

The Effects of Macroeconomic Factors on Housing Prices in China: Empirical Research and Linear Regression Analysis

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ABSTRACT

The housing market in China has experienced substantial development over the past years, and the macroeconomy carries considerable weight in driving the rapid increases in housing prices. This paper aims to study the relationship between the macroeconomy and housing prices in China, and analyze three typical macroeconomics factors, consisting with gross domestic product index (GDPI), consumer price index (CPI), and fixed asset investment price index (FAI), along with their effects on housing prices respectively. This paper uses aggregated annual data from 2010 to 2018 in a multivariate linear regression equation and reached a reliable conclusion with quantitative analysis. All three variables are positively related to housing prices, which is represented by commercial residential housing sales price. By model building and regression test, it is seen that the consumer price index is the variable with the most explanatory power for the housing price increase, followed by the gross domestic product index and fixed asset investment price index. The main content of this study also includes a brief review of the history of China's real estate market under the proper control and policy interventions by government.

Keywords: *Housing price, macroeconomics factors, empirical research, linear regression, data analysis, China real estate*

1. INTRODUCTION

China's real estate market has experienced a long-lasting blossomed over the past decades and is currently regarded as one of the fastest-growing economies. After the gradual privatization and housing market reform in the late 1980s, China's real estate market serves as an integral driver for the domestic economy and accounts for nearly 17% of GDP in 2018 [1]. In the same period, according to the National Bureau of Statistics, the average housing price has surged from 2063 Yuan per square meter in 1998, to 8737 Yuan per square meter in 2018, almost 424% increase over 20 years [2].

These are multiple devastating effects brought by soaring housing prices, and it is impossible to ignore the heated tension that they have flared in the government policy and commercial property arena. Millions of low-income Chinese citizens are unable to either afford to buy these outrageously expensive houses or slow down the growing trend of prices. The Chinese government was also aware of these issues and thus implement corresponding measures to cool down the market, such as the early intervention to limit housing prices, the supply of affordable housing, the stringent taxation policy, and increased down payments [3]. However, in spite of these efforts focused on administrative regulations, the housing price level is still exceedingly high when compared with other countries. In 2018, the world economic crisis had

taken a heavy roll on the Chinese economy, but surprisingly, China's real estate market remained resilient and recovered the modest loss shortly after the crisis. This phenomenon indicates that effective policy intervention and the macro-control system are of significance in facilitating the steady and sound development of the housing market.

This purpose aims to conduct empirical research and theoretical analysis on the relationship between macroeconomy determinants and housing prices, and to obtain a quantitative interpretation of the rapid increase in housing prices in China. In this context, this paper selects the most important macroeconomic variables and investigates their impact on housing prices in China by deploying a multivariate linear regression model.

2. REAL ESTATE MARKET IN CHINA

China's real estate market is known for its deep connections to the financial system and monetary policy through various channels. In the early stage, the housing system was carried out under the dominant control of the government, which built a significant amount of housing based on the workplace [4]. However, with the rapid development of the market economy and the dramatic increase in urban population, the defects of non-transparent operation and ignorance of market flexibility

were being exposed, resulting in the abolition of public housing system in the late 1970s.

A series of market-oriented housing reforms got on the historical stage in the 1990s, laying a solid foundation for the economic transition and long-lasting boom in the housing market. In 1998, to eliminate the barrier of the commercial housing market, the Chinese government abolished the welfare housing distribution system, unleashing plenty of market demands for private housing. The next few years witnessed the profound influence from the privatization of housing and its rapid market expansion. It is widely acknowledged in academia that this reform further stimulated the housing consumption and subsequent increases in housing prices [5]. Another essential impetus to the private property market is the low interest rates in residential mortgage loans, which have become the main financing channel for citizens to buy their houses. In addition, the People's Bank of China reduced the interest rate five times to encourage private purchases, and in consequence, China has become the biggest player in the Asian residential mortgage market [6]. In a nutshell, the broad range of reforms from the abolishment of welfare-oriented public housing distribution to the introduction of housing mortgage loans contributes to the housing price appreciation.

