The Co-movement of Real Estate Market and Stock Market under Monetary Policy Controlling

1. Problem description

1.1 Background information

There exist two relationships between Real Estate Market and Stock Market. One shows the reverse changes, that is, the Real Estate Market and Stock Market have the substitution effects. Another shows positive change relationship, that is, the Real Estate Market or Stock Market has wealth effect. The Monetary Policy, as a powerful tool in controlling the macroeconomic trends, may likely have an effect on the two different markets.

1.2 Project objective

The main objective of this project is to find a method to analyze the co-movements between the Real Estate Market and the Stock Market under the Monetary Controlling Policies. This purpose includes several aspects:

a) What is the relationship between the Real Estate Market and Stock Market?

b) How does the change of Monetary Policy influence the two markets?

c) What should the Monetary Authority do to control the movements of the two markets?

2. Analysis process

2.1 Data collection and description

Here I choose the data from Chinese markets for example.

Stock Price-----The sample for the Stock Market is Shanghai Stock Exchange Composite Index (denoted SH, monthly average closing price). The sample period is February 2003 to October 2012. Considering the volatility and uncertainty of the Stock Market, I use log transformation to smooth the data, stabilize the variance of the time series and simultaneously convert exponential trends to linear trends. The data after log transformation are denoted *LnSH*. (The data are from www.sina.com.)

Housing Price-----the sample for the Real Estate Market is the Chinese Real Estate Climate Index (denoted HS, monthly data). The sample period is February 2003 to October 2012. I use the average of the end of last year and that February as that January price since there is no data for every January. Then use log transformation denoted *LnHS*. (The data are from National Bureau of Statistics of China.)

Money Supply-----the sample for the change of monetary policy is the Represents Money Supply M2 (denoted M2, monthly data). The sample period is February 2003 to October 2012. Then use log transformation denoted *LnM2*. (The data are from www.sina.com.)

