading and hedging operations to avoid the risk of their own business. Also the international influence and power of the Shang Hai copper futures market have risen sharply because trade volume of copper futures markets has increased at an unbelievable speed. Now the Shang Hai copper futures market has become the second largest copper futures market in the world following the London Metal Exchange copper future market.

In the long-term, there is a correlation between community futures price movement and stock price movement, which means stock and futures markets hold an intrinsic link with each other. The aim of this paper is to determine that relationship

1.2 Purpose of the paper

The paper selects three listed companies in the Shang Hai and Shenzhen stock markets, copper futures price data in the Shang Hai community exchange and the Shang Hai spot copper metal price data.

Our starting premise is to recognize that futures prices can directly or indirectly affect the stock price of related companies because the future mature market is now mature and is able to discover the price of the commodity. Through the analysis on the correlation between futures prices and stock prices of related listed companies, our study wishes to determine what is the intrinsic link between a futures market and the stock market. Then investors can formulate more reasonable and lower risk investment portfolios with that useful information,.

In the second part of the paper is to test for Chinese financial market efficiency. Financial efficiency is a precondition for financial markets to play their key roles. So while futures and stock prices are related to each other, the efficiency of markets is also a prerequisite

1.3 Chapter Organization

The paper is organized into five parts. This chapter has provided a background for the study and its objectives. Chapter two introduces the literature review, and furthermore, explains the important research in the relevant study area. Chapter three explains statistical methods in the study and data sources and model formula. The analysis of the results of the models are discussed in Chapter 4. The fifth chapter provides a conclusion of the study and gives some advice to improve the Chinese financial markets.

Chapter 2

Literature Review

2.1 Price discovery theory

The price discovery function is not only a consideration of the spot market price itself but also a kind of base of modern financial market. In futures markets, it explains that predicted futures price movement can lead to spot market price movements. In the general case, futures market traders use their own rational prediction of futures spot community prices to trade the contracts. The futures prices are determined by the commodity supply-demand situation and free market bargaining. Then these rationally predicted prices in the futures markets are able to lead to the spot prices.

According to Garbade and Siber (1983), the price discovery function depends on future markets price fluctuation leading to spot market price fluctuations more often than the reverse. In over half the cases, futures markets reflect newly released news faster than spot markets, which suggests that the price discovery function of the futures market exists.

Booth et al (1998) wanted to test the price discovery function on the Canadian futures market. These economists picked four kinds of agricultural products (wheat, barley, oat and castor-oil plant) on Canadian Winnipeg commodity exchange, and then they used the Johansen co-integration model and IS model to analyze the relationship between futures prices and spot prices . The results of the tests found that the price discovery function was significant in the Canadian futures market. Within the four products, the castor-oil plants futures market in particular affects the level of spot price changes.

In addition, Chung et al (2007) found that up to 70% of price discovery events occurred in the Canadian government bond futures market. Furthermore, they believed that the price discovery function of the Canadian future market is a signal that Canadian future market have entered a mature phase. The study focuses that the key reason for this is low transaction costs. These encourage investors to trade repeatedly in the market and correct the price when new information is released or some investors provide biased prices. Other reasons include increasing the number of traders and speculators. If they want to generate a profit in a futures contract, they have to try their best by data analysis to predict a more accurate price.

2.2 Efficient market theory

The modern financial theory builds on the Efficient Market Hypothesis(EMH). Generally, the EMH is described as recently published information is able to affect the stock price rapidly and in an unbiased way.

Jensen's (1978) research indicated that if traders cannot generate abnormal profits with fresh news, the financial market remains in an efficient form. Since then, many studies have focused on testing whether the EMH exist,

From Fama's research (1970), the EMH explains that stock prices reflect all available information in the market. There are 3 types of information in the market: 1. Historical information normally describes stock price, company information and turnover volume in the past. 2.Public information describes the information published by the company recently such as dividend payments, company mergers. 3. Inside information is held within the company and not published in the public market.

Fama provides three different efficient market types to correspond to each of the three different kinds of information :1.)weak form efficiency, semi-strong form efficiency and strong form efficiency. Under the weak form efficiency, the price reflects all the historical data, therefore, the investors are unable to generate abnormal profits with analysis of the relevant historical data. 2.)In a semi-strong form, the price reflects all relevant historical and public information. Analyzing historical information and public information can hardly bring abnormal profit to investors. 3.)From strong form efficiency, the price reflects all the relevant existing information in the market (historical, public and insider information). In this case, investors have no chance to generate abnormal profits.

