LUND UNIVERSITY
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The Change of Relationship between Real Estate and Stock Markets in China

---An Application of VaR Mothod

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Abstract

The real estate market and stock market, as two major investment channels in China, had experienced dramatically skyrocketing and fluctuations. Especially, after 2008 financial crisis, the price index of these two asset markets tended to be alternately soaring and declining. It seems there is a new principle or new relationship generating between the real estate and stock markets. This study employs VAR model and on the base of data from 2003 January to 2013 December to explore and discuss whether the relationships between the real estate market and stock market changed after financial crisis in 2008 emerged in China. The results show that there is no significant relationship existing between the real estate market and stock market during 2003 to 2008; while there is a significantly negative long-term relationship after the financial crisis in 2008.

Keywords: Real Estate Market; Stock Market; Inflation; Financial Crisis; VAR Model

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1. Introduction

"Bubble economy", "Economic downtown", "Demographic dividend disappears" or "Wealth gap", no matter how many labels the mass media attached to Chinese Economy in the past 30 years, one thing they cannot deny is that the development of Chinese economy was much talked by people. Especially over the last two decades China has over taken the U.S, and the Germany to be the world's largest exporter. This fantastic development benefit from China's basic handicraft industry, and its summit was reached during 2003 to 2007 when Chinese GDP kept for 5 consecutive years of double-digit growth. But unfortunately, because of demographic dividend disappear and marginal labor costs rise, China's basic handicraft industry meets its bottleneck. The old economic development strategy seems cannot carry on China to the next new continent. In this very moment, economic transformation has become the urgent need as Chinese want to keep its highly economy development.

In fact, in the past one to two decades, there were two industries developing in China with dramatic performance which seems would instead of handicraft industry to be the core of Chinese economy. One is Chinese real estate market. It reformed in the July 1998 which replaced China's old welfare-based allocation of housing with a fully commercialized housing market. Since then the country's housing markets have seen some extraordinary peaks and valleys. Many of the largest movements can be tied to government policy actions (Richard *et al*, 2014). And according to China's National Bureau of Statistics, the real estate industry as a share of GDP was as high as 6%, but the real estate investment contribute to GDP increase rate was more than 50%, which means it still has a crazy increase in the future. The other one is the stock market in China. Since 1989, stock market, as one of the most important finance units, was supported by Chinese government with lots of policies. In the recent years, the total capitalization of stock market has shared more than half of GDP in China.

Based on these two markets' eye-catching performance, there are lots of scholars focusing on discussing about the mutual influence or so-called relationship between these two markets. One of the mainstream opinions is that the change of stock market index and real estate price are in inverse directions (Yin 2007; Zhou 2006; Zhao 2007; Okunev and Wilson 1997). This is to say that the relationship between them is negative. But here's where the story gets strange that both markets performance very well around 2010 in China, which is different from the former theoretical description. It is interesting for us to study the relationship between the real estate and stock markets. We notice that the latest financial crisis

influenced Chinese market a lot in 2008. Thus, we assume that financial crisis might be the major case which induces both markets performance different from former years. And according to this interesting phenomenon, we boldly put forward a research question: Did the relationship between the real estate and stock markets change due to finance crisis in 2008?

This paper is organized as follows. In Sec. 2, it provides background of the real estate market and stock market and a brief review of the relevant literature. Further, we find a gap contrasting with previous study. While Section 3 is to introduce selected variables and explain the reason why we choose these variables. Moreover, it is important to present the main methodologies including VAR Model and four tests such as Unit Root Test, Co-integration Test, Granger Causality Test, Impulse Response function and Variance Decomposition. In the following section, it comes to interpret the process of data analysis including VAR model, four tests and discussion of the outcome; and the analysis of regression results would be organized at the end of this section. The final section is to draw a conclusion on the change of relationships between the real estate market and stock market after financial crisis emerged in China.

2. Literature reviews

At the beginning of this section, we introduce the background of real estate market and stock market that means how to develop with different stages. Meanwhile, there are several factors influencing real estate price and stock price respectively. Finally, it discusses the previous study on relationship between the real estate and stock markets. According to previous literature, we find a gap that there is no literature studying whether finance crisis in 2008 influenced the relationship between both two markets.

2.1 Real Estate Market

Before 1998, housing was part of China's employment-based benefit system when the majority of employees work in government institutions or state-owned enterprises received free housing allocated by their employers. In 1998, this marks the official start of the residential real estate market in China, which means welfare-oriented public housing distribution system was completely dismantled in China. We discuss real estate market since 1998 and divide four phases of development history from 1998 to 2010.

Phase 1 (from 1998 to 2003) Since 1998, the Asian Financial Crisis like a storm swept across China. China adopted an expansionary monetary policy to stimulate domestic demand and combat this storm. Due to implement of this policy, the commercial banks were encouraged to make mortgage loans to individuals under the central bank's window guidance and the mortgage rate dropped from 10.53% to 5.76% during this period. Xu and Tao (2012) find that the real estate price emerged out of the negative impact of the Asian Financial Crisis and increased at a steady speed.

Phase 2 (from 2003 to 2008) The real estate price change from excessive growth to tepid growth. In order to promote healthy development in the real estate market, Chinese government proclaimed a series of notices to implement tightening monetary policy. Although tightening monetary policy was performed successfully, the Chinese real estate price continued to soar. During the last quarter of 2007 and first quarter of 2008, the national home price growth index surged to over 10%. According to this data, it was obviously a real estate bubble. However, since the second quarter of 2008, the real estate price growth began to decelerate due to the ongoing global financial crisis and the highly restrictive monetary policy in China (Xu and Tao, 2012).

Phase 3 (from 2008 to 2009) In order to combat global financial crisis, the PBC implemented expansionary monetary policy which resulted in tremendous expansion of money supply and bank loans. Meanwhile, lots of global investors paid their attention to China's real estate market resulting in hot money flowed into real estate market. And then the national home price growth index rebounded swiftly, from −1.1% to 5.8%.

Phase 4 (from 2009 to 2010) In order to control the overheating house price and reduce the risk of a real estate bubble, the Chinese State Council proclaimed many critical measures since the beginning of 2010. For example, the minimum down payment for the second home has been raised gradually to 50% as one measure of tightening monetary policy. With the implementation of tightening monetary policy, growth rate of the real estate decelerate.

After looking back at historical development of the real estate market, there are two relative important tools or policies to control the real estate price such as credit policy and the interest rate policy.

Credit policy is made by the central bank to direct financial institutions' credit size and structure according to macroeconomic policy, industrial policy and area economic development policy. For example, the PBC frequently revised its real estate credit policy by changing mortgage minimum down payment for regular first home. And it is issued by window guidance and it is effectively expand or restrict the supply of bank credit to the real estate sector.

The interest rate policy can be used as a monetary policy tool to affect the real estate home price growth. However, it is no worth in China. Benchmark interest rate in China is heavily controlled by the central bank. Unlike in the U.S. benchmark interest rate is driven by the market and frequently updated interest rates.