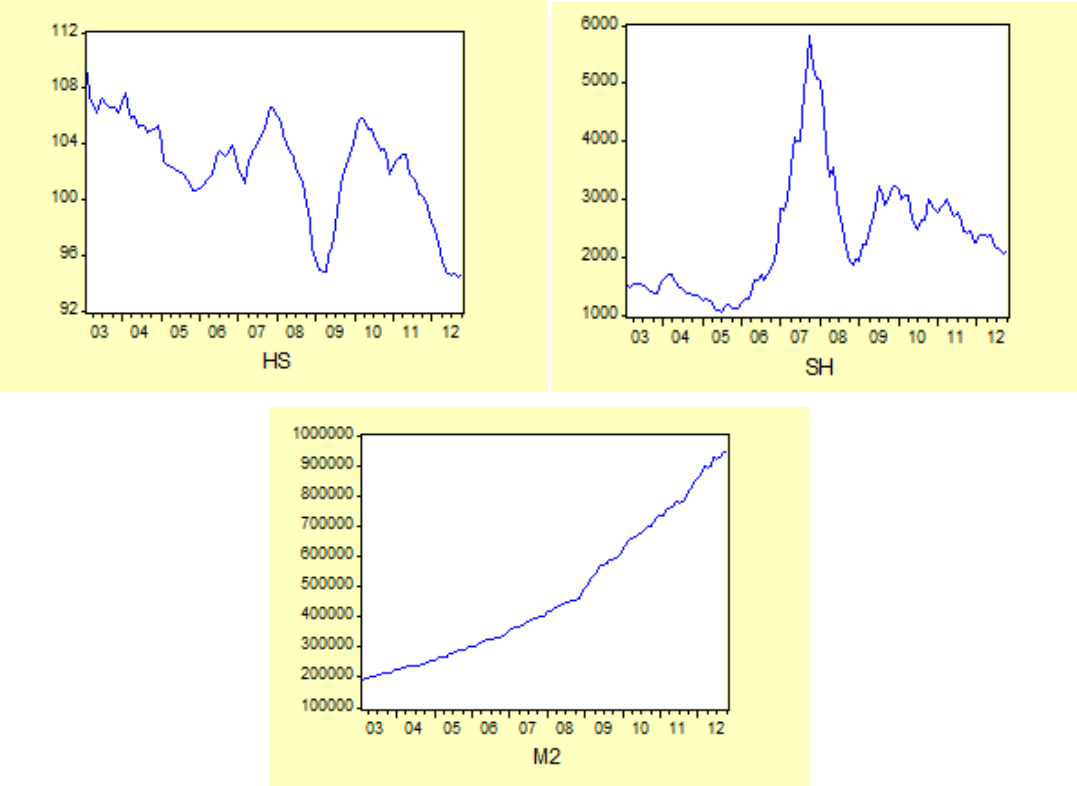

Figure 1: the trends of Housing Price, Stock Price and Money Supply

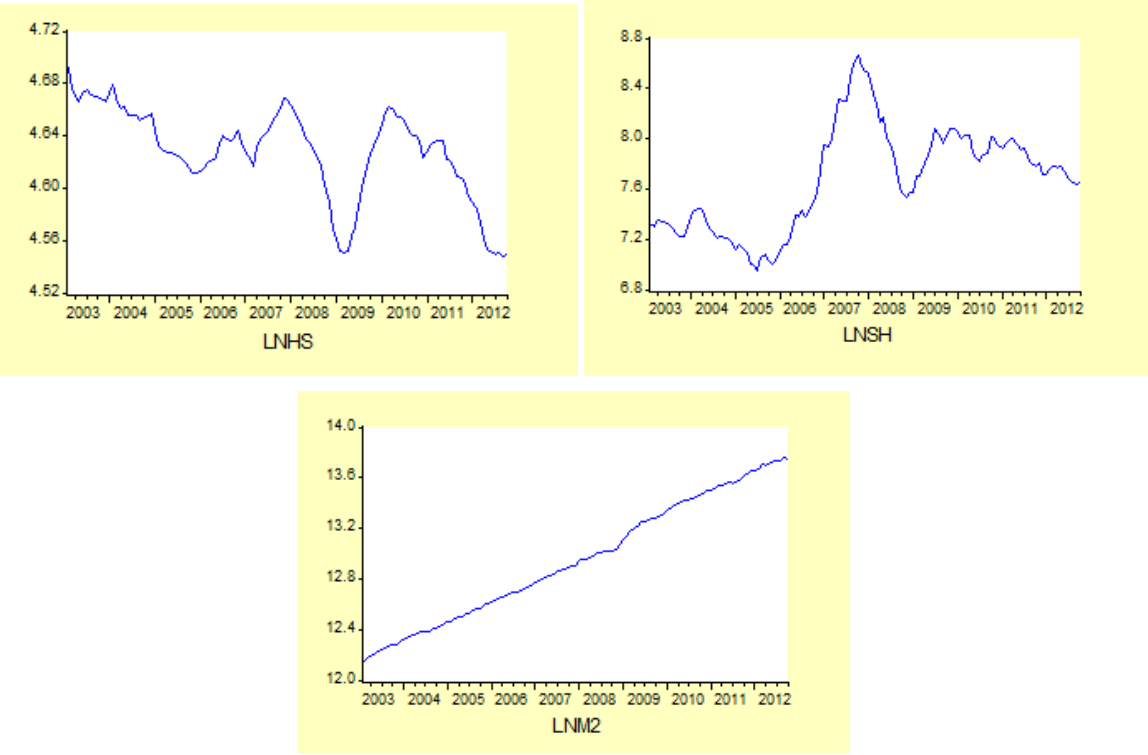

Figure 2: the trends of Housing Price, Stock Price and Money Supply

The *Figure 1* and *Figure 2* present the trends of Housing Price, Stock Price and Money Supply. In the sample period, the Real Estate Market had a trough at March 2009; Stock Market had a peak at October 2010; Money Supply had an increasing trend. The next *Table 1* shows the descriptive statistics of the three data. The Real Estate Market has a higher volatility than the Stock Market.

