House prices and the collapse of the stock market in mainland China:

An empirical study on house price index

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Abstract:
The house price index decreases in Mainland China during the last few months have been accompanied by a collapse of the stock market which has fallen to 40% of its original high point. Many investors are concerned that the falling stock market will bring similar uncertainty to the housing market and induce a similar collapse of house prices. It is important to study the relationship between these indexes in order to understand the impact of the stock market on the housing market. The analysis also provides information on investors' behavior and capital movement. The analysis of the relationships between the housing and the stock markets for mainland China employs an econometric approach. Monthly time-series data collected from the National Bureau of Statistics of China are tested and the empirical results suggest that the correlations between the housing and the stock markets are relatively weak. The collapse in the stock market is not likely to be duplicated in the housing market as while the stock market does impact on the housing market, the effect is relatively small. The paper starts with some background to the housing and stock markets to demonstrate the need for the current research. Secondly, the relationships and methodology and methods used to study markets are reviewed. Thirdly, the data collection and test procedures are outlined; and finally, the results from the tests and analysis and their implications are presented.

Keywords: housing price, stock market, investors' behavior, capital movement, China

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Introduction

During the past decade, housing demand created a boom in house price in China. New supplies were produced from a massive expansion in construction by both local and foreign developers. At the same time, China has experienced an unprecedented growth in its economy and a rising inflation problem. Speculative activities in the housing market have been viewed with concern by the Chinese authorities. The Government has introduced a number of anti-speculative measures in the past few years to cool down the housing market in order to avoid an oversupply that may lead to a crisis similar to the 1997 Asian Crisis. These measures consist of a) restrictions on lending for second house purchases; b) introduction of a property business tax and stricter control over land supply; c) limitation on foreign ownership of investment properties.

As a result, the house price index for 70 major cities in the mainland China rose only 0.7% in July 2008 from a year earlier after adjusted for inflation (The Financial Express, 2008). Figure 1a depicts the annual changes in residential property prices in which the price experienced a substantial rise after 2006 and a marked slowdown in 2008. Price falls are expected to be around 10% to 30% in several major cities (The Financial Express, 2008). Shanghai is one of the largest cities in China and its housing market has revealed the biggest falls in both volume and price over the past months (Figure 1b). The transactions volume for new housing in July 2008 declined 33 percent from June and is down some 67 percent compared to July 2007. The average transaction price of new housing fell 24.5% from 16,988 Yuan in June to 12,824 Yuan per square metre in July 2008 (Shanghai Daily, 2008).

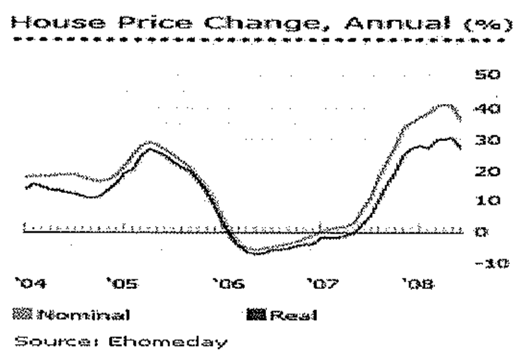

Figure 1a: Annual House price change in China

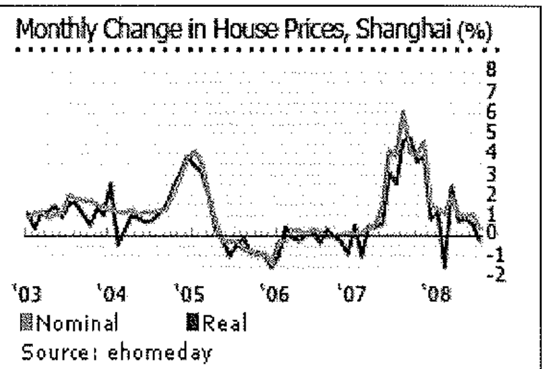

Figure 1b: Monthly house price change in Shanghai

Since April 2004, the China stock market (Shanghai) has risen from 1512 to a high of 6251 on October 2007, more than tripling in the index. The rise has been fed by a speculative fever gripping Chinese small investors, with new recruits to the 'bubble' at the rate of 300,000 per day (Walayat, 2007). The index declined after the peak to the lowest level of around 1800 on September 2008, decreased approximately 70 percent. Four months after the stock prices fell, the house price index started a decline which parelled the collapsed stock index. Figure 2 illustrates the correlations between the two indexes.

