Macroeconomic Factors Affecting Housing Prices: Take the United States as an Example

Xinying Ding[1,*]

[1] *Carey Business School, Johns Hopkins University, 100 International Drive, Baltimore, MD 21202, USA*
**Corresponding author. Email: xding15@jh.edu*

ABSTRACT
Residential real estate takes the largest part of asset market in the United States. This study investigates how changes in macroeconomic variables affect changes in housing prices, using time series data from 191 observation samples in the United States over the past 15 years. The dataset was collected from FRED and analysed by Stata/IC 16.1. Based on the model of multiple linear regression, the main results show that stock growth and economic growth are the major indicators of the rise of the housing price index. In contrast, mortgage rates and unemployment rates will have a negative effect on housing price. It is worth noting that in the regression model with 5% significance level, population growth as a determinant is not statistically significant. Compared with the existing literature, the main contribution of this paper is the relatively updated data in recent severe environments (Great Depression and COVID-19) to reinforce key discoveries.

Keywords: *Housing price, Stock growth, Mortgage rates, Unemployment rates, Population growth*

1. INTRODUCTION

Residential real estate is the largest asset market in the United States. According to the Federal Reserve's Financial Stability Report, the inventory scale of residential real estate in the United States reached 39.3 trillion dollars, accounting for about 31% of the total assets of the United States, followed by equity assets (37.2 trillion dollars), accounting for 29% [1]. Residential real estate accounts for the largest proportion of US assets, and financial products such as MBS derived from real estate are also an important part of the American securities market. In addition, in terms of asset allocation, real estate has occupied quite a large proportion of residents' assets and debts. Therefore, estate market analysis has always been a very important topic.

Besides, there are the following important reasons to explore the influencing factors of real estate prices. First, under the influence of-COVID-19, the global economy has seen signs of recession. During the epidemic, the US stock market plummeted several times, and the stock price also suffered a heavy blow. As one of the most common mortgage assets and financial investment products, the real estate price has a positive impact on the financial cycle. However, house prices in the United States have recorded the largest increase in a decade. House prices have been rising in all parts of the United States since last year. According to the latest house price index of the Federal Housing Finance Agency, house prices in the United States rose by 1% in January and 12% compared with the same period last year. In contrast, prices rose by 10.8% in 2020, the highest annual increase in history. After the outbreak of COVID-19, the hot real estate market in the United States has attracted wide attention. In order to better judge the future trend, this paper analyses the factors affecting real estate prices. Since the 1990s, American real estate prices have experienced cyclical changes. In view of the cyclical pattern of U.S. real estate prices, this paper calculates the data from 2005 to 2020 for analysis.

Compared to the previous literature, this paper used updated official data of the past 15 years, including specific period (Great Depression and COVID-19). It gives a reinforcement that the stock price index and economic growth are the key factors for the rise of house prices. In addition, the mortgage rate and unemployment rate have an adverse impact on house prices. While the population growth is not statistically significant as the determinant.

2. LITERATURE REVIEW

At the beginning of the study, the filtering of major macroeconomic variables should be completed. Based on the existing economic literature, it is often mentioned that the real disposable income item is the main determinant [2][3][4]. Schnure [3], Adams and Füss [5] studied the influence of unemployment rates on housing prices. McCarthy and Peach [4] also considered the stock index as a strong factor in the growth of housing prices. Besides, Meen [2], Adams and Füss [5] provided evidence that interest rates manipulate house prices. Jeanty, Partridge and Irwin [6] also pointed out the reasons why population growth stimulates house prices.

According to previous studies, our research is striving to explore the relationship between house price growth and population growth, stock price growth, real GDP growth, mortgage interest rate and unemployment rate.

3. MACROECONOMIC INDICATORS

In this section, the content is based on the previous economic literature to predict the signs of variables.

3.1. Population

The primary indicator is the population. People are the final demand subject of real estate; the number and structure of the population determine the demand of real estate. The increase of urban resident population and floating population will increase the demand for real estate and lead to the rise of real estate prices. From this perspective, the larger the population, the greater the demand for real estate. There are two mechanisms by which population changes affect housing prices. First of all, with the continuous supply of real estate, the increase of population leads to the increase of real estate demand, so real estate prices begin to rise. At the same time, the growth of population stimulates commerce and service industry, increases the demand for real estate, and leads to the rise of house prices.