Among the above tools, credit policy is a specific tool that can be used to affect real estate price growth by controlling the loans made by commercial banks to the real estate sector. From macro perspective, the growth of money supply may affect real estate price growth indirectly through two channels: first, a change in the growth of money supply will affect the loan-making ability of commercial banks, thus affecting the loans made to the real estate sector as well; second, an increase in the growth of money supply will affect the public's inflationary expectation, then affecting the real estate price growth indirectly.

2.2 Stock Market

The China's stock market was born in the early 1990s was a major step in the economic development strategy. It aimed to solve the problem of capital shortage for state-owned companies in the early (Zhang and Fung, 2006). With healthy development of China's stock market, there are two periods divided after 1990s.

Carrying historical significance, formation and initial development stage of national stock market occupied from 1992 to 1999. Then, the first wave of national stocks appeared. However, Due to incomplete supply and demand mechanism and market monitoring mechanism, China's stock prices showed volatility characteristics, with a strong speculative. For instance, in the Shanghai Stock Exchange, in May 1992 the share price was fully liberalized and free auction. Within only three days, the Shanghai Composite Index rose from 617 points to 1429 points. Subsequently, due to the IPO, there was an unprecedented large fluctuation that the Shanghai Composite Index fell all the way from 1429 points to 387 points. Base on this lesson, government was determined to establish a sound regulatory system of the stock market. Gradually, security regulatory system took shape that the Securities Commission of the State Council and the China Securities Regulatory Commission set up in October 1992. Overall, in the beginning of this stage, Chinese investors have not yet established the correct investment philosophy, coupled with the smaller size of the market, resulting in a time of speculation in vogue. Then the establishment of regulatory system played the role of regulating the market to further guide the public to establish the correct investment philosophy.

The second phase is specification and development phase of the stock market from 2000 to the present. There are three main aspects to reflect this phase. Aspect one: "Securities Act" on July 1, 1999 formally implemented which is the first law of Chinese norm securities issuance and trading behavior. Therefore, it confirmed the legal status of the capital market. Consequentially, in October 2005, National People's Congress amended the "Company Law" and implemented on January 1, 2006. Aspect two: Tradable share reform achieved the stock market's real supply and demand and the pricing mechanism. It is also conducive to improve the investment environment, promote the sustained and healthy development of the securities market and protect investors' legitimate rights and interests of public investors in particular. Aspect three: Sound Securities Company operation and monitoring system is the cornerstone

to maintain our long-term healthy development of the stock market. Securities Company implemented third-party depository system. Securities firms was to establish financial disclosure information and basic information publicity system, n order to improve the net capital as the core of risk monitoring and early warning system.

Although establishment of regulatory system, standardized and sound legal system and tradable share reform are good to improve the investment environment and promote sustained stable healthy stock market system, Chinese government's policy action is also powerful to influence stock price. For example: on the one hand, when stock market continued to slump in 1994, due to a large area of the entire stock market funds at low tide, then three good bailout policies that announced by The Securities Regulatory Commission and the State Council initiated rally so that achieved the purpose of stability and development of the stock market. And in the beginning of 2000, due to favorable policies one after another, stock price was created a record high. First, stock market allowed brokerages stock collateral loans, after the implementation of the placement of new shares emerged in the secondary market. On the other hand, when the stock market continued to surge, in order to curb the stock market continued to surge, traded fund securities were subject to price limits of Price 10% in 1996.

Moreover, stock price is not only influenced by unstable stock market before or diversification of domestic stock market so far, but the international economic situation also would affect the stock price. For example, large numbers of oversea investors come into Chinese stock market.

2.3 Relationship between Real Estate market and Stock Market

Based on the illustration of the reason why real estate price and stock price are influenced, there are some similar reasons for both of them. It is interesting to find that there is a specific relationship between real estate and stock market. And preview literature also has studied the relationship between the real estate and stock markets.

Lin and Lin (2011) studied the integration relationship between stock and real estate markets in China, Hong Kong, Japan, Singapore, South Korea, and Taiwan. They found that the Chinese stock market is partially integrated with the real estate market.

Zhang and Fund (2006) studied the relationship between the stock and real estate markets in the early 2000s, when there was an imbalance between simultaneous low stock market growth and high real estate market growth. They found that stock returns and real estate returns were negatively correlated from 1997 to 2005. Their results suggest that the heated housing market partially explains the bearish performance of the stock market in that period.

Chan and Chang (2014) analyzed the stock and real estate markets in China from February 2003 to June 2011. As asset classes, these two markets have their own volatility and return characteristics. They offered such a study with a Chinese perspective which will shed some light on the topics of dampening a soaring real estate market and the effects of using an aggressive lending rate policy as a tool to do so. There are significant price transmission effects from the stock market to the real estate market.

A large number of scholars' general conclusion was that the relationship between stock prices and real estate prices is negative and low (Yin 2007; Zhou 2006; Zhao 2007; Okunev and Wilson 1997). But here's where the story we mentioned before in the introduction gets strange that both markets performance very well around 2010 in China, which is totally different from the former theoretical description. This thesis tries to study the relationship between real estate and stock market, based on this strange phenomenon under financial crisis in 2008. Because we notice that the latest financial crisis influenced Chinese market a lot in 2008. Meanwhile, we consider that whether the relationships between real estate market and stock market changed after financial crisis emerged in China in this period? Although lots of scholars study the relation between two markets, they do not consider financial crisis in 2008 during their studies. Thus, we assume that financial crisis might be the major case, which induces both markets performance different from former years, and this is also a gap for us to put forward.

3. Model establishment

3.1 Selected variables

To examine the relationship between the stock market and real estate market in China, firstly we select Shanghai Composite index and national housing price index as our main indicators which represent the stock market and real estate market respectively. After picked up two main indicators, it comes to control variables.

Firstly, we decide to pick up inflation as our control variable as inflation is an important measurement for considering fiscal and economic stability by most emerging market economies and developing countries because their economies depend heavily on external financing for economic expansion (Anthony G *et al*, 2015). From a positive perspective, moderate inflation enables labor markets to reach equilibrium faster (Tobin &James, 1969), and moderate inflation would induce savers to substitute lending for some money holding as a means to finance future spending (Tobin &James, 1969). In a word, a financial market can keep running effectively with moderate inflation. While, from a negative perspective, high or unpredictable inflation rates can act as a drag on productivity as companies are forced to shift resources away from products and services in order to focus on profit and losses from currency inflation (Taylor &Timothy, 2008). Further, uncertainty about the future purchasing power of money, which lead by high inflation, discourages investment and saving (Bulkley & George, 1981). Anyway, no matter a moderate or high inflation, both of them could be considered as a key factor to human economy market. Thus, as the two core of Chinese market, stock market and real estate market are inevitably affected by inflation.

Secondly, we picked currency liquidity as our second control variables. Here currency liquidity refers to the relative amount of nominal money due to the amount of nominal money determine the total amount of funds which is available for investment in one society. There is strong empirical evidence of a direct relation between money-supply growth and long-term price inflation, at least for rapid increases in the amount of money in the economy (Milton Friedman, 1987). Further, M_2 also decide how much money is free for stock market and housing market in a short time. Thus, we picked M_2 as our second control variables and use GDP to weight M_2 in different years. Finally we select CPI as the indicator of inflation and M_2/GDP as the indicator of currency liquidity.