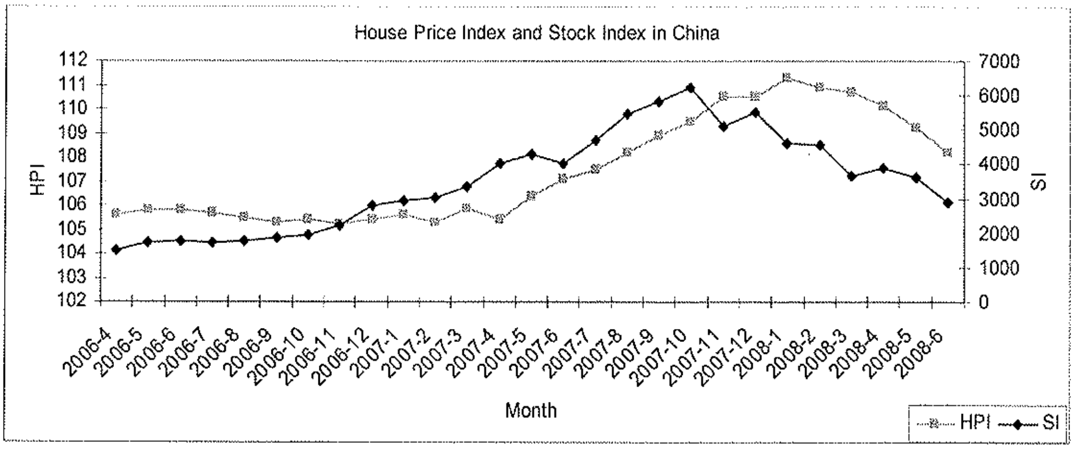

Figure 2: Correlations of house price index and stock index in China for the period of April 2006 to June 2008

Many investors are concerned that the falling stock market will bring uncertainty to the housing market and induce a similar collapse of house prices, especially facing the global effects of a deterioration caused by the Subprime Mortgage Crisis in the USA and the current implementation of a constrictive financial policy in China. It is important to study the correlation between these indexes in order to understand the level of impacts of stock market changes on the housing market. The analysis also provides information on investors' behavior and capital movement. This paper analyses the relationships between the housing and the stock markets for mainland China using a statistic approach. In the next section, the relationships and methodology and methods used to study the markets are reviewed. The data collection and test procedures are then outlined; and finally, the results from the tests and analysis and their implications are presented.

Literature Review

The research on relations between the Real Estate and Stock markets started in late 20th century. One of the earliest studies was conducted by Liu, et al. (1990). They found that the US securitized real estate market is integrated but that the commercial real estate market (direct) is segmented from the stock market.

The performance of stock in the economy reflect firms' underlying performance, while the performance of residential real estate reflect property markets performance, based on the interaction between demand for and supply of houses. Huang and Ge (2008) indicated that house supply change always lag behind the change of demand so that the house price fluctuation is mainly determined by housing demand. The housing demand curve depends on price expectations (Dusansky & Wilson, 1993) which determine current market prices (Ganesan, 1984). Housing price is driven primarily by irrational as well as rational house price expectations and investor psychology, rather than by wide swings in housing market fundamentals (Clayton, 1997). Ross (1976) claimed that one important question arising from this expectation is the nature and extent of the relation between the real estate prices and stock price both in long- and short-term in presence of macroeconomic factors. In good time, firms are encouraged to expand by growing profitability, in which further leads to rising short-term lagged supply. In the long-term, speculative development activity pursuing higher return in real estate can be related to the stock market (Liow, 2006).

Further more, stock collapse will influence the income of all citizens. Lamont and Stein (1999) and Malpezzi (1999) showed in U.S. that housing prices overreact to income shocks. Also, Francois and Sven (2006) present evidence of a strong and positive correlation between house prices and incomes, especial for the income of young household. Hence, the stock collapse may induce the house price fall through income shock.

Newell and Chau (1996) use simple correlation to show that performance of real estate companies had a high positive correlation with stock market. They also found a low positive correlation between the stock and real estate markets. However, simple correlation can not provide much insight and evidences of segmentation are also found. Liow (1998) observed that commercial real estate and property stock markets moved apart in Singapore. Additionally, a majority of studies appear to support the proposition that the two market are segmented, such as Okunev and Wilson (1997), He (1998) and Wilson at el. (1998). Furthermore, other methods and factors were suggested to develop the empirical test. More recently, Tuluca, et al. (2000) found that the price indices of capital and real estate markets (including stocks) are cointegrated.

Another kind of studies on correlation between Real Estate and Stock market focuses on investment return. Lizieri and Satchell (1997) suggested a strong contemporaneous correlation exist between property stock return and overall equity market return. However, Quan and Titman (1999) reported that, with the exception of Japan, the contemporaneous relationship between the yearly real estate prices changes and stock returns is not statistically significant. Ge and Lam (2002) built house price forecasting models for Hong Kong using quarterly time series data and suggested that stock index is one of the important variables to determine house prices. However, Tse (2001) demonstrated that both unexpected changes in Hong Kong residential and office property prices are important determinants of the change in stock prices. The stock market leads the property market in price changes (Fu, *et al.*, 1993; Cheung, *et al.*, 1995) in Hong Kong. A similar effect occurred in Singapore (Ong, 1994).

In China, Xie (2008) indicated that expectation is the fundamental factor for the fluctuations of house prices and stock indexes and that a key consideration in both is the Sheep Flock Effect. The Real estate market is closely related to changes in the GDP while the stock market is less sensitive to macroeconomic indicators (Liu and Zhang, 2007). However, the stock market reflects financial impact immediately while the real estate market takes time to react the changes, according to Zhang and Wu (2008), who summarized that the correlation between stock index and real estate market changes periodically and that there is a lag effect. In addition, using the analysis of cash flows, they showed that the time-lag between the markets is about three months. However, will the collapse of the stock market that has occurred in China be followed by a collapse in the real estate market? To find out the answer, the authors used econometrics to test the relationship between the stock market and real estate. The data collection and model development will be discussed in the next section.

