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Research on the linkage and spillover effects between Chinese stock market and Real estate market

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ABSTRACT

Most of existing researches about the linkage between stock market and real estate market are concentrated in long-term cointegration and short-term causality, though few of literatures related to the Spillover Effects between two markets, they just spilt market to study volatility spillover effect by using unitary GARCH model, which easily resulted in market information loss. This paper, by constructing VAR/VEC model and VAR-MVGARCH-BEKK model based on cointegration theory and Granger causality analysis, and especially with the National Real Estate Climate Index reflecting China's real estate market's running condition while with Shanghai Composite Index and Compositional Index of Shenzhen reflecting stock market's performance, tries to investigate the relationship and spillover effect between China's stock market and real estate market in an integrated and dynamic framework, which, compared with existing researches, may fully use related information between two markets and enhance the accuracy of analysis. The research results show that there is perennial weakly negative-going Equilibrium relationship between two kinds of markets, at the same time,there exist unidirectional volatility spillover effect and unidirectional causality from real estate market to stock market.

KEYWORDS

Stock market; Real estate market; Linkage; Spillover effect.

INTRODUCTION

Following Liu's[1] research on the correlation between American stock market and real estate market with CAPM theory, many scholars also conducted an investigation into this kind of correlation. Thereinto, Ambrose et al[2] studied the relationship between American stock market and real estate market and found that there was long-range cointegration. Stone and Ziemba[3] detected the positive correlation between Japanese land price and stock price. Nan Kuang Chen[4] and Raymond[5] respectively studied the relationships of Taiwan's and HongKong's stock market and real estate market and found the unidirectional Granger causality. While Okunev et al[6] found the directional Grange causality between Australian stock market and real estate market. Green[7] tested the Cause-and-effect relationship between NASDAQ Index and housing price in Santa Clara district and demonstrated the intervenient Grange Causality. Aman[8] studied the long-term cointegration among stock indexes and real estate market by using of VAREC model. In China, Zhou[9] detected the change of housing price could arouse the fluctuation of stock prices. Shen and Lu[10] found that housing price's rise may remarkably activate stock price's rising up while the latter only weakly activate the former. In addition, Ba[11]], Peng[12] and Guo et al[13] all researched the relationship between China's stock market and real estate market by means of statistical methods such as by constructing VAR model.

From aforementioned literatures, we can find that all of researches about the linkage between stock market and real estate market are concentrated in long-term cointegration and short-term causality, while few of literatures have studied the Spillover Effects between two markets. In view of this, this paper will combine the VAR model and multivariable GARCH-BEKK model and, with example of China's stock market and real estate market, study the linkage and spillover effects of two markets.

SOME BASIC MODELS

Firstly, as to multivariate time series $y_t = (y_{1t}, \cdots, y_{kt})$, call its components to be of (d, b) order cointegration where $(0 < b \le d)$,if $y_{it} \sim I(d), i = 1, \cdots, k$ and existing nonzero vector β so as to $\beta' y_t \sim I(d-b)$ where β is called a cointegration vector.
VAR (p) model just as following expressions (1)

$$\mathbf{y_t = \phi_0 + \sum_{i=1}^{p} \phi_i y_{t-i} + \varepsilon_t} \tag{1}$$

Where $y_{it}, i = 1, \cdots, k$ are non-stationary I (1) variables, $\phi_j, j = 1, \cdots, p$ are 2-order parameter matrice. ε_t is two-dimensional stochastic error vector.

In order to be convenient to relate,the constant term,trend term and exogenous variable in equation (1) are generally omited and by difference operation,it can be expressed as following

$$\mathbf{\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t} \tag{2}$$

Where $\Pi = \sum_{i=1}^{p} \phi_i - I$ be called compressed matrix with $\Gamma_i = -\sum_{j=i+1}^{p} \phi_j \, (i = 1, \cdots, p-1)$.