All of the variables are transformed into logarithm in order to eliminate the influence of extreme values which possibly stay in our time series data.

3.2 The source of data

All of our variables were selected over the period of 2003 January to 2013 October. CPI, M_2 and GDP are collected from China's National Bureau of Statistics. National housing price index and Shanghai composite index are obtained from the Sina Financial website www.finance.sina.com.cn.

3.3 Method and VAR Model

Because our study is not only considering about the relationship between Chinese stock market and real estate market, but also to see if relationship change after the beginning of the financial crisis. But what is the specific moment of the start of financial crisis in China? **We notice that the first time that Chinese government response to how to deal with financial crisis is the November 4, 2008 on Chinese council meeting, which announced that the global economic crisis spread to China already.** Therefore, we use this historical timing to separate our data into two time periods (2003 January to 2008 November; 2008 December to 2013 October).

Our research prefers Vector Auto regression model (Sims, 1980) to study what relationships were there between real estate market and stock market before and after financial crisis in China. This econometric model is used to describe interaction among multiple variables. The equation of VAR (i) in our model can be represented as:

$$\mathbf{LNSP_t=\alpha_0+\sum\alpha_{1i}LNSP_{t-i}+\sum\alpha_{2i}LNHP_{t-i}+\sum\alpha_{3i}LNCPI_{t-i}+\sum\alpha_{4i}LNCL_{t-i}+\mu_{1t}}$$

$$\mathbf{LNHP_t=\beta_0+\sum\beta_{1i}LNSP_{t-i}+\sum\beta_{2i}LNHP_{t-i}+\sum\beta_{3i}LNCPI_{t-i}+\sum\beta_{4i}LNCL_{t-i}+\mu_{1t}}$$

$$\mathbf{LNCPI_t=\gamma_0+\sum\gamma_{1i}LNSP_{t-i}+\sum\gamma_{2i}LNHP_{t-i}+\sum\gamma_{3i}LNCPI_{t-i}+\sum\gamma_{4i}LNCL_{t-i}+\mu_{1t}}$$

$$\mathbf{LNCL_t=\delta_0+\sum\delta_{1i}LNSP_{t-i}+\sum\delta_{2i}LNHP_{t-i}+\sum\delta_{3i}LNCPI_{t-i}+\sum\delta_{4i}LNCL_{t-i}+\mu_{1t}}$$

Where LNHP represents housing price index, LNSP represents Shanghai composite index, LNCPI represents Chinese inflation and LNCL represents currency liquidity. Besides, α_0, β_0, γ_0, δ_0 are intercepts for all equations, μ is the residual, and t and i are time number and lag period respectively.

4. Data Analysis

4.1 Unit Root Test

In order to avoid obtaining spurious regression, we need to ensure that all the time series are stationary before establishing VAR model. Appropriately, Augmented Dickey-Fuller (ADF) unit root test is employed to examine the stationary of time series. According to Dickey and Fuller (1979), the testing procedure of ADF is applied to the model:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \delta \Delta Y_{t-1} + \ldots + \delta_{p-1} \Delta Y_{t-p+1} + \varepsilon_t$$

Where α is constant, t is trend variable, γ is difference operator and ε_t is an i.i.d. $N(0, \sigma^2)$. And when constraints $\alpha = 0$ and $\beta = 0$ corresponds to model a random walk without interpret and when constraints $\beta = 0$ corresponds to model a random walk with interpret. The null hypothesis of above equation is H_0: $\gamma = 0$, while alternative hypothesis is H_1: $\gamma < 1$. These two hypotheses would be tested and chosen by the T-ratio of γ. And rejecting null hypothesis means time series has no unit root and it is stationary. The results are displayed in table 1 and 2.

Table 1: Unit root test before 2008 December

variable	test type	ADF test statistic	5% critical value
LNCL	(C,0,2)	-0.868	-2.890
D(LNCL)	(C,0,2)	-24.434*	-2.890
LNSP	(C,0,1)	-2.543	-2.890
D(LNSP)	(C,0,1)	-3.697*	-2.890
LNHP	(C,0,1)	-2.582	-2.890
D(LNHP)	(C,T,0)	-3.764*	-2.890
LNCPI	(C,0,1)	-1.860	-2.890
D(LNCPI)	(C,0,0)	-6.181*	-2.890

Note: Test type (C, T, K) indicates unit root test equations include intercept, trend and lag period.

"*" Indicates that at 5% level of significance reject original assumptions.

Table 2: Unit root test after 2008 December

variable	test type	ADF test statistic	5% critical value
LNCL	(C,0,2)	-4.958*	-2.890
D(LNCL)	(C,0,2)	-6.223*	-2.890
LNSP	(C,T,0)	-4.133*	-2.890
D(LNSP)	(C,0,0)	-7.562*	-2.890
LNHP	(C,0,0)	-1.073	-2.890
D(LNHP)	(C,0,0)	-3.864*	-2.890
LNCPI	(C,0,3)	-2.559	-2.890
D(LNCPI)	(C,0,2)	-3.057*	-2.890

Note: Test type (C, T, K) indicates unit root test equations include intercept, trend and lag period.
"*" indicates that at 5% level of significance reject original assumptions.

According to Table 1 and 2, at 5% level of significance, time serious of LNCL, LNSP, LNHP, LNCPI are all I(1) series before December 2008; after December 2008, time serious of LNCL and LNSP become I(0), while LNHP and LNCPI are still non-stationary, unless they are in first difference. Since there are non-stationary original time series at both periods of time, according to Co-integration theory, we are going to examine whether co-integration relation exists on our variables or not.

4.2 Co-integration test

Co-integration test is used to test whether there exist a long-term equilibrium relationship among variables. To achieve this test, we choose Johansen-Juselius multivariate maximum likelihood method as our model try to explore the long term relationship among four variables. Besides, in order to avoid bringing out loss of the information of original variables (Haiqing Yu *et al*, 2014), we prefer to regressing these variables at their original levels rather than regressing at differentials. The results are displayed in table 3 and 4 as follows.

Table 3: Co-integration test before 2008 December

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.390	72.012	47.856	0.0001
At most 1 *	0.229	37.863	29.797	0.0048
At most 2 *	0.154	19.945	15.495	0.01
At most 3 *	0.114	8.372	3.841	0.0038

Trace test indicates 4 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 4: Co-integration test after 2008 December

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.468	65.250	47.856	0.0005
At most 1 *	0.323	29.889	29.797	0.0488
At most 2	0.115	8.035	15.495	0.4617
At most 3	0.021	1.212	3.841	0.2709

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

* Denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 3 and 4 prove that at 5% level of significance, there are four co-integration relations among the variables before 2008 December and two co-integration relations among the variables after 2008 December. It shows that there exists several long term dynamic equilibriums relationships among inflation, currency liquidity, housing price index and shanghai composite index before and after 2008 December. Based on the results of Johansen-Juselius tests, we are admitted to establish VAR model with these four variables in both time periods.