Table 1: the descriptive statistics of Housing Price, Stock Price and Money Supply

	LNHS	**LNSH**	**LNM2**
Mean	4.628201	7.678437	12.95411
Median	4.634341	7.718754	12.90769
Maximum	4.692631	8.669763	13.75755
Minimum	4.547435	6.949070	12.15535
Std. Dev.	0.035017	0.417345	0.481886

2.2 The method ---VAR model

Vector Auto-Regression (VAR) model was introduced into economics by C.A.Sims (1980). Now it is a famous econometric model which captures the linear interdependencies among multiple time series and generalizes the univariate auto-regression (AR) model. The vector auto-regression (VAR) model is often used for analyzing the interrelation of time series and the dynamic impacts of random disturbances (or innovations) on the system of variables.

The VAR models are usually started with Unit Root test to determine the stationary of economic time series. Then the test for co-integration is used to get a long-run linear relationship. Next step is to present the results of impulse responses (that measure the effects of the different shocks on the variables) and variance decomposition (which measures the relative importance of the different shocks to the variation in the different variables). Finally, with the Granger Causality test (Block Exogeneity Wald Tests) and all the results from above, the VAR Model are presented the relationships between the variable.

I will directly use the data *LnHS, LnSH and LnM2* in the following steps.

I prefer the Eviews5 to analysis these economic time series since it has a complete VAR model analysis system.

2.2.1 Unit Root tests

The stationary is tested by Augmented Dickey–Fuller test (ADF) unit root test and Pillips-Perron (PP) unit root test. The results, reported in *Table 1*, point out that all variables under study are non-stationary in their levels. But to the first differences, for example the *dLnHS*, we can reject

the hypothesis that there exists a unit root using P-value and accept that the *LnHS* is stationary after first order differencing. That is *LnHS* integrated of order one, denoted *LnHS~I(1).* So do *LnSH~ I(1)* and *LnM2~I(1)*.

Table 2: Unit Root tests[1]

Variable	ADF test			PP test			
	Statistics	Critical value	P-value	Statistics	Critical value	P-value	Stationary
LnHS	-2.3308	-2.8872	0.1642	-1.7591	-2.8865	0.3991	Non-stat
dLnHS	-3.4897	-2.8874	0.0078	-5.9320	-2.8867	0.0000	stationary
LnSH	-2.3447	-2.8874	0.1600	-1.6825	-2.8865	0.4374	Non-stat
dLnSH	-3.8636	-2.8898	0.0032	-7.1863	-2.8867	0.0000	stationary
LnM2	0.0605	-2.8895	0.9612	-0.1614	-2.8865	0.9390	Non-stat
dLnM2	-2.2510	-2.8898	0.1899	-11.404	-2.8867	0.0000	stationary

2.2.2 Co-integration test

To test the co-integration in *Eviews5* is the Johansen Co-integration Test. Having identified the three variables —*LnHS, LnSH* and *LnM2*—are integrated of the same order *I(1)*, the VAR model is specified to obtain a long-run linear relationship.

The AIC criteria and SC criteria determine that the lag order should equal to 2. The result of co-integration test is reported in *Figure 3*. Both the Max-Eig (Max-Eigenvalue) and the Trace Test statistics indicate that in all cases there are no long-run linear relationships between Stock Price, Housing Price and Money Supply. In addition, we cannot use VEC (Vector Error Correction) model next step.

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	0	0	0
Max-Eig	1	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Figure 3: Co-integration Test among *LnHS, LnSH* and *LnM2*

[1]The Critical values of ADF test are at 5% level of significance given by MacKinnon (1996), and the Critical values of PP test are at 5% level of significance given by MacKinnon (1996).