In (2),since $y_t \sim I(1)$,then, $\Delta y_t \sim I(0)$,and with except of Πy_{t-1} ,all terms in (2) are stationary. If Πy_{t-1} is nonstationary, there will not be cointegration character among all components of y_t ,and vice verse. Assuming $rank(\Pi) = r$,then r denotes there exists r cointegration combinations and k-r $I(1)$

relationships. So that, Π can be decomposed into $\Pi = \alpha\beta'$ with $k \times r$ orders matrices α, β and $rank(\alpha) = rank(\beta) = r$, when denoting $vecm_{t-1} := \beta' y_{t-1}$, equation (2) may be expressed as

$$\Delta \mathbf{y}_t = \alpha \mathbf{vecm}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \mathbf{y}_{t-i} + \varepsilon_t \quad (3)$$

Equation (3) is called as the error correct model of an cointegration system, where $vecm_{t-1} := \beta' y_{t-1}$, reflecting the lasting equilibrium relationship, is called as error correct term.

Next, while the mean spillover effect test is based on (1), in order to test fluctation spillover effect, we should construct multivariate GARCH model just as expressions (4)(Luc[14])

$$\begin{cases} \mathbf{y}_t = \mu_t + \varepsilon_t \\ \varepsilon_t \mid \mathbf{I}_{t-1} = \mathbf{H}_t^{1/2} \mathbf{z}_t \\ \mathbf{z}_t \text{ i.i.d.}, \mathbf{E}(\mathbf{z}_t) = 0, \mathbf{Var}(\mathbf{z}_t) = \mathbf{I}_t \\ \mathbf{H}_t = \mathbf{H}_t^{1/2} (\mathbf{H}_t^{1/2})^T = \mathbf{Var}(\mathbf{y}_t) \end{cases} \quad (4)$$

The first equation in (4) is the conditional mean expressions of VAR (p) just like (1). where μ_t denotes mean vector, $U_t \sim N(0, H_t)$ and H_t is a k-order positive definite matrix, satisfying

$$\mathbf{H}_t = \mathbf{C}^T\mathbf{C} + \mathbf{A}\varepsilon_{t-1}\varepsilon_{t-1}^T\mathbf{A}^T + \mathbf{B}\mathbf{H}_{t-1}\mathbf{B}^T \quad (5)$$

In (5),C is a k-order Upper triangular matrix and A,B all are k-order matrices, where the diagonal terms of matrix A and matrix B denote ARCH effects and GARCH effects, respectively. The most remarkable merit of model (5) is few of parameters and apt to ensure H_t to be positive definite.

EMPIRICAL SPECIFICATION

Sample data and Statistical properties

Take acquirability and synchronization into account and the completion of China's Reform of housing system, In this paper, we select monthly historic data of National Real Estate Climate Index from January,1998 through September,2012 to reflect real estate market while selecting Shanghai Securities Complex Index and Shenzhen Component Index to reflect China's stock market situation. In order to eliminate influence of data's heteroscedasticity, we first make logarithmic operation, signing as ln (HP), ln (SH), ln (SZ).

Stationary testing

Here, we respectively introduce ADF and PP testing methods to test stationary of aforementioned 3 original logarithmic data series and their differential series. See table 1 as following.

TABLE 1 : Stationary testing

varibles	ADF value	PP value	Stationary or not
lnHP	-2.088829(0.5479)	-2.41579(0.3701)	no
lnSH	-1.605115(0.7872)	-2.20296(0.4845)	no
lnSZ	-2.333561(0.4132)	-2.23181(0.4686)	no
dlnHP	-8.522522(0.0000)	-8.68404(0.0000)	yes
dlnSH	-7.174758(0.0000)	-12.6135(0.0000)	yes
dlnSZ	-6.664718(0.0000)	-11.8839(0.0000)	yes

Note: letter d denotes differential operation, number in parentheses is P value

Cointegration testing and economic meaning

From table 1, we can see that three original data series are not stationary with significant level 10%, however, their differential series all are stationary even with significant level 1%, therefore, we can estimate that three series ln(HP), ln(SH) and ln(SZ) are I(1) and can be done cointegration analysis.

Firstly, we ascertain the lag phase of VAR model to be 2 according to AIC and SC criterion, then, construct an appropriate VAR model. Table 2 indicates the cointegration testing results of series ln(HP),ln(SH) and ln(SZ), from which one cointegration relationship can be found under significant 5%. In order to probe into the interrelation between three markets, we will construct VEC model about three series ln(HP),ln(SH) and ln(SZ) and the estimated results just showed in table 3. Further more, we can educe cointegration equation and VEC model as following equation (6) and equation (7),respectively.