4.3 Establish VAR model

Before we establish our VAR model, we need to decide the optimal lag number by AIC, FPE, SC and

HQ criterion. According to table 5 and 6, see appendix table 5 and 6, the optimal lag order for both time period is p = 2.

Although the SC and HQ criterions show different result compared to AIC and FPE criterions in table 6, we generally put a greater emphasis on AIC criterion rather than BIC due to AIC and AICc can be derived in the same Bayesian framework as BIC, just by using a different prior, what's more, AIC/AICc has theoretical advantages over BIC (Burnham & Anderson, 2002). Thus, we use AIC criterion to pick up the optimal lag for our model and the optimal lag of our model is p = 2. And unit root test on residual error of co-integration equation indicates that our model is valid and credible. Finally, with the results of co-integration test and the optimal lag, we can establish our VAR(2) model, see appendix table 7 and 8. One of the typical co-integration equations is displayed as follows: (t-statistics in parenthesis)

LNSP = 5.189683 +0.885447LNCPI(-1) -3.52957 LNCPI(-2)+
[3.32343] [0.48421] [-2.98417]
0.000452 LNCL(-1) -0.10471 LNCL(-2) -0.08958 LNHP(-1) +
[0.00397] [-0.89657] [-0.05181]
0.172836 LNHP(-2) +0.933047LNSP(-1) +0.097675 LNSP(-2)
[0.10249] [7.34402] [0.73087]
R^2= 0.970198 F= 248.2306

The equation illustrates that before 2008, the Shanghai composite index was mainly influenced by its lag period 1 and the lag period 2 of CPI. The influence coming from stock price itself is 0.933047, which means increasing 1 unit of Shanghai composite index in its lag period 1 will lead to 0.933047 unit raises of current Shanghai composite index. The other hand, 1% of CPI increases in lag period 2 will cause 3.52957% of Shanghai composite index go up.

4.4 Granger Causality Test

Co-integration tests as displayed earlier in this article illustrate that there exists long term equilibrium relationship among variables in both time periods (before and after 2008 December). But it falls in explaining the causality among variables. Granger causality test (Granger, 1969) can solve this problem wtih conducting a regression analysis on Y to X and its own lagged value (Haiqing Yu *et al*, 2014). The results are shown in table 9 and 10.

Table 9: Granger Causality test before 2008 December

Null Hypothesis:	Lag	F-Statistic	Prob.	Conclusion
LNCL does not Granger Cause LNCPI	2	0.572	0.567	Not rejected
LNCPI does not Granger Cause LNCL		1.137	0.327	Not rejected
LNHP does not Granger Cause LNCPI	2	0.673	0.514	Not rejected
LNCPI does not Granger Cause LNHP		0.121	0.887	Not rejected
LNSP does not Granger Cause LNCPI	2	6.345	0.003	Rejected
LNCPI does not Granger Cause LNSP		5.384	0.007	Rejected
LNHP does not Granger Cause LNCL	2	1.036	0.361	Not rejected
LNCL does not Granger Cause LNHP		0.039	0.962	Not rejected
LNSP does not Granger Cause LNCL	2	2.066	0.135	Not rejected
LNCL does not Granger Cause LNSP		0.222	0.802	Not rejected
LNSP does not Granger Cause LNHP	2	0.639	0.531	Not rejected
LNHP does not Granger Cause LNSP		0.095	0.909	Not rejected

Table 10: Granger Causality test after 2008 December

Null Hypothesis:	Lag	F-Statistic	Prob.	Conclusion
LNCPI does not Granger Cause LNCL	2	0.068	0.934	Not rejected
LNCL does not Granger Cause LNCPI		0.626	0.539	Not rejected
LNSP does not Granger Cause LNCL	2	0.123	0.885	Not rejected
LNCL does not Granger Cause LNSP		1.819	0.173	Not rejected
LNHP does not Granger Cause LNCL	2	0.088	0.916	Not rejected
LNCL does not Granger Cause LNHP		0.428	0.654	Not rejected
LNSP does not Granger Cause LNCPI	2	3.256	0.047	Rejected
LNCPI does not Granger Cause LNSP		2.209	0.120	Not rejected
LNHP does not Granger Cause LNCPI	2	3.943	0.026	Rejected
LNCPI does not Granger Cause LNHP		2.569	0.087	Rejected
LNHP does not Granger Cause LNSP	2	6.619	0.003	Rejected
LNSP does not Granger Cause LNHP		4.690	0.014	Rejected

Table 9 illustrates that there is a bidirectional causal relationship between inflation and Shanghai composite index before 2008 December. From table 10, we can see that, after 2008 December, Shanghai composite index Granger causes inflation; housing price is the bidirectional Granger reason for inflation

and Shanghai composite index.

From an empirical perspective to appraise the comparisons of these two Granger causality test results, there are two significant conclusions worth to be considered: i) there is no Granger causality relationship between housing price and Shanghai composite index before 2008 December based on our data; ii) inflation seems to be an extremely important variable in our model as it deeply matters both of housing price and Shanghai composite index in all time periods.

The first conclusion seems counterintuitive at first due to more than one former literatures (Zhou 2006, Zhao 2007; Ye Sun *et al 2009* and so forth) have proved that there is one-way or two-directional relationship between real estate industry and stock market in China. One of the best explanations is discussed by Zhao (2007). Zhao proves that the relationship between housing price index and stock price index is changing over time, which implies it is possible that losing relevance between stock market and real estate in a certain time period. The other explanation is depended on Granger causality test itself. According to Granger causality theory, generally Granger causality test can be separated into linear and nonparametric Granger causality tests. These two different Granger causality tests may lead to different results. For example, Aye *et al* had provided empirical evidence on the long- and short-run relationships between real estate industry and stock market of South Africa. In their study, the linear Granger causality test concluded a totally different result respect to nonparametric Granger causality test. Based on this situation, we put our time series into nonparametric Granger causality test for a retest. The result, see Appendix table 2, shows that real estate industry and stock market did not matter each other in first time period as well. Thus, we maintain that it is really no relationship existing between real estate industry and stock market during first time period.

Although our study mainly focuses on the relationship between real estate industry and stock market in China, inflation is noticed by us since it gets its popularity on significant degree corresponding to stock market and real estate market. Lots of scholars (Ke Tang *et al*, 2014; Tianfeng Li *et al*, 2014; Sandeep Mazumder 2014) had maintained that China has suffered from high inflation around financial crisis in 2008. More specifically, Mantas Valukonis (2013) found that there was a semi strong correlation existing between China's stock market indices and China inflation. Yiping Huang *et al* (2010) proved that stock price and housing price have a significantly positive impact on inflation in China.

4.5 Impulse Response Function

Granger causality test mainly focuses on demonstrating the causal relationship among all variables, but it is disadvantage for lack of describing the specific affecting process. To explain the impact of an endogenous variable on current and future value of other variables, impulse response function is recommended by Haiqing Yu *et al* due to impulse response function is based on VAR model and it used to describe the affect path resulted by one S.D innovation of random disturbance term to other variables change (Ye Sun *et al.,* 2009).