Fama provides a statistical method with which to test whether market prices fluctuate in a random walk to test for weak form efficiency. The random walk test method is widely accepted by economists, and they have used the random walk method to test the EMH weak form efficiency. As the literature reveals it is hard to achieve semi-strong or strong efficient market form for a developed country, so they have focused on tests on weak form efficiency.

Larson(1960) chose a two decade period with corn future price data to test whether the American futures market is weak form efficient. The results from a random work concluded that in this case, it was weak form efficient.

Bird (1986) tested the random walk method to find out whether the LME was a weak efficient form market. Four main trading metal products copper. lead, tin and zinc were used for the period (1962~1972). The findings found copper futures and spot markets both fail to achieve weak form efficiency. But Bird was not able to determine whether futures and spot markets of other metal products achieve weak form efficiency.

2.3 Relevant Chinese studies

In reference to the Chinese financial markets weak form efficient tests have been performed. Deng and Hu(2001) picked price data of twenty listed companies price data as a sample to test for Chinese stock market weak efficiency from using the stock auto regression methodology. At the same time, they also tested the Chinese stock market for semi-strong form using a case study method. In general, the Chinese stock market was found to be weak form efficient, but it failed to achieve semi-strong form efficiency.

In term of futures market efficiency, Wang, et al(1995) is an example of further EMH research. The report explained that the Dalian community exchange market is a weak form market. The methodology of the report, chose the serial correlation test method and the runs test method, and the data used Dalian futures market daily trading price.

According to Hua et al (2003), investors can enjoy the benefits of hedging in the Shang Hai copper futures market compared with a non-hedging investment plan. As time go by, copper futures hedging efficiency is improving as well as market efficiency. In that research, they picked 1733 copper futures contracts closing prices and corresponding copper futures contract settlement prices for June.1995 to July.2002.

The price discovery function is also a popular study direction especially in the Chinese Shang Hai community exchange market. Based on four different statistical methods, such as VECM model, VAR model, Granger causality test, Wang and Zhang (2005) estimate copper and aluminum futures market price discovery function affirm that it is statistically significant. The conclusion of the research is that copper and aluminum futures market prices take a leading place in the price discovery phase.

Chapter 3

Methodology

3.1 The VAR model

Vector Auto Regression (VAR) Model is a popular statistical method used in empirical studies. In 1980, SimS published a new model named the vector auto regression model which is intended to improve the flaws in simultaneous equations. All variables in the VAR model are endogenous variables, so a researcher can save time from distinguishing the endogenous variable and exogenous variables, and avoid making mistakes about design variables. Therefore, the VAR model can help the researcher to predict the relationships in the future.

3.2 VAR model formula

The VAR model utilized in the paper can be represented in Equation 3.1 below

$SP(\ )_t = \beta_1 SP(\ )_{t-1} + \beta_2\ SH(\ )_{t-1} + \beta_3\ FC(\ )_{t-1} + \varepsilon_t$.............................(3.1)

Where: (the name of listed company will be in the brackets)

Sp( )=stock price of listed company

SI( )=Shang hai securities composite index

FP( )=future market price of copper

$\beta 1$=coefficient of stock price

$\beta 2$ =coefficient of spot price

$\beta 3$=coefficient of future market price

εt=error item in study

The VAR model normally tests using the famous t-test statistical method, and researchers will test the coefficient of each parameters with critical value (P value). P values of coefficients less than 0.05 or 0.1 are a signal of passing the test.

3.3 Data sources

For this research, the Shang Hai copper community market daily future settlement price is the suitable choice because monthly or yearly data will lose large amounts of useful information. However, on the other hand, closing price may be manipulated by market makers. In the Chinese stock market, the companies chosen are leading companies in the copper market area: Yun Nan copper company(YN)，Jiang Xi copper company(JX) and XI Bu resource company (XB). In addition, these companies daily stock price data are utilized from 04, January 2011 to 31, December 2013. The reason is that a three year sample size is large enough to complete the research and avoid mistakes made by sample size. In the study, all data take natural logarithm forms to remove the account unit effect.

Chapter 4

Results

4.1. Basic data analysis

To clearly understand the features of the selected data, we require to do a basic statistical analysis. So Table 4.1 provides basic statistical characteristics of the sample data.