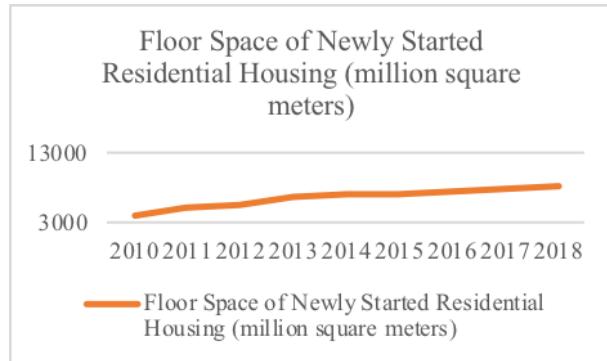


Figure 1 Floor space of newly started residential housing from 2010 to 2018



Figure 2 Total investment in real estate by region in 2018

To forestall real estate bubbles, the Chinese government has adopted relevant measures including tight monetary policy, increased transaction taxes, and reduced mortgage

lending. However, the housing prices still peaked in most cities in China, and housing remained over-valued relative to household income. It is of great significance to dive deep into the determining factors that drive the soaring housing prices. Hence, this paper would concentrate on the investigation of the macroeconomic determinants that heavily impact the housing prices and be committed to providing a simplified model to explain the aggregate behaviour of economic growth, household consumption, and inflation rate.



Figure 3 Average housing price from 2010 to 2018

3. EMPIRICAL ANALYSIS

3.1. Variables and Time-Series Data

With the aim to offer a simplified model to analyze the effects of macroeconomics determinants on the housing prices, this paper includes an empirical analysis of China's real estate market with time-series data from 2010 to 2018. In light of previous literature, the variables used in this paper are housing price, gross domestic product index (GDP), consumer price index (CPI), and fixed asset investment price index (FAI). To standardize the calibre of statistics, the variable of housing price is represented by commercial residential housing sales price (CRHP). The gross domestic product growth rate is calculated based on GDP original data, and all of the remaining data points can be directly retrieved from publicly available online China Statistical Yearbook. The time-series data is obtained from averages of annual data across different cities and is shown in the following table [3].

Table 1 Collection of original data

Time (Year)	CRHP (Yuan/m ²)	GDP (Billion Yuan)	CPI (Last Year=100)	FAI (Last Year=100)
2010	5032	41035	103.3	103.6
2011	5357	48339	105.4	106.6
2012	5791	53733	102.6	101.1
2013	6237	58814	102.6	100.3

2014	6324	64210	102.0	100.5
2015	6793	68339	101.4	98.2
2016	7476	73707	102.0	99.4
2017	7892	82010	101.6	105.8
2018	8738	89692	102.1	105.4

To ensure each metric is comparable with each other, this paper standardized GDP, CPI and FAI using statistics in 2019 as baselines.

Table 2 Collection of original data

Time (Year)	CRHP (Yuan/m^2)	GDP (2019=100)	CPI (2009=100)	FAI (2009=100)
2010	5032	117.9	103.3	103.6
2011	5357	117.8	108.9	110.4
2012	5791	111.2	111.7	111.7
2013	6237	109.5	114.6	112
2014	6324	109.2	116.9	112.5
2015	6793	106.4	118.5	110.5
2016	7476	107.9	120.9	109.9
2017	7892	111.3	122.8	116.2
2018	8738	109.4	125.4	122.5

Table 3 Descriptive Analysis

	CRHP	GDP	CPI	FAI
Mean	6627	111.16	115.9	112.1
Median	6324	109.46	116.9	111.7
Minimum	5032	106.43	103.3	103.6
Maximum	8738	117.94	125.4	122.5
Std. Dev	1219.87	4.08	7.05	5.10

3.2. Linear Regression Model

In the quantitative section, this paper selects the common econometrics model as shown below, and conducts linear regression to further analyze the relationship between housing price and macroeconomics determinants:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \mu \quad (1)$$