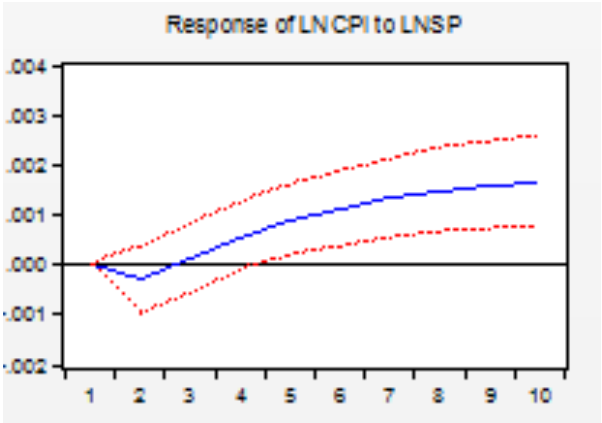

Fig.1. before 2008 December

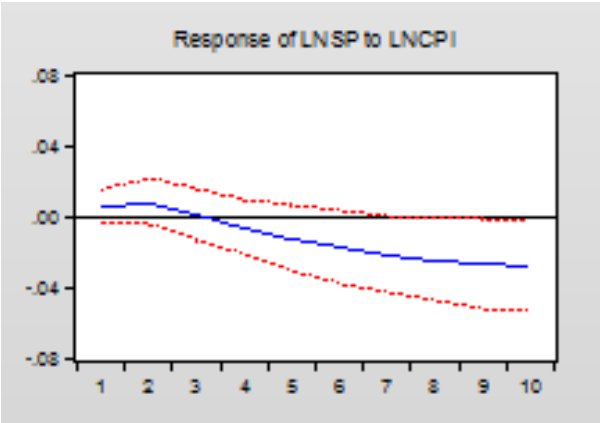

Fig.2. before 2008 December

According to Fig.1 and Fig.2, information is concluded that inflation has a little bit negative influence on Shanghai composite in the short term, but after 3th lag period it has a significant positive influence on Shanghai composite index and this kind of influence tend to be stable at the 8th period. While, the impact of Shanghai composite index to inflation is just on the contrast.

The process of response of inflation to Shanghai Composite index had been proved by Anari *et al* at 2001 that inflation has a negative short run effect on stock returns but few studies report a positive long run Fisher effect for stock return. What's more, AL-Sharkas and AL-Zoubi (2014) found the similar phenomenon in four Arab countries. Both of these studies prove that the conclusion shown in Fig.1 is credible. One more problem is, at the beginning of time line, the blue curves in Fig.1 and Fig.2 across X-axis for once. In most cases, many scholars, such as Berlemann *et al*, would argue that stock index (inflation) do not react significantly to inflation (stock index). The likely interpretation of this result is

put forward by *Arjoon et al* 2012 that there may be any deviations in the short run.

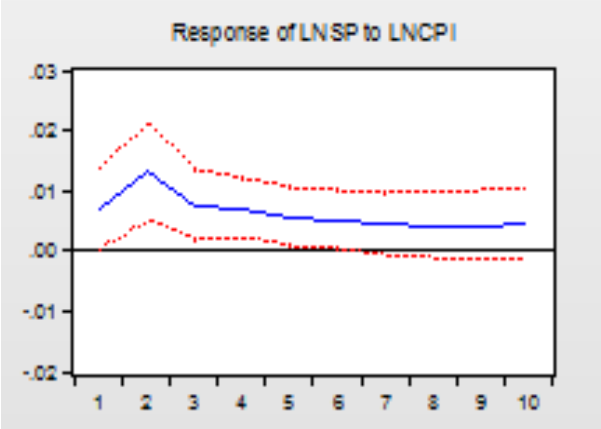

Fig.3. after 2008 December

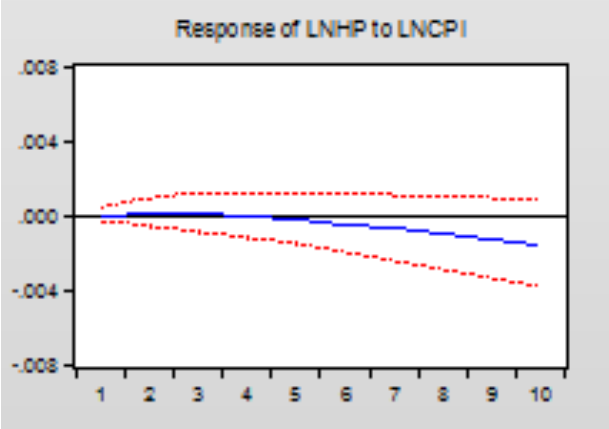

Fig.4. after 2008 December

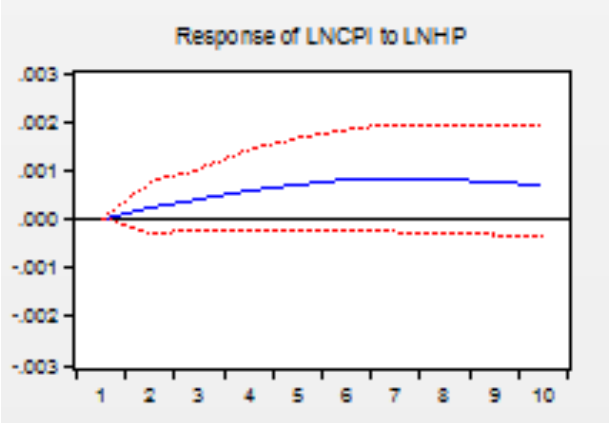

Fig.5. after 2008 December

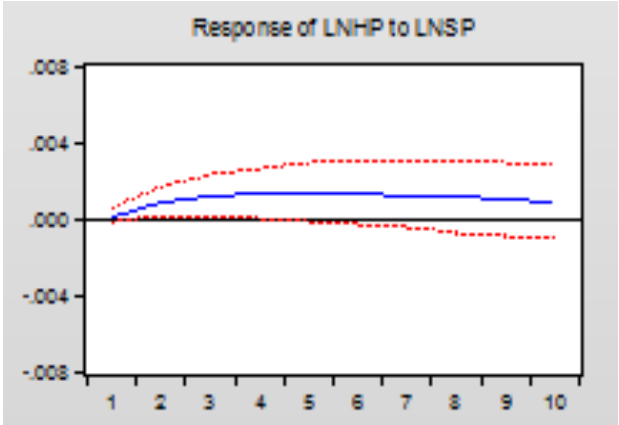

Fig.6. after 2008 December

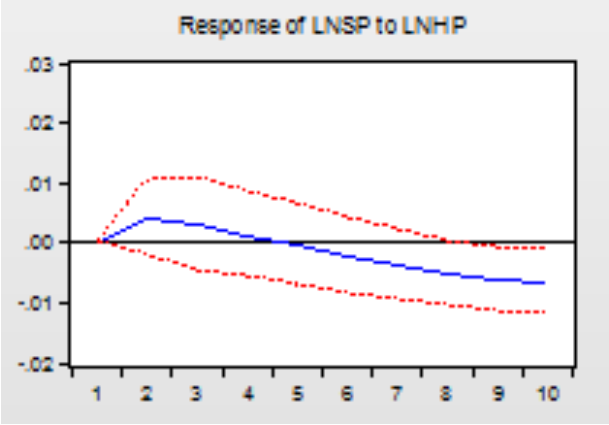

Fig.7. after 2008 December

The results of impulse response function after 2008 are more interesting. Fig.3 clearly shows that an increase in Shanghai Composite Index leads to a significant increase in inflation after 2008 December. And it is obvious that housing price index input leads to a decrease of inflation based on Fig.4. Meanwhile, the increase of inflation did a significantly positive effect on the housing price index in Fig.5.