Table 4.1:

Variable	**Mean**	**Max**	**Min**	**Sd**	**Skewness**	**Kurtosis**
YN	2.765845	3.353756	2.111425	2.765845	-.4074628	2.367987
X B	2.283126	2.776083	1.776646	2.283126	.1963719	2.493453
JX	3.189846	3.806218	2.640485	3.189846	.1008709	2.3205
fc	10.97505	11.25065	10.78311	10.97505	.6344753	2.327266
sh	7.759635	8.025297	7.575591	7.759635	.6798	2.509691

(YN=Yun Nan copper company, XB= Xi Bu resource company, JX= Jiang Xi copper company, fc= futures copper price. sh=Shang Hai composite index)

In Table 4.1, the standard deviation of the future copper market price is the obvious largest one, and the standard deviation of Shang Hai securities composite index follows the standard deviation of copper future market price stay in second place. The three standard deviations of the listed companies stock price is much lower compare with standard deviations of the copper future market price data and Shang Hai securities composite index. The standard deviation at a high level is a sign of high sample volatility. Conversely, a low level standard deviation means low volatility of the sample data.

The Yun Nan copper company (YN) price data value of skewness is less than zero, which means the price data contains a considerable degree of left skew. The other two companies(JX XB) price data value of skewness are greater than zero, so the price data have a right skew. Futures copper market price data also enjoy a right skew as does the Shang Hai securities composite index data.

For the all sample data, the value of kurtosis is greater than zero, so all sample data hold an obvious pinnacle. Therefore, basic data analysis believes that no one has the normal distribution in the research.

4.2 Correlation tests

In order to determine the correlation between each data sample, we can find the correlation coefficient of the data . The results are as follows (Table 4.2)

Table 4.2

	lYN	lXB	lJX	lfc	lsh
lYN	1.0000				
lXB	0.8743	1.0000			
lJX	0.9545	0.8932	1.0000		
lfc	0.8540	0.8417	0.9258	1.0000	
lsh	0.7902	0.8422	0.8976	0.8647	1.0000

The correlation coefficients in Table 4.2 explain that each data sample has relatively high correlation with other data sample. The future copper market prices correlate with three listed companies at a high positive level, because the smallest correlation coefficient is 0.8540. The correlation coefficient of the Jiang Xi copper company stock price and futures copper market price is the largest(0.92), so the Jiang Xi copper company stock price normally rise with future copper market price rises and falls with futures copper market price falls. The Shang Hai securities composite index is positively correlated with the three price of listed companies, but the correlation level is not high enough as the copper market price correlating level. For investor risk, the Shang Hai securities composite index change is a part of systematic risk, and future copper market price change is more an unsystematic risk.

On the other hand, some Chinese economists believe that the Chinese stock market has "broad effect". In the same industry or similar markets, listed companies stock prices rise or fall in the same way. From the above correlation coefficient table, the correlation coefficients between three companies with each other are 0.8743(YN,XB), 0.9545(YN JX) and 0.8932(JX XB). So these three listed companies have an elevated level positive correlation which means these three listed companies enjoy the "board effect". The Yun Nan copper company and Jiang Xi copper company have the closest relationship, therefore, any of these two companies published some important news may affect both company stock prices.

4.3 VAR model analysis of results

Based on the AIC test result, we can find that three lags are the suitable choice for the VAR model, and then we use stata to get the VAR model results:

Table 4.3

Vector autoregression

Sample: 4 - 721		No. of obs	= 718
Log likelihood =	6246.436	AIC	= -17.31598
FPE =	6.06e-12	HQIC	= -17.24215
Det(Sigma_ml) =	5.57e-12	SBIC	= -17.12476

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lJX	10	.02125	0.9945	129340.2	0.0000
lfc	10	.011366	0.9906	75340.49	0.0000
lsh	10	.010562	0.9912	80650.98	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lJX						
lJX						
L1.	.9218963	.0380665	24.22	0.000	.8472874	.9965052
L2.	-.0800592	.0516613	-1.55	0.121	-.1813134	.021195
L3.	.1495441	.0407592	3.67	0.000	.0696575	.2294306
lfc						
L1.	.065187	.0687468	0.95	0.343	-.0695543	.1999282
L2.	-.0477704	.0980801	-0.49	0.626	-.2400037	.144463
L3.	.0102245	.0680721	0.15	0.881	-.1231943	.1436433
lsh						
L1.	.4188024	.0767783	5.45	0.000	.2683196	.5692851
L2.	-.1348417	.0987323	-1.37	0.172	-.3283536	.0586701
L3.	-.2979845	.0726893	-4.10	0.000	-.4404529	-.155516
_cons	-.1686328	.1939584	-0.87	0.385	-.5487843	.2115188

The stata results in Table 4.3 show the R squared of the Jiang Xi copper company in the VAR model is at a really high level 0.99 which explains that 99% of the stock price data can be explained in a equation with following segments: copper market price three lags, stock price three lags , Shang Hai securities composite index three lags. If this equation passes the T-test, investors are able to predict possible stock price, But the T-test rejects all three copper futures price coefficients ,stock price second lag coefficient and Shang Hai securities composite index second lag at both 5%and 10% significance levels.