Data Collection and Model Development

China has undergone profound economic and social transformation as it moves towards a market-oriented economy over the past thirty years. The emergence of the stock exchange in Shanghai in 1990 was an inevitable outcome of the revolution. Housing reforms are implicated in this ongoing transformation since 1998 from traditional regulated housing to the open market system, which gradually expanded from the large cities along the coast to the inner cities. The time series data for China housing market is relatively short and appeared fluctuations since the process of changing system and transformation. The relationships between housing market and stock market in China have studied by the Zhang and Wu (2008), who indicates four phases when from Jan. 1998 to Feb. 1999, the correlation between these two markets was positive and both of them decrease to the bottom level. The second phase lasted from Mar. 1999 to Jun. 2002, with positive relation and increase. From Jul. 2002 the correlation changed to negative and it retained until 2005. Additionally, the forth phase began after 2005; the fluctuation of stock index induced the house price change with time lag of three to four months. This study adopts recently data series because the authors believe that the opening housing market in China has become mature and the data is more reliable.

Thus, the national house price index (*HPI*) for the period of April 2006 to June 2008 from the National Bureau of Statistics of China was collected for the study. Monthly data time series data is needed as it helps to test the correlation precisely. The stock index (*SI*) refers to the average of the Shanghai stock index for the whole month, which was collected from the published index online.

The model is developed on the assumption that there is a linear relationship between the house price index and stock index. The house price index at period t is determined by the index of the last period (Peng & Wheaton, 1994 and Ge, 2004) and the impact from the stock market.

$$HPI_t = f(v) \times HPI_{t-1} + g(v;SI) \quad \text{---------------- (1)}$$

Where HPI refers to the house price index and SI means the index for stock. Functions f and g are real functions, which are: $R^n \longrightarrow R$. Therefore, $f(v)$ is a coefficient of HPI_{t-1} which can be denoted α. Vector v indicates the macroeconomic factors effect on house price. Many researchers, including McCue and Kling (1994), Ling and Naranjo (1997), Kayolyi and Sanders (1998), Brooks and Tsolacos (1999) and Liow (2000), had studied and demonstrated the linkages between key macroeconomic factors and real estate and stock markets.

Suppose the impact from vector *v* and *SI* can be separated, which means function *g* can be divided into two functions with variable *v* and *SI*. Also assume that HPI_t is a linearly affected by *SI* and the time-lag exists. The Equation (1) becomes as follows:

$$HPI_t = \alpha HPI_{t-1} + \beta + \sum_{i=kn}^{\infty} \beta_{t-i} SI_{t-i} \qquad (n \in \mathrm{Z}) \qquad \text{-------------------} (2)$$

α , β , β_{t-i} and *k* are constants in the Equation. *k* refers to the lag period in each of the impacts.

Correlation and Time-lag Analysis

In order to analyze the correlation between house price index (*HPI*) and stock index (*SI*) and their time-lags in China, the correlations between the two indexes are tested, followed by an observation of their trends and time-lags. After that, the impacts of stock index to house price index were tested using Eview software. The two indexes for the period of April 2006 to June 2008, a total of 26 sets of data, were tested in Excel and show a relative strong positive correlation, which implies that when the stock index is high, the house price index also tends to be high and *vice verse*.

However, the correlation does not tell us whether one causes the other. The cause-effect relationships thus have been tested using Eview and the result suggested that house price changes are reflected by changes of stock index. After establishing the causal relationships, the correlations and time-lags between the two indexes are observed. Figure 3 shows similar trends of the two indexes. The points marked by squares (red on house price index and blue on stock index) show the distance between the starting points and the peaks. The peak of *HPI*, which is on Jan. 2008, is three months behind the peak of *SI*, which indicates on Oct. 2007. Additionally, the starting points show the same pattern. Therefore, the time-lag between the indices is three months.

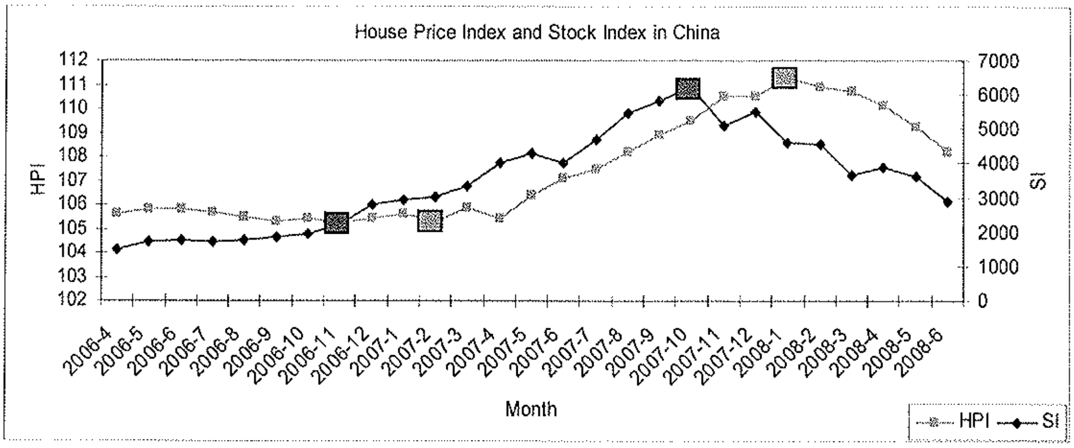

Figure 3: Correlation analysis between house price index and sock index in China

To verify the result, the two indexes have been applied to Eview for testing the correlation coefficient using 90% significant level. Table 1 shows the test results, which suggest the two index are correlated, and *HPI* will be impacted three months after the *SI* changes and the effects from the *SI* lasts for seven months.