When it comes to the relationship between housing price index and Shanghai Composite index, Fig.6 strongly illustrates that an increase of housing price index leads to an increase of Shanghai Composite index and this sort of positive influence tends to be stable at the 4th period. While the change of Shanghai Composite index leads to a reverse growth of housing price in the long term according to Fig.7.

4.6 Variance Decomposition

Variance decomposition is a method to analyze the relative importance of every innovation to endogenous variables by decomposing the fluctuation and the reason of each variable in VAR model (Haiqing Yu *et al*).

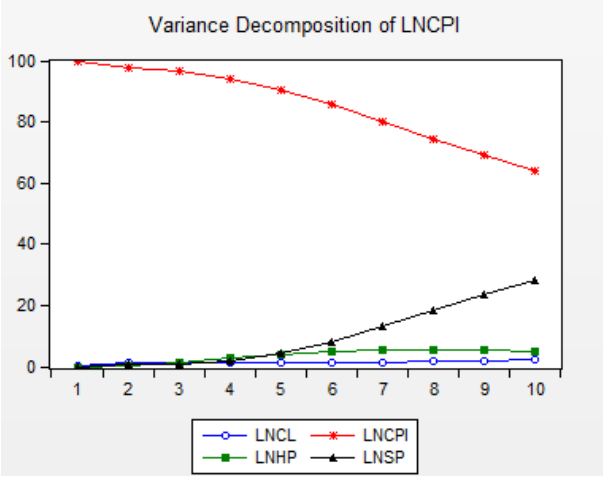

Fig.8. before 2008 December

Based on Fig.8, it illustrates that about 65% of inflation fluctuations were resulted from its own disturbance; the other mainly disturbance was resulted from Shanghai Composite index before 2008 December. The contribution degree of housing price and currency liquidity were little.

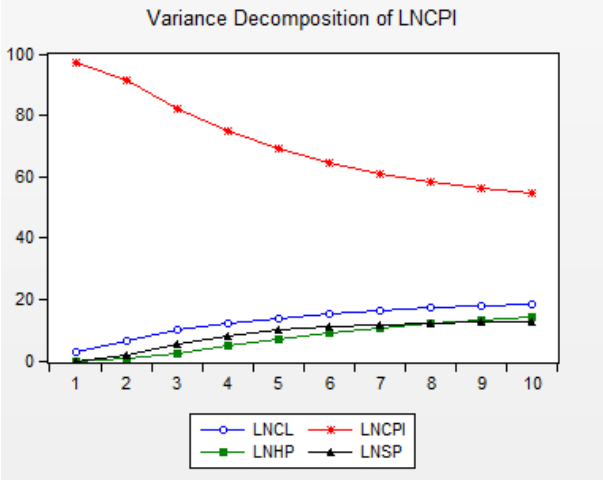

Fig.9. after 2008 December

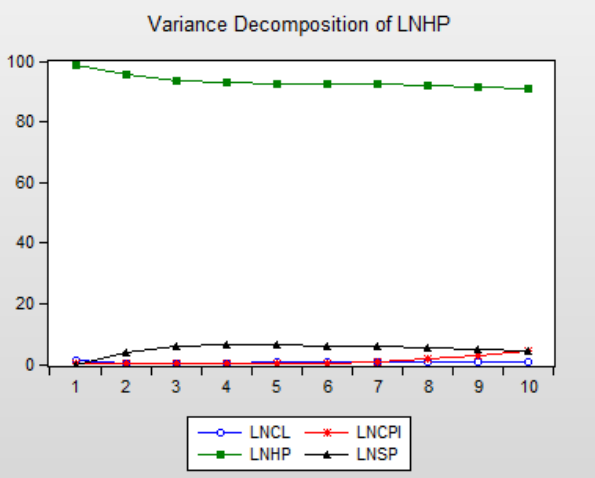

Fig.10. after 2008 December

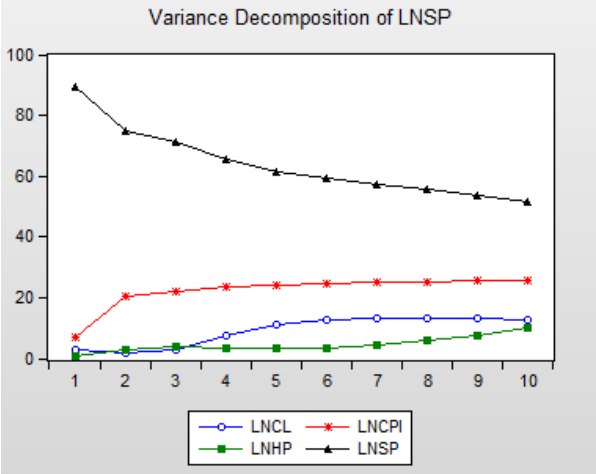

Fig.11. after 2008 December

According to Fig.9, after 2008 December, there is still 60% of inflation fluctuations were resulted from its own disturbance. The contribution degree of Shanghai Composite index, currency liquidity and housing price index were about 11%, 17% and 12% respectively. The valid lag period was 6.

Fig.10 indicates that after 3th period the impact of housing price index on itself was more than 90% which means housing price index after 2008 December was mainly influenced by itself. Significantly but not too much, Shanghai Composite index shows its bigger degree of contribution compared to other two variables after 3th period, but the degree is only about 8% or 9%.

The Shanghai Composite index was impacted by lots of variables. In Fig.11, firstly 60% of Shanghai Composite index fluctuations were influenced by its own disturbance. On the other hand, after 3th period, the degree of contribution to inflation is about 25%. After 5th period, the impact of currency liquidity reaches to about 10%. While, at 10th the housing price index become more influential as much as currency liquidity.