Finally, the stock price of Jiang xi copper company can be explained by its stock first lag, and stock price third lag, Shang Hai securities composite index by its first lag and Shang Hai securities composite index third lag these four parts. Except for the Shang Hai securities composite index third lag, the other three parts have a positive correlation with stock prices.

Table 4.4

```
. var lYN lfc lsh,lag(1/3)

Vector autoregression

Sample:  4 - 721                                 No. of obs      =       718
Log likelihood =  6232.807                       AIC             = -17.27801
FPE            =  6.29e-12                       HQIC            = -17.20418
Det(Sigma_ml)  =  5.79e-12                       SBIC            =  -17.0868
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lYN	10	.021097	0.9956	163316.1	0.0000
lfc	10	.011797	0.9898	69885.15	0.0000
lsh	10	.010454	0.9914	82339.4	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lYN						
lYN						
L1.	.952773	.0390693	24.39	0.000	.8761986	1.029347
L2.	.0141664	.0531658	0.27	0.790	-.0900366	.1183694
L3.	.0313466	.0422408	0.74	0.458	-.0514439	.1141371
lfc						
L1.	-.0813447	.0677864	-1.20	0.230	-.2142036	.0515141
L2.	.0758267	.0982608	0.77	0.440	-.116761	.2684144
L3.	.0112513	.0677601	0.17	0.868	-.1215561	.1440587
lsh						
L1.	.2192688	.0778315	2.82	0.005	.0667218	.3718159
L2.	-.0675052	.0983648	-0.69	0.493	-.2602967	.1252863
L3.	-.1589852	.0719223	-2.21	0.027	-.2999502	-.0180201
_cons	-.003797	.1320265	-0.03	0.977	-.2625642	.2549702

In the similar situation, the R squared of the Yun Nan copper company for the VAR model also holds a high level around 0.99 ,so 99% stock price data can be explained in the equation with the following segments: copper market price three lags，stock price three lags,   Shang Hai securities composite index three lags. But the t-test result only accepts the stock price first lag coefficient, Shang Hai securities composite index first lag coefficient and third lags coefficient in both 5%and 10% significance levels.

The stock price of the Yun Nan copper company can be explained by its stock first lag, Shang Hai securities composite index first lag and Shang Hai securities composite index third lag. Except for the Shang Hai securities composite index third lag, the other three parts are positive correlated with stock prices.

Table 4.5

```
. var lXB lfc lsh,lag(1/3)

Vector autoregression

Sample:  4 - 721                                  No. of obs      =       718
Log likelihood =  5927.342                        AIC             = -16.42714
FPE            =  1.47e-11                        HQIC            = -16.35331
Det(Sigma_ml)  =  1.36e-11                        SBIC            = -16.23592
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lXB	10	.028082	0.9847	46177.96	0.0000
lfc	10	.011892	0.9897	68751.58	0.0000
lsh	10	.011367	0.9898	69539.57	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lXB						
lXB						
L1.	.9844932	.0372188	26.45	0.000	.9115457	1.057441
L2.	-.1100562	.0520289	-2.12	0.034	-.2120309	-.0080814
L3.	.07795	.0365884	2.13	0.033	.006238	.1496619
lfc						
L1.	-.099224	.0888098	-1.12	0.264	-.273288	.07484
L2.	.2332959	.1290045	1.81	0.071	-.0195482	.48614
L3.	-.0634247	.0899621	-0.71	0.481	-.2397473	.1128978
lsh						
L1.	-.0534906	.0928755	-0.58	0.565	-.2355232	.1285419
L2.	.1362901	.1292832	1.05	0.292	-.1171004	.3896806
L3.	-.0623834	.0928769	-0.67	0.502	-.2444187	.1196519
_cons	-.8260019	.1740683	-4.75	0.000	-1.16717	-.4848343

In Table 4.5, the R squared of the Xi Bu recourse company for the VAR model stays at the high point 0.99 which means that 99% stock price data can be explained in a equation with following segments: copper market price three lags, stock price three lags , Shang Hai securities composite index in three lags. From the t-test result, three lags of the stock price and the second lags of futures copper market price can pass the test.

