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Empirical Study on China's House Prices

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Abstract: This study aims to empirically study house prices and their relationship with China's critical economic and financial metrics. The key metrics include interest rate, inflation rate, and stock index prices. This study shows that stock index prices do not significantly impact house prices in China. At the same time, long-term interest and inflation rates positively impact house prices in China.Additionally, short-term interest rate possesses a negative impact on house prices. This can shed light on policymakers in China when making economic decisions to influence house prices in China. On top of this, this study also compared house prices and real estate stock index prices and concluded that the two differ significantly.

Keywords: house prices, interest rate, stock index, inflation rate.

1. Introduction

Housing is a significant subject in livelihood, economics, and finance. The housing market in China is unique in many ways. To start with, Chinese people, like many East-Asian people, are keen to own their houses. Therefore, the percentage of the population that are house owners is significantly high in China, compared with that in America or Europe [1]. Secondly, house prices in China are extremely high compared with the average income in China. To put this into context, the house price to income ratio in China is in the range of 20:1 to 35:1, while the house price to income ratio in America is in the range of 0.5:1 to 3:1 [2]. Therefore, many studies have been done on China's housing market. Nevertheless, most such studies are done from the perspective of macro-economic or microeconomics.

The mainstream studies on China's housing market focus on the reasons for the high house prices in China and their impact on China's economy. The reasons for the high house prices in China are believed to be social issues. Shen [3] attributed high house prices in China to Chinese traditions and current policies. For instance, traditionally, a man must have a house before finding a bride. Additionally, legacy policies like the one-child policy led to an incredibly imbalanced men-to-women ratio in China. Therefore, when the men are in surplus, obtaining a house is essential for them to find a bride. On top of this, the development in different cities varies significantly in China. Big cities are far more developed with more opportunities than small towns, and hence many people are eager to go to big cities, pushing house prices even higher in those cities. Lastly, since 2010, there have been a series of government policies aiming to cap the number of people purchasing a house in a particular place or the number of houses a person can purchase. Such policies only worked to drive the house prices even higher because they gave out the signal that houses are scarce and hence purchas-

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ing a house is a good investment. When it comes to China's house prices and its relationship with China's economy, mainstream scholars believe China's house prices are at such a high level that it is harming China's economy. Zhang, An, and Yu [4] claimed that while the high house prices contributed to the high GDP in China, they negatively impacted economic circulation. Around 20 years ago, scholars attributed China's rapid economic development to high saving rates in China [5]. However, such high saving rates, backed by the need to save up for the purchase of a house, leads to decreased consumption from the public on everything else [6].

Additionally, China's rapid economic growth brings a high inflation rate, and houses have proved to be a safe asset against inflation [7]. This is also because the financial market in China is not well developed and the public in China is well educated to protect their assets against inflation with financial products. However, with houses taking up most of everyone's savings, there is not much room left for the financial market to develop [7].

This research aims to study house prices in China from an empirical perspective. This study will first study the correlation between the house prices in China and critical metrics, like short-term interest rate, long-term interest rate, inflation rate, and stock market index. This can shed light on the relationship between house prices and other vital metrics in the economic and financial world. This study will also look into the performance of the real estate stock index to see whether investing in the real estate stock index is an alternative to investing in houses in China.

2. Literature Review

2.1. House Prices and Interest Rate, Inflation Rate and Stock Index

The relationship between house prices and other economic and financial metrics like interest rate, inflation rate, and stock index prices have been extensive studies. However, there is no consensus among the scholars. As a result, the conclusion varies from country to country. For instance, Lean and Smyth [8] studied Malaysia's house prices and stock prices. They concluded that when looking at Malaysia data as a whole, the house prices are not cointegrated with the stock prices or the interest rates. However, city-level data tells a different story. For instance, Kuala Lumper data supports the cointegration among house prices, stock prices, and interest rates.

Nevertheless, Kakes and Van Den End [9] drew different conclusions from the Netherlands market. They claimed a significant correlation between house prices and stock prices in the Netherlands, and the correlation is negative. Additionally, such a relationship is more robust in more expensive segments in the Netherlands. Kakes and Van Den End are not alone. Batayneh and Al-Malki [10] echoed their conclusion with data from Saudi Arabia. Batayneh and Al-Malki [10] empirically studied house prices, stock prices, and economic growth in Saudi Arabia. They claimed that stock prices negatively impact house prices while economic growth positively impacts house prices.

Moreover, using the Granger-causality test, Batayneh and Al-Malki [10] concluded that the stock price is the most significant factor that can impact house prices. In contrast, economic growth's impact on house prices comes second. Similar studies have also been done in European markets. For example, Irandoust [11] studied seven European countries with their house price and stock price data. As a result, Irandoust [11] empirically found that stock prices would hostilely impact house prices in seven European countries.