Table 1 Correlation Analysis

Correlation Coefficient between HPI and SI		
Time Index	**HPI lag**	**HPI lead**
0	0.7260	0.7260
1	0.8273	0.5807
2	0.8843	0.4233
3	0.9236	0.2722
4	0.8994	0.1214
5	0.8418	-0.0128
6	0.7344	-0.1284
7	0.6067	-0.2144
8	0.4439	-0.2948
9	0.2890	-0.3302
10	0.1428	-0.3660
11	0.0022	-0.3781
12	-0.1176	-0.3880

The analyzed results align with the previous findings by Fu *et al.* (1993), Cheung *et al.* (1995) and Ong (1994) where the stock market leads the property market in price changes; and Zhang and Wu (2008) where the time-lag between the markets is about 3 months.

Since the *SI* impact on *HPI* lasts for 7 months, the Equation (2) thus can be restricted and modified as follows:

$$HPI_t = \alpha HPI_{t-1} + \beta + \sum_{t=kn}^{7} \beta_{t-i} SI_{t-i} \qquad (n \in Z) \qquad \text{-------------------- (3)}$$

With the time-lag is 3 months, i.e. $k = 3$.

Empirical Study

Because monthly time series data have been used for this research, the first-order autoregressive process was used to test stationarity for both *HPI* and *SI* time series, though perfect stationarity does not exist (Naidu, 1996). The results suggested that the current price were positively related to recent past prices. This suggests that regression model must be verified and the cointegration technique for the relation between two variables will be tested at the end of the modeling.

According to equation (3), which is a model developed to estimate the impact on house prices when the stock market changes. Linear regression analysis can been used and tested by Eview. The dependent variable is the monthly house price index and the independent variable is the stock index. Descriptive statistics indicate that the time-lag between house price index and stock index is three months, that is house price will be effected three months after changes in stock index. To further verify the findings, the empirical study will test three scenarios, which are SI_{t-2}, SI_{t-3} and SI_{t-6}. The values of adjust *R* square, *t*-Statistic, *F*-test, and Durbin Watson Statistics will be used for evaluating the significance of the developed models. Table 2 depicts the regression results.

Table 2: House Price Models for China (Test results are shown in the Appendix)

	Model_1	**Model_2**	**Model_3**
Dependent	HPI_t	HPI_t	HPI_t
Constant	32.635 (4.607)	49.952 (6.012)	51.566 (2.599)
HPI_{t-1}	.6811 (9.911)	.5129 (6.349)	.4961 (2.558)
SI_{t-2}	.000492 (4.785)		
SI_{t-3}		.000718 (6.005)	.000782 (4.870)
SI_{t-6}			$-1.59E^{-05}$ (-.0801)
Adjusted R^2	.9657	.9735	.9695
F-test	339.27	423.78	212.78
Significance	.000	.000	.000
DW	2.4922	1.7829	1.9120
Data sets	25	24	21

Model 1 tests a time-lag of two months between house price index and stock index with twenty-five data sets. With the adjust R square of .9657, the model explains 96.57 percent of the variations in the house price index. The model indicates that for a one-percent change in the previous month housing price index, there are approximately 0.68- percent variations in the house price index; and a one-percent change in the stock index two month ago, will lead to .000492 percent variations in the house price index. However, the Durbin Watson test suggests there is an autocorrelation problem in the model.

Twenty-four sets of data have been used in Model 2 to regress the three months time-lags between the house price and stock indexes. The model is statistical significant in all indicators and all variable shows the expected sign. Approximately 97.35 percent of variation in the house price index has been explained by the model. It suggests that one-percent change in the previous month house price index will cause .51 percent variation in the current period house price index; whereas one-percent changes in the stock index three month ago causes approximately .00072 percent variation in the house price index.

Model 3 used only twenty-one data sets for deriving the regression model as six months time-lags between house price index and stock index are employed. Though the general statistic results suggest that the model is statistic significant, the stock index six months ago shows a negative sign and the t-statistic for the variable is insignificant. Thus, the model should be rejected.

Obviously, model 2 is the preferred model and therefore can be used for forecasting. According to Equation (3), the house price model becomes as follows:

$$HPI_t = 0.512959 \times HPI_{t-1} + 49.95172 + 0.000718 \times SI_{t-3} \quad \text{-------------(4)}$$

By using Equation (4), the house price index can be forecasted. Figure 4 demonstrates the estimated curve fits the original trend in the house price index well. The model forecasts three months ahead and suggests that the house price index will decline slightly in the next three months, i.e. from July 2008 to September 2008, but will not decrease dramatically.