In the model (1), Y is the variable to be explained and represents the housing price, which refers to the commercial residential housing sales price (CRHP) in this article. X1, X2, and X3 are the explanatory variables that denote the macro factors and represent the gross domestic product index (GDPI), consumer price index (CPI), and fixed asset investment price index (FAI) respectively. Thus, the expression can be written as:

$$CHRP = \beta_0 + \beta_1 * GDPI + \beta_2 * CPI + \beta_3 * FAI + \mu \quad (2)$$

3.3. Result Analysis

Since this paper concentrates on finding out the quantitative impact of the macroeconomy on housing prices, the data collected in section 3.1 will be imported in the EViews software and used for the estimated linear

regression model. The regression statistics and summary output are presented in the following table:

Table 4 Regression analysis

Regression Statistics	
Multiple R	0.99040589
R Square	0.98090384
Adjusted R Square	0.96658171
Standard Error	207.787082
Observations	8

Table 5 Summary output

	Coefficients	Standard Error
Intercept	-23897.531	4925.84383
117.939845	37.4029938	34.8665135
103.3	196.504733	28.7586615
103.6	31.0527063	30.3905956
t Stat	-4.8514594	0.00833061
	1.07274832	0.34379253
	6.83288869	0.00239956
	1.0217867	0.36464898
Lower 95%	-37573.866	-10221.196
	-59.401967	134.207955
	116.657888	276.351578
	-53.325114	115.430527
Upper 95%		

The results indicate that there is a good linear response in a linear fitting degree of 0.98090384 and a significantly positive relationship between the macroeconomy and housing prices. It is confident to quantify the model as:

$$CHRP = -23897.53 + 37.40 * GDPI + 196.50 * CPI + 31.05 * FAI \\ (3) \quad (-4.8515) \quad (1.0727) \quad (6.8329) \quad (1.0218)$$

3.4. The Effects of Macroeconomic Factors on Housing Prices

This estimated linear regression verifies that the macroeconomy exerts great influence on housing prices, which can be well explained by the forces of gross domestic product growth index, consumer price index, and fixed asset investment price index. The correlation coefficients of these variables have correct signs and are highly statistically significant. From the linear regression multi-variable model above, it is clear that the consumer price index has the dominant influence on housing prices, implying that for each percentage increase of consumer price index, the relative housing price is expected to rise by nearly twice as much. It makes sense theoretically for housing prices largely depend on inflation, which is normally evaluated by the consumer price index. This result is also manifest that the previous housing market prosperity was rooted in the low interest rate in China [7][10]. Furthermore, the impact of gross domestic product

growth index and fixed asset investment price index are very close and their percentage increase can bring about over 0.3% increase in housing prices. Strong GDP growth means a relatively greater portion of personal spending would be shifted to residential housing. And with the expansion of the housing market in China, fixed asset investment starts a craze and an increasing percentage of the money supply is channeled into the real estate market [8][9].

4. CONCLUSION

This study inquires into the interaction between the macroeconomy and housing prices in China, and it is found that under the macroscopical policy intervention by the government, macroeconomic trends are closely associated with housing price fluctuations. This paper also deploys multi-variate linear regression to quantitatively investigate the macroeconomic determinants of housing prices in China, including yearly data in GDP index (GDPI), consumer price index (CPI), and fixed asset investment price index (FAI). The significance test reveals that all these variables are decisive factors that promote housing prices. Specifically, GDPI, CPI, and FAI are positively correlated with housing prices, and among these factors, CPI has the greatest impact compared with the other two. The results are consistent with existing theoretical analysis and are in accord with objective laws. The full paper also summarizes the history of real estate market in China and the transitional features of each stage under macro-regulations, proposing meaningful research directions in the future. Looking forward, it is also suggestive to further analyze the driving forces of housing prices from the perspective of macroeconomic factors and set up relevant policies accordingly.

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