TABLE 2 : Cointegration test

Johansen Cointetration Test				
Trend assumption: Linear deterministic trend				
Series: LNHP LNSH LNSZ				
Lags interval (in first differences): 1 to 4				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.124992	30.03680	29.79707	0.0469
At most 1	0.042698	7.738498	15.49471	0.4938
At most 2	0.002698	0.451237	3.841466	0.5017

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level

TABLe 3 VEC model

Vector Error Correction Estimates			
Standard errors in () & t-statistics in []			
Cointegrating Eq:	**CointEq1**		
LNHP (-1)	1.000000		
LNSH (-1)	0.071157		
LNSZ (-1)	0.003958		
C	-5.198402		
Error Correction:	**D (LNHP)**	**D (LNSH)**	**D (LNSZ)**
CointEq1	-0.013241	-0.471105	-0.350681
D (LNHP (-1))	0.337082	0.052530	-0.553740
D (LNHP (-2))	0.052773	0.915310	0.481668
D (LNSH (-1))	0.018786	-0.460096	-0.282077
D (LNSH (-2))	0.008402	-0.405010	-0.431843
D (LNSZ (-1))	-0.007732	0.461531	0.332938
D (LNSZ (-2))	0.004122	0.578714	0.619608
C	-0.000169	0.001152	0.002497

$$CointEq_1 = \ln HP + 0.071157 \ln SH + 0.003958 \ln SZ - 5.198402 \quad (6)$$

$$\begin{pmatrix} \Delta \ln HP_t \\ \Delta \ln SH_t \\ \Delta \ln SZ_t \end{pmatrix} = \begin{pmatrix} 0.34 & 0.02 & -0.01 \\ 0.05 & -0.46 & 0.46 \\ -0.55 & -0.28 & 0.33 \end{pmatrix} \begin{pmatrix} \Delta \ln HP_{t-1} \\ \Delta \ln SH_{t-1} \\ \Delta \ln SZ_{t-1} \end{pmatrix} + \begin{pmatrix} 0.05 & 0.01 & 0.004 \\ 0.92 & -0.41 & 0.58 \\ 0.48 & -0.43 & 0.62 \end{pmatrix} \begin{pmatrix} \Delta \ln HP_{t-2} \\ \Delta \ln SH_{t-2} \\ \Delta \ln SZ_{t-2} \end{pmatrix} + \begin{pmatrix} -0.01 \\ -0.47 \\ -0.35 \end{pmatrix} CointEq_1 + \begin{pmatrix} -0.0001 \\ 0.001 \\ 0.002 \end{pmatrix} \quad (7)$$

Seeing from (6), as to ln(HP),ln(SH) and ln(SZ), we can know that there are negative correlations between the former and the latter two. In addition, the Unit Root Testing results (showed in table 4) of series generated from (6) also validate the cointegration relationship showed as in table 2. At the same time, form equation (7), the current period yield rate of National Real Estate Index is of positive correlation with its prior period yield rate and that of Shanghai Composite Index while the current period yield rate of National Real Estate Index is of negative correlation with the prior period yield rate of Shenzhen Component Index. However, the current period yield rate of Shanghai Composite Index is of negative correlation with its prior period yield rate while being of positive correlation with National Real Estate Index and Shenzhen Component Index, and Shenzhen Component Index is in a similar way.

TABLE 4 : Unit Root Testing

Null Hypothesis: VECM has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		**-2.701249**	**0.0071**
Test critical values:	1% level	-2.578799	
	5% level	-1.942733	
	10% level	-1.615446	

***MacKinnon (1996) one-sided p-values.**

The spillover effect analysis

Having analyzed the incidence relations between China's stock market and real estate market, in this section, respectively based on VAR model and BEKK-MVGARCH model, we'll analyze the mean spillover effects and volatility spillover effects between two markets.

Firstly, we define series y_1, y_2, y_3 with $y_{it} = \ln P_{it} - \ln P_{i,t-1}, i = 1,2,3$, respectively denoting logarithmic yield rate of National Real Estate Climate Index, Shanghai Securities Complex Index and Shenzhen Component Index, thus, equation (1) can be decomposed into as following equation (8)

$$y_{k,t} = \mu_k + \sum_{i=1}^{p} \alpha_{ki} y_{1,t-i} + \sum_{i=1}^{p} \beta_{ki} y_{2,t-i} + \sum_{i=1}^{p} \gamma_{ki} y_{3,t-i} + \varepsilon_{kt} \quad (8)$$