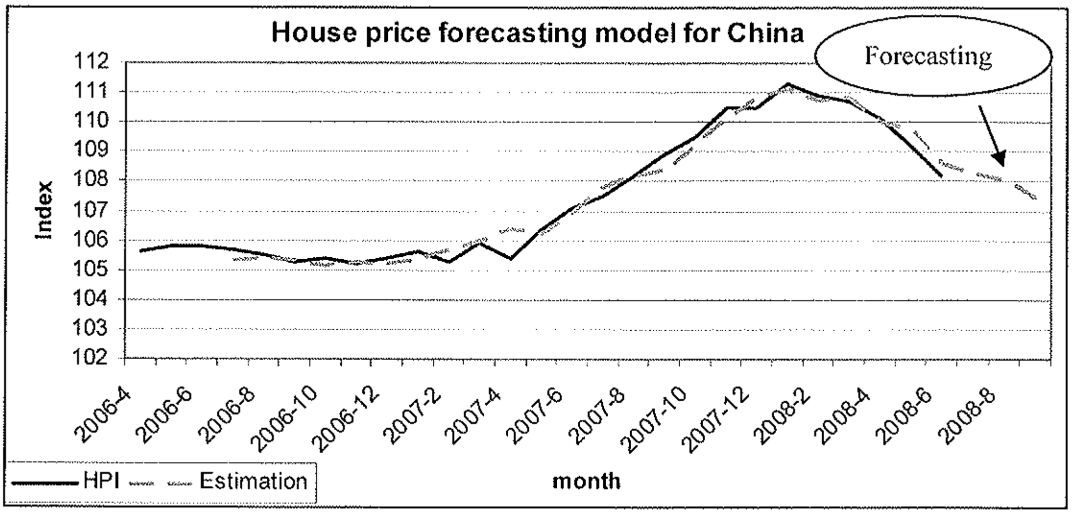

Figure 4: House price forecasting model for China

The model has been verified by using the Engle-Granger test for the cointegration of the variables. The nonequilibrium differences series by using the Augmented Dickey-Fuller (ADF) test was performed to examine if the residual data are stationary (Appendix). The result (Figure 5) suggests that the series of residuals is stationary. It can be concluded that the house price index and the stock index are cointegrated and the model is long-tern stationary.

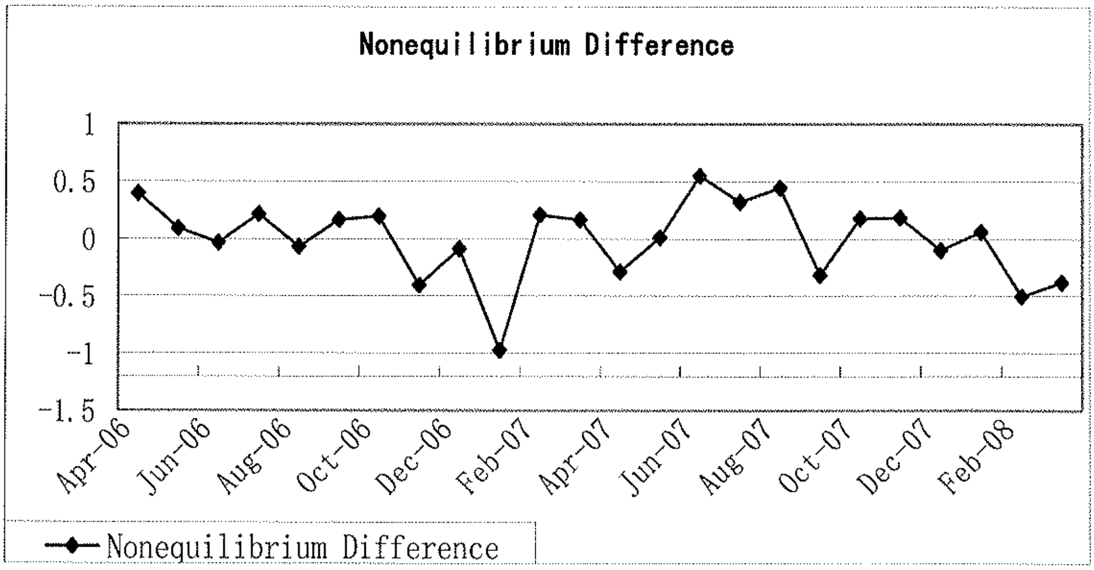

Figure 5: Nonequilibrium Difference Series

Analysis of stock market impact on house market

In the last section, a statistical significant, well fitting house price model was derived. The findings suggest that house price fluctuations are closely related to the price on the previous month and the stock market performance three months ago. These findings are consistent with the literatures in which households' expectation are an important determinant of house prices (Poterba, 1991). However, the findings of this model indicates only 0.51- percent variation in the house price following a one-percent changes of house price in the previous month; which is relatively low compared to the previous research, where for a one-percent change in the lagged housing price, there is approximately 0.98- percent variations in the housing price (New Zealand) (Ge and Boon, 2008) and 0.837-percent increase (Tse, Ho, and Ganesan, 1999) or a 0.76-percent increase (Peng and Wheaton, 1994) (Hong Kong). Expectation of market performances is one of the important factors determine changes of house prices and the stock index (Xie, 2008) because investors respond market changes by buying and selling for expected profits.

The results of this model also confirm that house prices have been affected three months after variations in the stock market (Zhang and Wu, 2008). The stock market reacts immediately to variations in macroeconomic fundamentals. This is because stock market has been characterized as a perfect market in term of trading free, information transparently and efficiently (Google, 2008). Investors may enter and exit instantly and easily by using small amounts of funds to buy or sell shares in stock market without any restrictions to test their expectations of the market in response to macroeconomic changes. On the other hand, buying and selling real estate properties are relatively difficult and time consuming. Unlike the stock market, it is a big decision-making process to buy and sell real properties. Real properties are unique, durable and less risky (as opposed to the stock market), thus investors take time to search for favorable property and they have to prepare enough deposits and financial support for mortgage payment in order to entry into the market. Most households require finance. Thus, investors tend to go into the stock market first. As a result, the stock market will be expected to fluctuate more and earlier than the property market, (Fu, *et al.*, 1993; Cheung, *et al.*, 1995).