2.2.3 VAR estimates of Housing Price, Stock Price and Money Supply

Since all the variables are integrated of order one, we should use the first order differences — *dLnHS, dLnSH* and *dLnM2* —in the VAR model. According to AIC and SC criteria, the lag order is 1. The *Table 3* presents the outcome of VAR model.

Table 3: Vector Auto-regression Estimates[1]

Variables	**dLnHS(-1)**	**dLnSH(-1)**	**dLnM2(-1)**	**C**
dLnHS	0.523209*	0.021781*	0.057242	-0.001300
	(6.93201)	(3.00188)	(1.13601)	(-1.52391)
dLnSH	0.496952	0.398561*	1.351800*	-0.016293
	(-0.54554)	(4.55123)	(2.22284)	(-1.58240)
dLnM2	-0.158893	0.032878*	-0.117579	0.015012*
	(-1.11600)	(2.40207)	(1.23702)	(9.32886)

The *Table 3* shows some findings.

First, the change of Housing Price *(dLnHS)* is significantly related to its own lags and the lags of the change of Stock Price *(dLnSH)*. And the Stock Price has a positive influence on Housing Price.

Second, the change of Stock Price *(dLnSH)* is significantly related to its own lags and the lags of the change of Money Supple *(dLnM2)* without the lags of the change of Money Supple *(dLnM2)*.

Last, the change of Money Supple *(dLnM2)* is significantly related to the lags of the change of Stock Price *(dLnSH)* without the lags of the change of Housing Price *(dLnHS)* and its own lags.

In order to understand the relationships among the three variables directly, I will do Impulse Responses and Variance Decomposition.

2.2.4 Impulse Responses and Variance Decomposition

Impulse Responses trace the paths of different variables after a shock is injected to the system. After a period, the system will turn to original stable status.

[1]( ) are t-statistics and the critical values are 1.66 at 5% level of significance. Coefficients marked with asterisks (*) are significant at the 5% level.