3.2. Stock Price

The stock price also influences the real estate price. The first mechanism is called wealth effect, which holds that with the rise of the stock market, investors with unexpected increase in wealth will have higher demand for housing [4]. Therefore, the increase of market capitalization will affect the real state price. The second mechanism is the credit-price effect, that is, the real estate price, as an integral part of the balance sheet, improves the companies' balance sheet and credit. As a result. the higher the real estate price, the higher the level of investment activity.. After all, real estate prices may be positively correlated with stock prices [7].

3.3. RGDP

RGDP is the ratio of the ending GNP to the base GNP. Since it is different from nominal GNP, the ending GNP calculated at the base period price rather than the ending price. It can reflect the change of the economic activities and can be used as a dynamic factor to measure whether the given zone has the power to increase the economy. The prosperity of the household will be positively affected by the growth of RGDP. In other words, if consumers have stronger spending power, their demand for house purchase will increase. Therefore, as the housing supply is fixed in the short term, the increasing demand will lead to the rise of house prices.

3.4. Mortgage Rate

The adjustment of mortgage rate will have a significant impact on real estate developers, consumers, speculators, housing consumption patterns, and so on, thus affecting house prices. Economic literatures indicate that mortgage rates will have a great harm on house prices. To be more specific, the increase of mortgage rate directly increases the housing loan pressure of home buyers, thus inhibiting the housing consumption demand. A large number of housing consumer demand withdrew from the real estate market, which seriously impacted the real estate market and greatly reduced the prosperity index of the real estate market, thus affecting the expectations of real estate developers for the future real estate market.

3.5. Unemployment Rate

Moreover, the unemployment rate is estimated to be negatively correlated with real estate prices. Countries with high unemployment rates have lower demand for properties, so house prices fall. The government, in contrast, may increase the investment in the real estate industries to improve the economy and reduce unemployment [8].

4. DATA SOURCE

The data comes from the monthly statistics of the United States provided by FRED. The data sets span from January 1, 2005 to December 1, 2020, and some of them are selected according to availability [1].

%Δ HPI - the percentage change of HPI. Employ S&P/Case-Shiller U.S. National Home Price Index is regarded as the dependent variable, the housing price (HPI).

%ΔPOP - the percentage change of population (POP). The unit of POP is thousand.

%ΔSPI - the percentage change of SPI. Employ Total Share Prices for All Shares for the United States is regarded as the stock price index (SPI).

%ΔRGDP - the percentage change of RGDP. RGDP is explained by Brave-Butters-Kelley Real Gross Domestic Product. The raw data have been annualized as a percentage change from the previous period. Divide the data by 100 as %ΔRGDP.

MR - Average of 30-Year Fixed Rate Mortgages in percentage terms.

UN - the unemployment rate in percentage terms.

To summarize our estimation:

%ΔHPI = F (%ΔPOP, %Δ SPI, %Δ RGDP, MR, UN)

(+) (+) (+) (-) (-)

The impact of indicators on the dependent variable is represented by "+/-" sign, which means "positive" and "negative".

5. MODEL AND METHODOLOGY

The main objective of the research is to measure the key indicators of house price changes in the short term. Our estimates of potential determinants refer to extant literature. The economic model is specified as:

$$\%\Delta \text{ HPI} = \beta_0 + \beta_1*(\%\Delta POP) + \beta_2*(\%\Delta SPI) + \beta_3*(\%\Delta RGDP)^2 + \beta_4*(MR) + \beta_5*(UN) \quad (1)$$

The economic model is a multiple regression model, including two or more explanatory variables.. In order to consider the difference between the observed data and the expected value, a random error term is added, ε_i = %Δ Housing Price – E(%Δ Housing Price), the econometric model is as follows:

$$\%\Delta \text{ HPI} = \beta_0 + \beta_1*(\%\Delta POP) + \beta_2*(\%\Delta SPI) + \beta_3*(\%\Delta RGDP)^2 + \beta_4*(MR) + \beta_5*(UN) + \varepsilon_i. \quad (2)$$

The underlying assumption is that the observed values of econometric model meet the population relationship and abide by strict rules of exogeneity, conditional homoskedasticity, conditionally uncorrelated errors and error normality. Besides, there is no exact linear relationship between explanatory variables.

6. EMPIRICAL STATISTICS

The data analysis software used is Stata/IC 16.1.