The derived model in this research suggests that the coefficient of the stock index three-months ago is 0.000718, a low impact on house prices. The result implies that the changes in the stock market have effects on house market but the impacts are relative small. For example, the peak of the Shanghai Stock Index of 6429.28 was recorded on Oct. 16th, 2007 after which it fell to 2869.94 on June 2008, i.e. decreased by 124%. According to the derived model, the impact from the stock market on house prices should be less than 9% for the same period. Apparently, the collapse of the stock market will not be duplicated in the real estate market in mainland China, but the fluctuations in the stock market will influence house prices directly.

The demand for and supply of houses is fundamental to the real estate markets. There are demands for the use of houses and demands for investment (Reichert, 1990). As the supply of real estate is typically stable in the short-term, housing markets appear to be more sensitive to changes in demand (Omar & Ruddock, 2002). The variables of household income (Dieleman, *et al.* 2000), demographic factors (DiPasquale and Wheaton, 1994), expectation and speculation (Levin and Wright, 1997) and macroeconomic factors have been identified in the literature. The availability of funds for investment and speculative activities affect both the both property and stock markets.

Chinese people have tradition of saving money in the bank for security. The implementations of an open economic policy have made the Chinese wealthy. Figure 6 depicts the total savings of the Chinese from 210.6 hundred billion Yuan (Approximately AU$35.1 billions) in 1978 to 172,534 hundred billion Yuan (Approximately AU$28,755.6 billions) in 2007, around 818.25 times for the last 30 years. The growth trend has demonstrated a substantial increase of wealthy of the nation, in which funds have been encouraged to flow into both the stock and the property markets for investment by comparatively low returns from savings. As discussed previously, people tend to invest funds to the stock market first pursuing higher returns since the trading process is relatively easy and the size of funds required is small. The trading volume in the stock market thus becomes much higher than the transaction volume in the property market prosperous year. However, in bad years, investment funds are probably shifted from the stock to the property market.

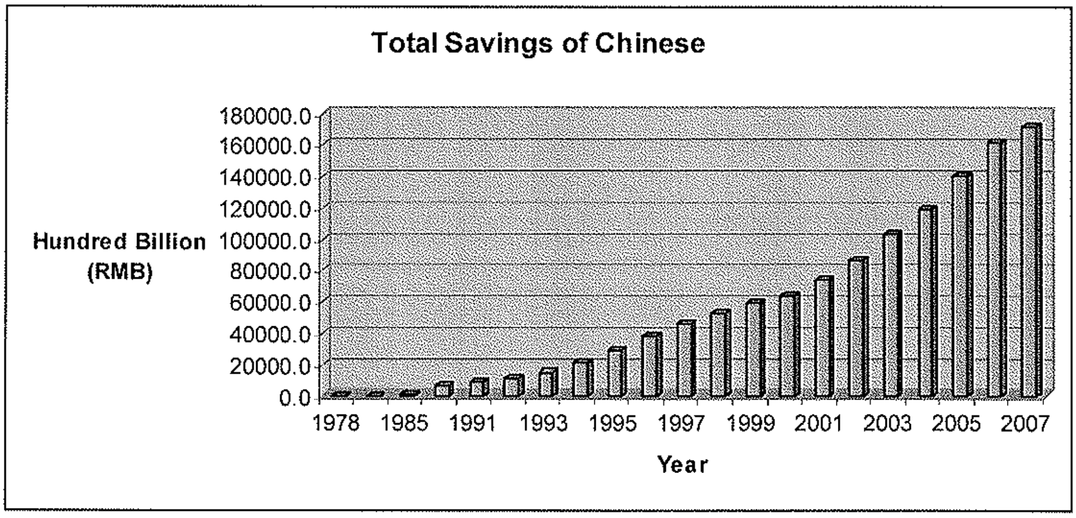

Figure 6: Total savings of Chinese for the period of 1978 to 2007 (Source: China Statistics, 2008)

Figure 7 expresses the relationship of total volume of transactions (in billion Chinese Yuan) between the stock market and the property market for the period of April 2006 to June 2008. According to the descriptive statistics, the correlation between the two transaction volumes is .683, which implies a relatively strong connection between them. The chart indicates that more funds flowed into the stock market than to the house market. The chart also shows that the volume of house transaction caused less fluctuation than the trading volume of the stock market. In the stock market, from Feb. 2007 to Dec. 2007, the volume of sales raised to a high level, and closed at 6,000 billions (approximately AU$1000 billions) on May 2007. It then declined to 1,686 billions (Approximately AU$281 billions) on June 2008, i.e., decreased by 70% over a 13 months period, which implies that less funds have been invested in the stock market. In the property market, the transaction volume reached 286.4 billions (Approximately AU$47.7 billions), on August 2007 (three months after the peak of stock market) and dropped to 189.6 billions (Approximately AU$31.6 billions) on June 2008, only reduced by 50.9% as opposed to the stock market (256%) for the same period. The evidences of fund transactions indicate that variations in transaction volume in the property market is affected by changing trading volumes in the stock market and the effects on the housing market will happen around three months after the actions in the stock market. The impact on the property market will not be amplified in China because of the underlying demand for housing in the market. This result coincides with the movements in the price indexes of the two markets.