Furthermore, if denoting

$$H_t = \begin{bmatrix} h_{11,t} & h_{12,t} & h_{13,t} \\ h_{21,t} & h_{22,t} & h_{23,t} \\ h_{31,t} & h_{32,t} & h_{33,t} \end{bmatrix} C = \begin{bmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{bmatrix} \quad A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}, B = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}$$

Then equation (5) can be denoted as

$$h_{lm,t} = \sum_{i=1}^{l} c_{il} c_{im} + \sum_{j=1}^{3}\sum_{i=1}^{3} a_{il} a_{jm} \varepsilon_{j,t-1} \varepsilon_{i,t-1} + \sum_{j=1}^{3}\sum_{i=1}^{3} b_{il} b_{jm} h_{ij,t-1} \quad \textbf{(9)}$$

Where, $l = 1,2,3; m = l, l+1, \cdots, 3$,and $h_{ii,t}$ denoting conditional variance of market i while $h_{ij,t}$ denoting conditional covariance between market i and market j.

According AIC and SC criterion, we confirm the lagged order of VAR model is 2-order and the estimated results of VAR(2) model is just as in following table 5. Form table 5, we can know that the current period National Real Estate Climate Index is simultaneously affected by current period Shanghai Securities Complex Index and Shenzhen Component Index with exception of past period National Real Estate Climate Index, for example, the current period logarithmic National Real Estate Climate Index will rise up 0.021049 or descend 0.011046 while the past period logarithmic Shanghai Securities Complex Index or the past period logarithmic Shenzhen Component Index rise up 1, in a similar way, the current period Shanghai Securities Complex Index(or the current period Shenzhen Component Index) is simultaneously affected by other two indexes, which denotes that Shanghai Security Market and Shenzhen Security Market take on bidirectional mean spillover effects but there is only unidirectional mean spillover effects from two Security Markets to Real Estate Market of China.

TABLE 5 : estimated results of VAR model

Vector Autoregression Estimates			
Standard errors in () & t-statistics in []			
	LNHP	**LNSH**	**LNSZ**
LNHP (-1)	1.319468	-0.107284	-0.885393
LNHP (-2)	-0.382626	-0.384628	0.444985
LNSH (-1)	0.021049	0.605120	-0.202413
LNSH (-2)	-0.007890	0.403923	0.247326
LNSZ (-1)	-0.011046	0.411215	1.282897
LNSZ (-2)	0.002268	-0.436754	-0.326866
C	0.268147	2.429511	2.079933

Now, in equation (9), elements lying on the leading diagonal of constant matrice C decide fluctuation intensity of each market, the bigger absolute element value, the more intensive the market fluctuate. Elements in Matrix A denote the influence intensity of past period random disturbance to current period fluctuation, significant a_{ii} under given significance level denoting significant influence of past period market yield rate to current period conditional variance, likewise, significant $a_{ij} (i \neq j)$ under given significance level denoting significant influence of past period market yield rate of market i to current period conditional covariance of market j. Elements in Matrix B denote the influence intensity of past period variance to current period variance, significant b_{ii} under given significance level denoting significant influence of past period market's conditional variance to current period conditional variance, and significant $b_{ij}\,(i \neq j)$ under given significance level denoting significant influence of past period market i's conditional variance to current period conditional covariance of market j. The estimated results are showed in following table 6.

TABLE 6 : Estimated results of BEKK-GARCH model

被估矩阵	估计结果
$C=\begin{bmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{bmatrix}$	$\begin{bmatrix} 0.0067^{***} & 0 & 0 \\ 0.0322^{***} & 0.0569^{***} & 0 \\ 0.0338^{***} & 0.0420^{***} & -0.0153^{*} \end{bmatrix}$
$A=\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$	$\begin{bmatrix} 0.9609^{***} & -0.3354 & -0.2448 \\ 0.0193^{***} & 1.0004^{***} & -0.0263 \\ -0.0134^{***} & -0.0012 & 1.0167^{***} \end{bmatrix}$
$B=\begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}$	$\begin{bmatrix} -0.0171 & -0.9955^{***} & -1.2949^{***} \\ 0.0033 & 0.0025 & 0.0358 \\ -0.0053 & -0.1185^{**} & -0.2363^{**} \end{bmatrix}$

Note:*,**,* denote being significant under significance level 1%,5%,10%,respectively**