The result of regression analysis (as shown in figure 1) illustrates that there are 191 observations, including 5 explanatory variables. The multiple regression model is further expressed as:

$$\%\Delta HPI=0.021+5.528*(\%\Delta POP)+0.0322*(\%\Delta SPI)+0.0178*(\%\Delta RGDP)^2-0.347*(MR)-0.101*(UN)+\varepsilon_i \quad (3)$$

Source	SS	df	MS	Number of obs	=	191
				F(5, 185)	=	20.12
Model	.002480597	5	.000496119	Prob > F	=	0.0000
Residual	.004561418	185	.000024656	R-squared	=	0.3523
				Adj R-squared	=	0.3348
Total	.007042015	190	.000037063	Root MSE	=	.00497

pctgrowth_HPI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pctgrowth_POP	5.527682	3.804425	1.45	0.148	-1.977954	13.03332
pctgrowth_SPI	.0322351	.0091672	3.52	0.001	.0141493	.0503208
pctgrowth_RGDP_sqr	.0178063	.0089176	2.00	0.047	.000213	.0353997
pct_MR	-.3469785	.0544381	-6.37	0.000	-.4543778	-.2395792
pct_UN	-.1012745	.0190819	-5.31	0.000	-.1389207	-.0636283
_cons	.0206528	.0021325	9.68	0.000	.0164457	.02486

Figure 1 Regression table

The model reveals that when the population growth rate increases by 1 unit, the house price growth rate will increase by 5.528 units correspondingly, ceteris paribus. under the same conditions. For each unit of increase in the growth rate of stock price or real GDP, the change direction of house price growth rate will be 0.0322 and 0.0178 respectively. Nevertheless, the rise of mortgage interest rate or unemployment rate will lead to the reverse change of house price growth rate of 0.347 or 0.101 units respectively. To test the significance of the independent variables, assume the null hypothesis to be H0: $\beta i = 0$, where i = 1 to 6, otherwise it is an alternative hypothesis. At the 5% significance level, when the p-value is less than 0.05, the null hypothesis is rejected and the index coefficient is significant. It can be clearly seen from the regression chart that except for "pctgrowth_POP" (population growth rate), other coefficients are significant.7. Empirical results

The regression of the equation shows that all variables verify the expected signs, which is in line with the economic theory discussed in Part 3.The first indicator, population growth (%ΔPOP), has a positive impact on housing price changes. It should be noted that the null hypothesis is rejected, and the population growth rate as a determinant is not significant. In other words, it cannot be claimed that there is statistical significance between the population growth rate and the house price, but this does not mean that it has no economic significance. Through the relationship between supply and demand in economics, with the growth of population, house prices will become more and more expensive, because the basic function of a house is to live. With the growth of population, people's demand for housing is increasing. It is difficult for house prices in the market to fall. However, what makes it impossible for us to conclude from a statistical point of view that there is a significant relationship between the two?

First, the intensification of aging seriously affects the purchasing power of young people. Once the aging

is too serious, young people will lose the ability to buy a house because of the pressure to support the elderly. In this case, it is challenging to raise the house price even if they are willing to. Therefore, if the population growth rate is very low or even negative, the relationship between the two will become blurred. Second, the reason may be that the population structure of the United States is relatively stable and the urbanization process has been completed. The population will have an important impact on the real estate price in the early stage of the urbanization process, but after the urbanization process is completed, the impact on the real estate price is very small. Third, the data revealed that the state with the fastest population growth in the United States is in the middle of the country [9], while some states in New England have the highest house price growth [10]. And they have different weights in their respective data, which will also lead to the blurring of the relationship between the them again.

The second indicator, the percentage change of stock price index (%ΔSPI), should have a positive effect on the real estate price. The stock price coefficient is also significant. This shows that the wealth effect and the credit-price effect of the stock market should be related to the real estate market. Therefore, this two indexes may be interdependent.

The third indicator, the square of RGDP growth rate (%ΔRGDP), has a positive impact on housing price changes, which is significant at the 5% significance level. The reason is that GDP growth shows that people's family conditions become better and they can afford houses. If the supply of houses remains unchanged in the short term, people's demand for housing will increase and then lead to the rise of house prices.