According to the analysis above, the collapse of the stock market will drag down the property market in China. Together with the implementation of credit restrictions by the Chinese government, the transaction volume will be expected to decrease and the house prices will slip down further for the rest of 2008. However, the crash in the stock market will not be duplicated in the housing market. The reasons are three: first, there is underlying demand for housing; second, when the stock market collapses, property market becomes a favourite place for settling idle funds and investors will take prudential action for their investments; and third, because of the lagged effects in the property market, policy makers will excise expansionary policies such as reductions of interest rate when the stock market is deteriorating and investors will have their confidence boosted and the property market will be sustained.

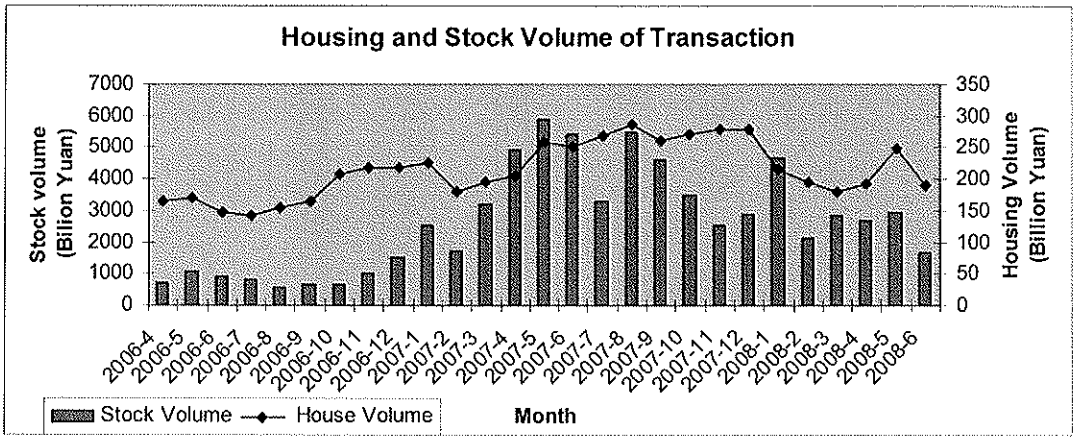

Figure 7: Comparison between housing and stock volume of transaction (Source: Shanghai Daily)

Conclusion

This research has studied the relationship between the property market and the stock market in China and explored whether the collapse of the stock market will lead to a crash in the property market. The research has applied econometrics to develop house price models for analysing the correlation between indexes and transaction volumes the both markets. The empirical tests have provided evidences as follows: first, there is a strong positive correlation between the markets; second, the property market fluctuates less than the stock market, i.e., the stock market is much more sensitive to the changing environment of the economy; third, the stock market leads the property market by around three months. The findings suggest that the property market will be supported by the demands for housing in the market and a destination for idle funds for investment activities. The conclusion thus can be drawn that it is possible that property price will slip as a results of the stock market turmoil, however, the property market will not collapse. Further study will be required when there is longer the time series data available.

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Appendix: DF test of House Price Index 1

Dependent Variable: HP
Method: Least Squares
Date: 11/24/08 Time: 22:16
Sample(adjusted): 2006:05 2008:06
Included observations: 26 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.755713	5.415144	0.878225	0.3885
HP1	0.956655	0.050405	18.97952	0.0000

R-squared	0.937536	Mean dependent var	107.5115
Adjusted R-squared	0.934933	S.D. dependent var	2.187113
S.E. of regression	0.557892	Akaike info criterion	1.744500
Sum squared resid	7.469840	Schwarz criterion	1.841277
Log likelihood	-20.67850	F-statistic	360.2220
Durbin-Watson stat	1.126645	Prob(F-statistic)	0.000000

Appendix: DF test of House Price Index 2

Dependent Variable: HP
Method: Least Squares
Date: 11/24/08 Time: 22:21
Sample(adjusted): 2006:05 2008:06
Included observations: 26 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP1	1.000913	0.001014	987.3436	0.0000

R-squared	0.935529	Mean dependent var	107.5115
Adjusted R-squared	0.935529	S.D. dependent var	2.187113
S.E. of regression	0.555334	Akaike info criterion	1.699208
Sum squared resid	7.709895	Schwarz criterion	1.747596
Log likelihood	-21.08971	Durbin-Watson stat	1.134530

Appendix: DF test of Stock Index 1

Dependent Variable: STOCK
Method: Least Squares
Date: 11/24/08 Time: 22:25
Sample(adjusted): 2006:05 2008:05
Included observations: 25 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	416.9902	251.0257	1.661146	0.1103
Z1	0.905806	0.065586	13.81100	0.0000

R-squared	0.892395	Mean dependent var	3622.622
Adjusted R-squared	0.887716	S.D. dependent var	1426.555
S.E. of regression	478.0216	Akaike info criterion	15.25381
Sum squared resid	5255608.	Schwarz criterion	15.35132
Log likelihood	-188.6726	F-statistic	190.7437
Durbin-Watson stat	2.065242	Prob(F-statistic)	0.000000

Appendix: DF test of Stock Index 1

Dependent Variable: STOCK
Method: Least Squares
Date: 11/24/08 Time: 22:26
Sample(adjusted): 2006:05 2008:05
Included observations: 25 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Z1	1.006542	0.025878	38.89560	0.0000