From table 6, firstly, we know that the two Security markets fluctuate more tempestuously than the Real Estate market, which China's Security markets is not very perfect, such as imperfect market information circulating mechanism, thus, China must strengthen market supervision and stop opportunistic practice. Secondly, all elements in matrix A apart from $a_{12}, a_{13}, a_{23}, a_{32}$, which denotes that the influence of two security markets' past period random disturbance to real estate market's current period variance is not significant while two security markets' current period random disturbance to real estate market's current period variance is significant. Lastly, in matrix B, b_{21}, b_{31} are not significant, which denotes two security markets' past period variance don't significantly affect the current period variance of real estate market, on the contrary, b_{12}, b_{13} are significant, i.e., two security markets's current variance are significantly affected by past period variance of real estate market. By this token, between two kinds of markets, there is only unidirectional variance spillover effect from real estate market to security market, which is in accord with results of Granger Causality Test.

On all accounts, there exists a long-range steady-going equilibrium between China's real estate market and security markets, and they are reversely associated. In fact, with finite investment vehicle in China, real estate investment and securities investment can substitute each other.

CONCLUSIONS AND POLICY PROPOSAL

This paper has investigated the relationship and spillover effects between China's stock market and real estate market. By constructing Var/Vec model and Var-MV-Garch-Bekk model based on cointegration theory and Granger causality analysis, we found that there was perennial weakly negative-going Equilibrium relationship between two kinds of markets, at the same time,there existed unidirectional volatility spillover effect and unidirectional causality from real estate market to stock market. Furthermore, the research results also showed that China's financial markets were not very perfect, we must strengthen market supervision and extend investment channel.

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REFERENCES

[1] C.H.Liu, D.J.Hartzell et al; The integration of the real estate market and the stock market: Some preliminary evidence, Journal of Real Estate Finance and Economics, **3**, 261-282 **(1990)**.

[2] B.W.Ambrose, E.Ancel, M.D.Griffiths; The Fractal Structure of Real Estate Investment Trust Returns: the Search for Evidence of Market Segmentation and Nonlinear Dependency, Real Estate Economics, **20**, 25-45 **(1992)**.

[3] D.Stone, W.Ziemba; Land and stock prices in Japan, Journal of Economic Perspectives, **17(3)**, 149-165 **(1993)**.

[4] N.K.Chen; Asset price fluctuations in Taiwan: Evidence from stock and real estate prices 1973 to 1992, Journal of Asian Economics, **12**, 215-232 **(2001)**.

[5] Raymond Y.C.Tse.; Impact of Property Prices on Stock Prices in Hong Kong," Review of Pacific Basin FinancialMarkets and Policies, **4**, 29-43 **(2001)**.

[6] Okunev, Wilson, Zurbruegg; Relationships betweenAustralian real estate and stock market prices -a case ofmarket inefficiency, Journal of Forecasting, **21**, 181-192 **(2002)**.

[7] R.Green; Stock prices and house prices in California: a new evidence of a wealth effect?" Regional Science and Urban Economics, **32**, 75-83 **(2002)**.

[8] U.Aman, Z.G.Zhou; Real estate and stock returns: a multivariate VAREC model, Property Management, **21(1)**, 8-24 **(2003)**.

[9] Zhou Jingkui; Study on Fluctuation Mechanism of China's Assets' Prices: 1998-2005," Shanghai Economic Review, **4**, 21-29 **(2006)**.

[10] Shen Yue, Lu Wen-bing; A Study on the Relationship between Real Estate and Stock Prices in China, Modern Economic Science, **30**, 87-92 **(2008)**.

[11] Ba Shu-song, Qin Chuan-tao, Zhu Yuan-qian; Interaction between China Real Estate and Stock Market,"Systems Engineering, **9**, 22-28 **(2009)**.

[12] Peng Xingting; Study on the Correlation between the Real Estate Market and the Stock Market of China, Journal of Beijing Institute of Technology (Social Sciences Edition), **13(5)**, 39-43 **(2011)**.

[13] Guo Shi-ping, JI Jie; Real Estate Prices and Stock Index: A Study in Correlation, Journal of Shenzhen University (Humanities & Social Sciences), **29(5)**, 106-112 **(2012)**.

[14] B.Luc; Multivariate Garch Models: A Survey, Journal of Applied Econometrics, **21(1)**, 79-109 **(2006)**.