4.7 Discussion

Based on the results of granger causality test, impulse response function and Variance decomposition test in the first time period, we find that inflation has a significantly positive influence on stock price, and stock price has a significantly negative influence on inflation. We argue that there are three main factors inducing this situation. Firstly, as we all know, because of subprime crisis, American economy was getting worse before 2008. Bad economic conditions made many American enterprises have to cut their overseas orders. China, as an export-oriented developing country, lost a large number of orders from United States. Decreased overseas orders produced lots of working capital in China. Secondly, with performance of the comprehensive shareholding reform plan and the expected appreciation of Chinese Yuan, China's stock market ushered in an unprecedented development way. Booming stock market provided an excellent investment channel. And certainly it attracted lots of idle capital to join. Thirdly, because of the sustained rapid economic development before 2008, inflation, which always stayed at a high level in China, also contributed its catalytic ability to Chinese stock market (Anthony G *et al*, 2015). Under this inflationary pressure, all the individuals, who have lots of free money in their pockets in China, are eager to do some investments preventing property devaluation. This is why inflation has a significantly positive influence on stock price. And certainly, when large amounts of free money flow into stock market, the influence of inflation would decrease due to the total money in society have been digested partly by stock market. This is why stock price has a significantly negative influence on inflation. But at the same time, because of its high investment threshold and relatively long investment cycle, real estate industry did not develop as fast as stock market. We argue that this imbalanced development led to relationship temporary disappeared between stock market and real estate market based on data before financial crisis swept in China.

The second part of results of our regression gave us more interesting information. Firstly, we find that

inflation has a significantly positive influence on housing price; however housing price has a significantly negative influence on inflation. Secondly, housing price has a significantly positive influence on stock market, while stock market force on suppressing housing market. All of these situations could be explained by the “four trillion” program.

The “four trillion” program put forward by Chinese government in Chinese council on November 4, 2008, aiming to stimulate the Chinese economy under financial crisis. The specific content of plan is to inject four trillion capitals into Chinese market for increasing liquidity by banks. But unfortunately, this plan owned its drawbacks. Firstly, these four trillion directly pushed inflation up in Chinese market. Secondly, because all the money was lend by banks, it to some extent made all the money flow into same direction. As we all know, Chinese real estate industry has some features including high expected income, low industry risk and a great deal of investment which get its popularity in front of bank lending officer. Therefore, in fact, most of capitals in “four trillion” program flowed into real estate industry by lending in China after 2008 (Sina website, 2009). This is why inflation has a significant positive influence on housing price after financial crisis emerged, as the “four trillion money” established certain strongly internal relationship between inflation and housing price. While when it comes to the significant relationship between housing market and stock market, it is easy to be understood as well. There are several real estate firms listed in stock market which refers to a booming housing market would push Shanghai Composite index up. At the same time, stock price has a negative impact on housing price in long-term, since stock market in most of cases only separate the free capitals from housing market. This is the reason why housing price has a significantly positive influence on stock market; while stock market force on suppressing housing market after financial crisis emerged.

5. Conclusion

This paper devotes the whole sections to study whether the relationship between the real estate market and stock market changed after financial crisis emerged in 2008 in China. According to former literatures, inflation and currency liquidity as control variables are employed into our VAR model. In order to implement our empirical studies with VAR model, we adopt ADF test, Co-integration test, Granger Causality test, impulse response function and variance decomposition and so forth to study the relationship among four time series by Eviews 8. According to the results drawn from several tests, we can conclude several summaries.

(1) Johansen-Juselius test illustrates that there were several long-term equilibrium relationships among variables in both time periods. According to our results, individual investors should adopt a cautiously attitude towards investing stock market or real estate market, and Chinese government should consider the problem of inflation and currency liquidity as well. Because as long as these variables can impact each other, any one of variables go into an unexpected shock would create widely erratic fluctuation of market price which would do harm to the benefit of investors and Chinese government.

(2) The result of Granger Causality test in first time period illustrates that there is a bidirectional causal relationship between inflation and Shanghai composite index in second lag period before 2008. But the result did not indicate that there is a relationship existing between housing price index and Shanghai composite index during 2003 January to 2008 December.

The result of Granger Causality test in second time period becomes more complicated. Compared to the first time period, one side Shanghai Composite index started to unilateral affect inflation; on the other side there is a significant relationship existing between housing price index and Shanghai composite index. Further, inflation becomes a bidirectional granger reason for housing price index. It is a signal for both investors and Chinese government that the fluctuations of Stock market price and real estate price have to follow certain “rules” in China now. And these “rules” could be described in details by impulse response function and variance decomposition as follow.

(3) The results of impulse response function and variance decomposition technology in first time period

illustrate that there is a significant mutual influence between inflation and Shanghai Composite index in the long term before 2008 December.

The results of impulse response function and variance decomposition technology in second time period illustrate that the growth of housing price index has a positive influence on Shanghai composite index, but has a negative influence on inflation. However, from a long-term perspective, the growth of Shanghai composite index has a negative influence on housing price index. This result reminds investors and Chinese government of the stock market's and real estate market's price rational return after financial crisis.

Look back to our analysis of our data regression results, we can confidently answer to our research question that the relationship between stock market and housing market exactly changed before and after financial crisis happened in China. But does this change caused by financial crisis? According to the factual basis, we find that financial crisis partly changed the relationship between stock market and real estate market. For example, after financial crisis happened in China, Chinese government put forward "four trillion" program making housing price has a significantly positive influence on stock market, which is totally different from the relationship before financial crisis happen. All in all, based on this conclusion, we are sure that we fill our gap that financial crisis plays an important role to influence the relationship between the real estate and stock markets during the period of financial crisis.

Appendix

1. The result of optimal lag number

Table 5: optimal lag test before 2008 December

Lag	LogL	LR	FPE	AIC	SC	HQ
0	451.6908	NA	2.25E-11	-13.16738	-13.0368	-13.1156
1	858.7585	754.2725	2.27E-16	-24.66937	-23.9188	-24.4107
2	889.1886	52.80516*	1.50e-16*	-25.09378*	-24.01657*	-24.62820*
3	903.8247	23.67606	1.58E-16	-25.05367	-23.3564	-24.3812
4	910.0601	9.353038	2.15E-16	-24.76647	-22.547	-23.887

* indicates lag order selected by the criterion

Table 6: optimal lag test after 2008 Decenmber

Lag	LogL	LR	FPE	AIC	SC	HQ
0	495.9331	NA	1.44E-13	-18.21974	-18.07241	-18.1629
1	739.8778	442.7145	3.10E-17	-26.66214	-25.92548*	-26.37804*
2	761.7161	36.39722*	2.53e-17*	-26.87838*	-25.55239	-26.367
3	771.867	15.41433	3.22E-17	-26.66174	-24.74642	-25.9231
4	779.3392	10.23962	4.64E-17	-26.3459	-23.84125	-25.38

* indicates lag order selected by the criterion

2. The non-parameter Granger Causality test results for both time periods.

Before 2008

Dependent variable: LNCPI			
Excluded	Chi-sq	df	Prob.
LNCL	1.222327	2	0.5427
LNHP	3.261486	2	0.1958
LNSP	14.57812	2	0.0007
All	17.50758	6	0.0076
Dependent variable: LNCL			
Excluded	Chi-sq	df	Prob.
LNCPI	0.271198	2	0.8732
LNHP	0.592047	2	0.7438
LNSP	2.028326	2	0.3627
All	5.008326	6	0.5427
Dependent variable: LNHP			
Excluded	Chi-sq	df	Prob.
LNCPI	0.03084	2	0.9847
LNCL	0.062568	2	0.9692
LNSP	0.963769	2	0.6176
All	1.293017	6	0.972
Dependent variable: LNSP			
Excluded	Chi-sq	df	Prob.
LNCPI	12.78319	2	0.0017
LNCL	1.104158	2	0.5758
LNHP	1.449742	2	0.4844
All	13.44329	6	0.0365