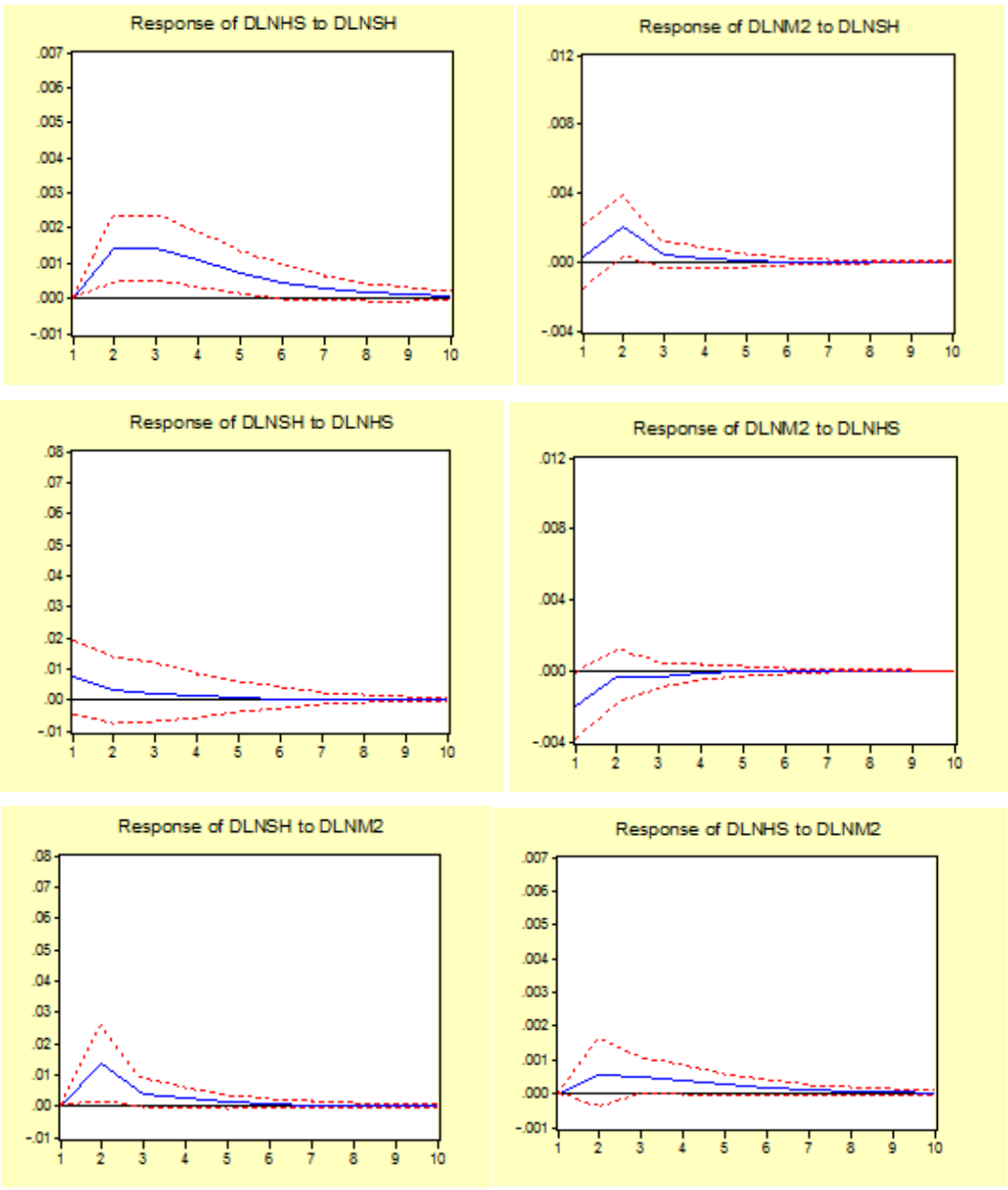

Figure 4: Impulse Responses

Figure 4 presents the Impulse Response processes of the changes of Housing Price, Stock Price and Money Supply after shocks

1) After a positive shock is injected to the Stock Price, the changes of Housing Price and Money Supply attain their maximums at t=2, then the system will return to its original stable status.

2) After a positive shock is injected to the Housing Price, Stock Price has a short positive change and Money Supply has a short negative change, then the system will return to its original stable status.

3) After a positive shock is injected to the Money Supply, the changes of Housing Price and Stock Price attain their maximum at t=2 and t=3 respectively, then the system will return to its original stable status.

Table 4: Variance Decomposition

Forecast Period	dLnHS			dLnSH			dLnM2		
	dLnHS	dLnSH	dLnM2	dLnHS	dLnSH	dLnM2	dLnHS	dLnSH	dLnM2
1	100.000	0.0000	0.0000	1.3019	98.6981	0.0000	3.7622	0.0965	96.1414
2	94.0505	5.1280	0.8215	1.2514	95.1930	3.5556	3.6923	4.0805	92.2272
3	89.4152	9.2294	1.3554	1.2831	94.9944	3.7225	3.7654	4.2001	92.0346
4	87.0398	11.3333	1.6270	1.2960	94.8985	3.8055	3.7813	4.2293	91.9895
5	86.0082	12.2492	1.7426	1.3016	94.8762	3.8222	3.7865	4.2299	91.9837
6	85.6012	12.6109	1.7879	1.3036	94.8694	3.8271	3.7879	4.2298	91.9823
7	85.4506	12.7448	1.8046	1.3043	94.8674	3.8283	3.7883	4.2299	91.9818
8	85.3973	12.7922	1.8105	1.3045	94.8668	3.8287	3.7884	4.2300	91.9815

From *Table 4*, we can get the conclusions:

For the 5 forecast period,

1) The variance of the changes of Housing Price *(dLnHS)* can be explained about 12% by the changes Stock Price *(dLnSH)* and about 1.8% by the changes of Money Supply *(dLnM2);*

2) The variance of the changes of Stock Price *(dLnSH)* can be explained about 3.8% by the changes of Money Supply *(dLnM2)* and only 1.3% by the changes of Housing Price *(dLnHS).* And at the same period, the variance of the changes of Stock Price *(dLnSH)* cannot be explained by the changes of Money Supply *(dLnM2);*

3) The changes of Money Supply *(dLnM2)* can be explained about 3.7% by the changes Stock Price *(dLnSH)* and about 4.2% by the changes of Stock Price *(dLnSH)*.

2.2.5 Granger Causality test (Block Exogeneity Wald Tests)

Granger Causality test is to determine whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown through a series of tests on the lags of X (with lags of Y). Then the lags of X can be retained to the Y's regression equation.

Table 5: Granger Causality test

Null hypothesis	df	Chi-sq statistics	P-value	
dLnSH does not Granger cause dLnHS	1	9.011312	0.0027	Reject
dLnM2 does not Granger cause dLnHS	1	1.290517	0.2560	Not reject
The system does not Granger cause dLnHS	2	11.17998	0.0037	Reject
dLnHS does not Granger cause dLnSH	1	0.297608	0.5854	Not reject
dLnM2 does not Granger cause dLnSH	1	4.941004	0.0262	Reject
The system does not Granger cause dLnSH	2	4.979549	0.0829	Not reject
dLnHS does not Granger cause dLnM2	1	1.245459	0.2644	Not reject
dLnSH does not Granger cause dLnM2	1	5.769925	0.0163	Reject
The system does not Granger cause dLnM2	2	6.002023	0.0497	Reject

Table 5 presents some results.

1) *dLnSH* does Granger cause *dLnHS.*

2) *dLnM2* does Granger cause *dLnSH.*

3) *dLnSH* does Granger cause *dLnM2.*

That is, the change of Stock Price has an effect on the change of Housing Price and the converse is not true. The change of Money Supply only influences the Stock pricing.

2.3 The conclusions of whole VAR model

Following the analysis process using VAR model, I will make some conclusions.

1) There are no long-run linear relationships between Stock Market, Real Estate Market and monetary policies.

2) The Stock Market significantly influences both Real Estate Market and monetary policies, but Real Estate Market doesn't influence Stock Market and monetary policies.

So the final estimate equations are:

$$dLnHS = 0.523209*dLnHS(-1) + 0.021781*dLnSH(-1) - 0.0013 \quad (1)$$

$$dLnSH = 0.398561*dLnSH(-1) + 1.351800*dLnM2(-1) - 0.016293 \quad (2)$$

$$dLnM2 = 0.032878*dLnSH(-1) - 0.117579*dLnM2(-1) + 0.015012 \quad (3)$$

Equation (1) means that the change of Housing Price will increase about 0.021781% when the change of Stock Price (lag 1) increases 1%.

Equation (2) means that the change of Stock Price will increase about 1.3518% when the change of Money Supply (lag 1) increases 1%.

Equation (3) means that the change of Money Supply will increase about 0.0268% when the change of Stock Price (lag 1) increases 1%.

3 Conclusions

In China, the positive one-side relationship between the Stock Market and Real Estate Market means that there exists wealth effect in the Stock Market. When the price of Stock Market increases, the stock investor will spend more money on the Real Estate Market, correspondingly the Housing Price will increase.

The Money Supply also has positive one-side relationship with the Stock Market. So the Monetary Authority could use Monetary Policies to control the Stock Market by changing the Money Supply.

The results show that the Money Supply is not significantly related to the Real Estate Market; however, this conclusion is inconsistent with our economic intuition. Future work includes finding why this happens.