R-squared	0.879485	Mean dependent var	3622.622
Adjusted R-squared	0.879485	S.D. dependent var	1426.555
S.E. of regression	495.2333	Akaike info criterion	15.28711
Sum squared resid	5886145.	Schwarz criterion	15.33587
Log likelihood	-190.0889	Durbin-Watson stat	2.038817

Appendix: Correlation Analysis

Date: 08/06/08 Time: 16:19
Sample: 2006:04 2008:06
Included observations: 26
Correlations are asymptotically consistent approximations

HP,STOCK(-i)	HP,STOCK(+i)	i	lag	lead
		0	0.7260	0.7260
		1	0.8273	0.5807
		2	0.8843	0.4233
		3	0.9236	0.2722
		4	0.8994	0.1214
		5	0.8418	-0.0128
		6	0.7344	-0.1284
		7	0.6067	-0.2144
		8	0.4439	-0.2948
		9	0.2890	-0.3302
		10	0.1428	-0.3660
		11	0.0022	-0.3781
		12	-0.1176	-0.3880

Appendix: Regression 1

Dependent Variable: HP
Method: Least Squares
Date: 09/08/08 Time: 21:47
Sample(adjusted): 2006:10 2008:06
Included observations: 21 after adjusting endpoints
HP=C(1)*HP1+C(2)+C(3)*Z3+C(6)*Z6

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.496062	0.193883	2.558557	0.0203
C(2)	51.56639	19.84163	2.598899	0.0187
C(3)	0.000782	0.000160	4.870403	0.0001
C(6)	-1.59E-05	0.000197	-0.080760	0.9366

R-squared	0.974059	Mean dependent var	107.9619
Adjusted R-squared	0.969481	S.D. dependent var	2.205102
S.E. of regression	0.385221	Akaike info criterion	1.099647
Sum squared resid	2.522725	Schwarz criterion	1.298603
Log likelihood	-7.546289	F-statistic	212.7799
Durbin-Watson stat	1.912025	Prob(F-statistic)	0.000000

Appendix: Regression 2

Dependent Variable: HP
Method: Least Squares
Date: 09/09/08 Time: 18:09
Sample(adjusted): 2006:07 2008:06
Included observations: 24 after adjusting endpoints
HP=C(1)*HP1+C(2)+C(3)*Z3

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.512959	0.080796	6.348815	0.0000
C(2)	49.95172	8.308493	6.012127	0.0000
C(3)	0.000718	0.000120	6.004927	0.0000

R-squared	0.975822	Mean dependent var	107.6542
Adjusted R-squared	0.973520	S.D. dependent var	2.218887
S.E. of regression	0.361074	Akaike info criterion	0.917000
Sum squared resid	2.737860	Schwarz criterion	1.064257
Log likelihood	-8.003999	F-statistic	423.7864
Durbin-Watson stat	1.782912	Prob(F-statistic)	0.000000

Appendix: Regression 3

Dependent Variable: HP
Method: Least Squares
Date: 09/09/08 Time: 18:30
Sample(adjusted): 2006:06 2008:06
Included observations: 25 after adjusting endpoints
HP=C(1)*HP1+C(3)+C(2)*Z2

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.681051	0.068717	9.911006	0.0000
C(3)	32.63547	7.083621	4.607173	0.0001
C(2)	0.000492	0.000103	4.785390	0.0001

R-squared	0.968596	Mean dependent var	107.5800
Adjusted R-squared	0.965741	S.D. dependent var	2.203596
S.E. of regression	0.407867	Akaike info criterion	1.156414
Sum squared resid	3.659817	Schwarz criterion	1.302679
Log likelihood	-11.45518	F-statistic	339.2743
Durbin-Watson stat	2.492193	Prob(F-statistic)	0.000000

Appendix: ADF test of Nonequilibrium Difference Series 1

ADF Test Statistic	-5.166641	1% Critical Value*	-2.6819
		5% Critical Value	-1.9583
		10% Critical Value	-1.6242

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(E,2)
Method: Least Squares
Date: 11/25/08 Time: 13:42
Sample(adjusted): 2006:10 2008:06
Included observations: 21 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(E(-1))	-1.986748	0.384534	-5.166641	0.0001
D(E(-1),2)	0.301120	0.223054	1.349986	0.1929

R-squared	0.786467	Mean dependent var	0.011597
Adjusted R-squared	0.775229	S.D. dependent var	0.855266
S.E. of regression	0.405482	Akaike info criterion	1.122913
Sum squared resid	3.123899	Schwarz criterion	1.222391
Log likelihood	-9.790581	F-statistic	69.97938
Durbin-Watson stat	2.033251	Prob(F-statistic)	0.000000

Appendix: ADF test of Nonequilibrium Difference Series 2

ADF Test Statistic	-8.182248	1% Critical Value*	-2.6756
		5% Critical Value	-1.9574
		10% Critical Value	-1.6238

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(E,2)
Method: Least Squares
Date: 11/25/08 Time: 13:43
Sample(adjusted): 2006:09 2008:06
Included observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(E(-1))	-1.514606	0.185109	-8.182248	0.0000

R-squared	0.761093	Mean dependent var	0.019240
Adjusted R-squared	0.761093	S.D. dependent var	0.835424
S.E. of regression	0.408339	Akaike info criterion	1.090953
Sum squared resid	3.501563	Schwarz criterion	1.140546
Log likelihood	-11.00048	Durbin-Watson stat	2.297589