2.2. House Prices and Real Estate Stock Index Prices

Compared with the study on house prices and other economic and financial metrics, the study on house prices and real estate stock index prices is quite limited. Ghysels et al. [12] studied USA data and claimed that real estate stock index prices are correlated with house prices in the USA, and the former can be used to predict future trends of the latter. Guo and Huang [13] also studied the rela-

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tionship between house prices and real estate stock index prices. They aimed to conclude whether investing in the real estate stock index can be an alternative to investing directly in the housing market. Guo and Huang [13] claim that house prices and real estate stock indexes differ in multiple ways. The former is significantly more stable than the latter, especially during turbulent economic times. However, in the long run, house prices and real estate stock index prices tend to follow similar trends. Another critical factor to consider is the vast difference in liquidity between the two investment tools. While investing in houses directly can be illiquid, investing in the real estate stock index is very liquid.

3. Methodology

3.1. Linear Regression

Linear regression is an effective way to quantify the impact of independent variables on the dependent variables. In this model, the dependent variable is the house price. At the same time, there are four independent variables long-term interest rate, short-term interest rate, inflation rate, and SSE Composite Index price. By doing the linear regression analysis, this research will be able to tell whether the four independent variables significantly impact house prices in China. Additionally, if one or more of the independent variables significantly impact house prices, the scale of the impact can also be concluded from the linear regression model.

The linear regression model is captured in (1)

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \varepsilon \quad (1)$$

Where y is the dependent variable, x_i is the independent variable, and β_i is the coefficient for each independent variable.

3.2. Data

House prices are captured as the monthly average price of 1m2 residential houses in China. The data are obtained from the National Bureau of Statistics of China. Key metrics correlated with house prices in China and are used in this research include short-term interest rate, long-term interest rate, inflation rate, and stock index. The stock index is chosen as the Shanghai stock exchange index – SSE Composite Index. Shanghai stock exchange is one of the two stock exchanges in China. The other is the Shenzhen stock exchange. Among the two stock exchanges, the Shanghai stock exchange is made up mainly of large corporations or blue-chip companies. At the same time, the Shenzhen stock exchange is more for small companies. Therefore, SSE Composite Index is generally used as the indicator of stock performance in China. Interest rate, inflation rate, and SSE Composite Index are obtained monthly to be in line with the house price data and are obtained from the Wind database. Data used in this study cover 16 years of data from the beginning of 2006 to the end of 2021.

Additionally, the daily real estate stock index is obtained from Wind from the beginning of 2006 to the end of 2021. In the Shanghai stock market, listed corporations are put into five groups: industrial, commercial, real estate, public utilities, and comprehensive industries. The index for each group is a weighted average of the stock price for every listed company. In addition, the real estate stock index is used to study its correlation with house prices in China.

4. GARCH Model

A lot of economic and financial data are time series data. However, time series data tend to have multiple characteristics. For instance, time series data tend to be non-stationary. This means that statistics of the time series can vary. Additionally, time series data tend to have different variances at

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different times [14]. Engle brought up the autoregressive conditional heteroskedasticity (ARCH) model to capture such characteristics of time series. The GARCH model is a generalized version of the ARCH model and has been proven successful in fitting time series data with volatilities changing with time. In this research, the return on the house prices and the real estate stock index return will fit into a GARCH model to quantify its volatility.

Table 1: its volatility.

	Coefficients	Standard Error	t Stat	P-value
Intercept	25682.05795	1139.648944	22.53506054	3.27431E-53
X Variable 1	4220.385669	504.6001105	8.363822323	2.00248E-14
X Variable 2	-5504.060446	421.3527661	-13.06283212	1.55625E-27
X Variable 3	239.2752061	48.90016954	4.893136534	2.26965E-06

The GARCH model is detailed in (2)

$$r_t = u_t\varepsilon_t$$
$$\varepsilon_t|\Phi_t \sim N(0, {\sigma_t}^2)$$
$${\sigma_t}^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i {\varepsilon_{t-i}}^2 + \sum_{i=1}^{p} \beta_i {\sigma_{t-i}}^2 \quad (2)$$

where r_t is the return data, and ε_t is the residual.

4.1. Analysis and Discussions

STATA is used in this research to fit the data into the linear regression and GARCH models.

4.2. House Prices and Interest Rate, Inflation Rate and Stock Index

TA linear regression is firstly done with four independent variables - X Variables 1 to 4 are long-term interest rate, short-term interest rate, inflation rate, and SSE Composite Index, respectively. The result is shown in Table 2. The R-squared and the Adjusted R-squared for this model are 0.7807 and 0.7756. This means that the model can explain around 77% of changes in house prices. Additionally, judging from Table 1, it can be concluded that SSE Composite Index does not have a significant relationship with house prices. Therefore, SSE Composite Index is taken out of the linear regression model, and another linear regression model is established with the remaining three independent variables. The results are shown in Table 3.

Table 2: Linear Regression Model 1.