After 2008

Dependent variable: LNCL			
Excluded	Chi-sq	df	Prob.
LNCPI	0.886564	2	0.6419
LNSP	0.675532	2	0.7134
LNHP	0.995074	2	0.608
All	1.296264	6	0.9719
Dependent variable: LNCPI			
Excluded	Chi-sq	df	Prob.
LNCL	2.165591	2	0.3386
LNSP	5.640101	2	0.0596
LNHP	8.025948	2	0.0181
All	15.64342	6	0.0158
Dependent variable: LNSP			
Excluded	Chi-sq	df	Prob.
LNCL	2.49512	2	0.2872
LNCPI	8.087165	2	0.0175
LNHP	15.98759	2	0.0003
All	27.99415	6	0.0001
Dependent variable: LNHP			
Excluded	Chi-sq	df	Prob.
LNCL	0.927052	2	0.6291
LNCPI	5.824959	2	0.0543
LNSP	9.098299	2	0.0106
All	16.1642	6	0.0129

3. The whole VAR model

Table.7. the VAR model Equations before 2008 December

	LNCPI	LNCL	LNHP	LNSP
LNCPI(-1)	1.038978	1.001338	0.016658	0.885447
	-0.12388	-1.94617	-0.10089	-1.82863
	[8.38672]	[0.51452]	[0.16511]	[0.48421]
LNCPI(-2)	-0.24468	-0.80949	-0.01201	-3.52957
	-0.12051	-1.89321	-0.09815	-1.77887
	[-2.03030]	[-0.42758]	[-0.12234]	[-1.98417]
LNCL(-1)	0.008318	0.69331	-0.00076	0.000452
	-0.0077	-0.12095	-0.00627	-0.11364
	[1.08038]	[5.73236]	[-0.12108]	[0.00397]
LNCL(-2)	-0.00607	-0.26625	-0.00079	-0.10471
	-0.00791	-0.12429	-0.00644	-0.11678
	[-0.76676]	[-2.14214]	[-0.12279]	[-0.89657]
LNHP(-1)	0.131584	0.380462	1.636357	-0.08958
	-0.11713	-1.84004	-0.09539	-1.72891
	[1.12342]	[0.20677]	[17.1544]	[-0.05181]
LNHP(-2)	-0.13504	-0.42686	-0.64698	0.172836
	-0.11425	-1.79476	-0.09304	-1.68636
	[-1.18205]	[-0.23784]	[-6.95361]	[0.10249]
LNSP(-1)	-0.00808	0.179979	0.006498	0.933047
	-0.00861	-0.13521	-0.00701	-0.12705
	[-0.93905]	[1.33106]	[0.92695]	[7.34402]
LNSP(-2)	0.017436	-0.20186	-0.00591	0.097675
	-0.00905	-0.14223	-0.00737	-0.13364
	[1.92580]	[-1.41923]	[-0.80141]	[0.73087]
C	0.387151	0.489585	0.013121	5.189683
	-0.10579	-1.66192	-0.08616	-1.56154
	[3.65964]	[0.29459]	[0.15229]	[3.32343]
R-squared	0.929462	0.418797	0.99942	0.970198
Adj. R-squared	0.920212	0.342573	0.999344	0.96629
Sum sq. resids	0.000433	0.106824	0.000287	0.094311
S.E. equation	0.002664	0.041848	0.002169	0.03932
F-statistic	100.4733	5.494336	13139.01	248.2306
Log likelihood	320.4509	127.6516	334.8216	132.0123
Akaike AIC	-8.8986	-3.39004	-9.30919	-3.51464
Schwarz SC	-8.60951	-3.10095	-9.0201	-3.22554
Mean dependent	2.013795	1.246144	1.997245	3.281642
S.D. dependent	0.00943	0.051612	0.084698	0.214158

Table.8. the VAR model Equations after 2008 December

Standard errors in ( ) & t-statistics in [ ]				
	LNCL	LNCPI	LNSP	LNHP
LNCL(-1)	0.718237	-0.00617	0.095399	-0.00312
	-0.15154	-0.00673	-0.08063	-0.00469
	[4.73959]	[-0.91744]	[1.18316]	[-0.66466]
LNCL(-2)	-0.28852	-0.00298	-0.12456	-0.00097
	-0.15304	-0.00679	-0.08143	-0.00473
	[-1.88531]	[-0.43921]	[-1.52971]	[-0.20474]
LNCPI(-1)	-2.37631	0.5632	4.325047	-0.0254
	-3.04271	-0.13509	-1.61896	-0.09412
	[-0.78099]	[4.16906]	[2.67150]	[-0.26985]
LNCPI(-2)	0.85838	0.263569	-2.21272	-0.09251
	-2.569	-0.11406	-1.36691	-0.07947
	[0.33413]	[2.31082]	[-1.61878]	[-1.16408]
LNSP(-1)	0.186318	0.013302	0.567774	0.023956
	-0.25771	-0.01144	-0.13712	-0.00797
	[0.72297]	[1.16253]	[4.14063]	[3.00506]
LNSP(-2)	-0.02375	0.010914	-0.11718	-0.01454
	-0.24123	-0.01071	-0.12835	-0.00746
	[-0.09845]	[1.01903]	[-0.91296]	[-1.94850]
LNHP(-1)	-1.81141	0.14	2.66062	1.577993
	-4.00862	-0.17798	-2.1329	-0.124
	[-0.45188]	[0.78662]	[1.24742]	[12.7255]
LNHP(-2)	2.449254	-0.08749	-3.98152	-0.5441
	-4.39619	-0.19518	-2.33912	-0.13599
	[0.55713]	[-0.44826]	[-1.70215]	[-4.00101]
C	1.879779	0.165419	0.4904	0.138609
	-2.01153	-0.08931	-1.07029	-0.06222
	[0.93450]	[1.85223]	[0.45819]	[2.22757]
R-squared	0.380919	0.951636	0.848625	0.997512
Adj. R-squared	0.275544	0.943404	0.822859	0.997088
Sum sq. resids	0.112332	0.000221	0.031802	0.000107
S.E. equation	0.048888	0.002171	0.026012	0.001512
F-statistic	3.61488	115.6008	32.93598	2355.278
Log likelihood	94.46568	268.8809	129.7997	289.1162
Akaike AIC	-3.05235	-9.28146	-4.31428	-10.0042

Schwarz SC	-2.72684	-8.95596	-3.98877	-9.67865
Mean dependent	1.310071	2.011773	3.400921	2.152725
S.D. dependent	0.057438	0.009124	0.061804	0.028026

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