In the end, the stock price of Yun Nan copper company can be explained by its stock three different lags and second lag of futures copper market price. The Copper futures market price can lead the stock price of Xi Bu resource company with a 0.233 positive coefficient

Chapter 5

Conclusions

The paper attempts to search for the relationship between futures copper markets and the related copper listed company stock market, Chapter 4 uses the VAR model and the T-test method . We can make the following conclusions.

Firstly, the Chinese futures market holds an insignificant relationship between the related stock market, because only one of three listed company stock prices are affected by the futures copper market price from the VAR model results. In addition, the coefficient of futures copper market price for the Xi Bu resource company, the VAR model shows just 0.233 which is not the main part to explain the stock price change. Furthermore, the coefficient of futures copper market price for the Xi Bu recourse company is not able to pass the 5% significance T-test that shows the coefficient is not statistically significant. Therefore, result of VAR model analysis shows that the futures copper market hardly affects to stock market at the 5% and 10% significance levels, and investors may not need to consider futures market price when they make stock investment plans.

Secondly, there is a nearly weak efficient market form in Chinese financial markets. This research selected different past time price as samples such as first lag (yesterday), second lag (the day before yesterday) or third lag (three days ago). The results of the research show that stock price past information almost always leads the futures stock price change. However, there are some historical information such as futures copper market prices and Shang Hai securities composite index that indicate that they do not lead the stock price change. I think the Chinese financial market is near to the weak form efficient market.

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Appendix

AIC test result:

Selection-order criteria

Sample: 14 - 721 Number of obs = 708

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	6073.09				7.2e-12	-17.1472	-17.1397	-17.1278
1	6148.42	150.66	9	0.000	5.9e-12	-17.3345	-17.3047	-17.2572*
2	6157.54	18.241	9	0.032	5.9e-12	-17.3349	-17.2826	-17.1995
3	6188.46	61.829*	9	0.000	5.6e-12*	-17.3968*	-17.3221*	-17.2035
4	6196.63	16.335	9	0.060	5.6e-12	-17.3944	-17.2973	-17.1431
5	6201.05	8.8589	9	0.450	5.7e-12	-17.3815	-17.262	-17.0722
6	6207.46	12.812	9	0.171	5.7e-12	-17.3742	-17.2323	-17.0069
7	6210.12	5.323	9	0.805	5.8e-12	-17.3563	-17.192	-16.931
8	6214.78	9.3217	9	0.408	5.9e-12	-17.344	-17.1573	-16.8607
9	6219.4	9.2275	9	0.417	6.0e-12	-17.3316	-17.1225	-16.7903
10	6226.78	14.757	9	0.098	6.0e-12	-17.3271	-17.0955	-16.7277
11	6229.82	6.0957	9	0.730	6.1e-12	-17.3102	-17.0563	-16.6529
12	6233.66	7.6822	9	0.566	6.2e-12	-17.2957	-17.0193	-16.5804

Endogenous: dyn dfc dsh

Exogenous: _cons

Selection-order criteria

Sample: 14 - 721 Number of obs = 708

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	6045.1				7.8e-12	-17.0681	-17.0606	-17.0488
1	6125.49	160.78	9	0.000	6.3e-12	-17.2698	-17.2399	-17.1924
2	6170.29	89.594	9	0.000	5.7e-12	-17.3709	-17.3186	-17.2356*
3	6189.46	38.339	9	0.000	5.6e-12	-17.3996	-17.3249*	-17.2063
4	6197.4	15.875	9	0.070	5.6e-12	-17.3966	-17.2995	-17.1453
5	6206.81	18.823	9	0.027	5.6e-12	-17.3978	-17.2783	-17.0884
6	6218.07	22.525*	9	0.007	5.5e-12*	-17.4042*	-17.2622	-17.0368
7	6219.84	3.5392	9	0.939	5.7e-12	-17.3837	-17.2194	-16.9584
8	6225.96	12.244	9	0.200	5.7e-12	-17.3756	-17.1889	-16.8923
9	6230.61	9.293	9	0.411	5.8e-12	-17.3633	-17.1542	-16.822
10	6237.28	13.334	9	0.148	5.8e-12	-17.3567	-17.1252	-16.7574
11	6240.45	6.3489	9	0.705	5.9e-12	-17.3403	-17.0863	-16.683
12	6247.76	14.613	9	0.102	5.9e-12	-17.3355	-17.0591	-16.6202

Endogenous: djx dfc dsh

Exogenous: _cons