	Coefficients	Standard Error	t Stat	P-value
Intercept	25048.87308	1197.177591	20.92327259	5.07032E-49
X Variable 1	4248.739459	502.3874908	8.457096437	1.17226E-14
X Variable 2	-5479.3493	419.5271098	-13.06077527	1.73881E-27
X Variable 3	208.4733003	52.11639541	4.000148105	9.4084E-05
X Variable 4	0.177088508	0.107342248	1.649755912	0.100828574

The linear regression with three independent variables returned an R-squared at 0.7773 and an adjusted R-squared at 0.7734. This model again can explain around 77% of changes in house prices. On top of this, in this model, all three independent variables significantly impact house prices.

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Table 3: Linear Regression Model 2.

	Coefficients	Standard Error	t Stat	P-value
Intercept	25682.05795	1139.648944	22.53506054	3.27431E-53
X Variable 1	4220.385669	504.6001105	8.363822323	2.00248E-14
X Variable 2	-5504.060446	421.3527661	-13.06283212	1.55625E-27
X Variable 3	239.2752061	48.90016954	4.893136534	2.26965E-06

The analysis shows that SSE Composite Index does not significantly impact house prices. This finding is in line with Lean and Smyth (2014)'s findings with Malaysian data but in contradiction to studies of other scholars like Kakes and Van Den End (2004), Batayneh and Al-Malki (2015), and Irandoust (2020). This may indicate that China's housing and stock markets are not comparable. While the stock market is deemed a financial market for investment purposes, the housing market is mainly used for self-endowment. Additionally, the analysis shows that the inflation rate positively impacts house prices. When the inflation rate increases, on the one hand, it means house prices would increase as other commodities. On the other hand, the house is one of the commodities that can be used against inflation. Therefore, it is expected to see a positive impact of the inflation rate on house prices. Moreover, this analysis shows that both the long-term and the short-term interest rates significantly impact house prices. Although the former poses a positive impact while the latter poses a negative impact. Understanding the negative impact of short-term interest rates and house prices is easier. When the short-term interest rate decreases, it is cheaper for people to borrow, and such money can be used to purchase a house. This means the house prices decrease for purchasers that need financing. On top of this, it is counter-intuitive to see the positive impact of long-term interest rates on house prices. One possible explanation is that in China, when purchasing houses, the required deposits are normally at least 30%; this is much higher compared with the 10% in Europe. Higher deposits mean less financing and hence less exposure to interest rate risks. At the same time, a high-interest rate normally comes with a high inflation rate, which can positively impact house prices. Future studies can work on setting one metric as the instrument variable. Regressions with instrumental variables will shed more light on the true relationship between long-term interest rates and house prices.

4.3. House Prices and Real Estate Stock Index Prices

To start with, the statistic of the monthly house price returns and the monthly real estate stock index returns are listed in Table 4. The data shows that the real estate stock index returns are more volatile than the returns of the house prices.

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Table 4: Statistic of Monthly Returns for House Prices and Real Estate Stock Index.

	Monthly Return of House Prices	Monthly Return of Real Estate Stock Index
Mean	-0.71%	-1.57%
Median	-0.04%	0.49%
Min	-10.61%	-26.18%
Max	27.91%	40.21%
Standard Deviation	4.86%	11.28%
Kurtosis	14.2869	1.6085
Skewness	3.2718	0.7940

Additionally, the daily return data of the real estate stock index is fit into GARCH (1,1) model for understanding their volatility. The result is shown in Table 5. Meanwhile, the return on the house prices does not fit into a GARCH model. This means that the real estate stock index possesses auto-regressive conditional heteroskedasticity. This means that the returns of house prices and the real estate stock index are not comparable to time series. This echoes the previous findings that the stock index does not significantly impact house prices in China. This is because the stock market, including the real estate stock index, is a financial product delivering investment returns, while the housing market is mainly for its endowment.

Table 5: GARCH Model for Daily Real Estate Stock Index Return.

return	Coefficient	OPG std. err.	z	P>|z|	[95% conf. interval]	
return						
_cons	.0004906	.0002915	1.68	0.092	-.0000807	.001062
ARCH						
arch L1.	.2267961	.0205884	11.02	0.000	.1864435	.267148
garch L1.	.7885508	.0487562	16.17	0.000	.6929904	.8841113
_cons	-.0000187	.0000156	-1.20	0.231	-.0000493	.0000119

5. Conclusion

This research empirically studied the relationship between house prices and other economic and financial metrics like interest rate, inflation rate, and stock index prices with data from the beginning of 2006 to the end of 2021. This research focuses on the study in China, where the housing market differs from the rest of the world. This research shows that long-term interest rates and inflation rates positively impact house prices; the short-term interest rate hurts house prices, while stock index prices do not significantly impact house prices.

Moreover, this research also looked into house and real estate stock index prices and claimed that the latter is more volatile than the former. Additionally, the volatility of the latter can be captured

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with a generalized autoregressive conditional heteroskedasticity model, while the volatility of the former cannot.

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