However, mortgage rate (MR) is negatively correlated with housing price changes. As mentioned before, the increase of the mortgage rate reduces people's affordability of housing assets, which compels some potential buyers to abandon this market. In the short term, if the housing supply remains unchanged, people's demand for housing will decrease, which will lead to the decline of house prices.

There is a negative correlation between the unemployment rate (UN) and the change of housing prices, which is significant at the level of 5%. When the unemployment rate is too high, the overall economic downturn has a significant inhibitory effect on real estate investment. On the contrary, the reduction of unemployment rate will stimulate the increase of real estate investment and increase the supply of real estate, which will have an impact on real estate prices. Furthermore, the rise of unemployment rate has seriously reduced the disposable income of residents, thus reducing the consumption ability of residents to buy houses and the demand for real estate. If the supply of real estate remains unchanged in the short term, it will lead to a decline in real estate prices.

7. LIMITATIONS AND EXTENSIONS

Although this study finds meaningful results for the analysis of macroeconomic factors affecting house prices, it still has several limitations and extensions. Due to the outliers' effect, the impact of economic growth is different from our expectations. In other words, it is sometimes negatively correlated with house prices. Therefore, the Subprime Crisis and the extreme situation of COVID-19 have become the root of the irregularities. Subsequently, the square of the original growth is applied instead. Thus, it may limit the due effect of economic growth in some way.

As mentioned in the first part, inflation will also become the main source of outlier effect. The selected time period includes some extreme situations, so it is difficult to find an appropriate way to deal with this dilemma. But inflation has a significant impact on house prices.

For possible extensions, the time span should be extended. The data span is from January 2005 to December 2020. This may not be a long time for the real estate market and macroeconomic environment. In the initial stage of the model, the cycle is extended to the last century, for example, the 1990s or earlier. However, data availability and correlation force us to focus on a relatively short period of time.

The use of panel data methods for samples from many countries will be more fully implemented. Due to the availability of data, this research only uses the data of the United States. However, the representativeness of middle-income countries and emerging markets is not strong. For example, the impact of population growth may be more significant than that of developed countries such as the United States. If the panel data method is applied to the samples of many countries, it will produce more complete research results. In addition, panel data methodology can be used to examine different states in the United States.

8. CONCLUSION

In a nutshell, the application of multiple linear regression model indicates that the house price index in the past 15 years is positively correlated with stock price growth and economic growth, and negatively correlated with mortgage rate and unemployment rate. Different from previous research results, population growth and house price index do not seem to be statistically significant. The research also helps to estimate future house price index changes related to major macroeconomic variables in the short run.

There are several key points that future researches could focus on. The effect of COVID-19 on house prices among different countries would be an important topic. And panel data method could be a major tool to apply.

AUTHORS' CONTRIBUTIONS

Compared with the existing literature, the main contribution of this study is to use the updated data from the Great Depression and COVID-19 to enhance key discoveries.

REFERENCES

[1] Board of Governors of the Federal Reserve System. (2020). Financial Stability Report - November 2020. Retrieved from https://www.federalreserve.gov/publications/2020-november-financial-stability-reportasset-valuation.htm

[2] G. Meen. (2002). The Time-Series Behavior of House Prices: A Transatlantic Divide? Journal of Housing Economics, Volume 11, Issue 1, Pages 1-23. Retrieved from https://EconPapers.repec.org/RePEc:eee:jhouse:v:11:y:2002:i:1:p:1-23.

[3] C. Schnure. (2005). Boom-Bust Cycles in Housing: The Changing Role of Financial Structure. IMF Working Paper 2005/200. International Monetary Fund.

[4] J. McCarthy, R.Peach. (2004). Are Home Prices the Next Bubble?. Economic Policy Review, Volumn 10, Pages 1-17.

[5] Z. Adams, R. Füss. (2010). Macroeconomic Determinants of International Housing Markets. Journal of Housing Economics 19, Pages 38–50.

[6] P. Jeanty, M. Partridge, E. Irwin. (2010). Estimation of A Spatial Simultaneous Equation Model of Population Migration and Housing Price Dynamics. Regional Science and Urban Economics, Volume 40, Issue 5, Pages 343-352, ISSN 0166-0462. DOI: https://doi.org/10.1016/j.regsciurbeco.2010.01.002.

[7] R.K. Green. (2002). Stock Prices and House Prices in California: New Evidence of A Wealth Effect? Regional Science and Urban Economics, Volume 32, Issue 6, Pages 775-783, ISSN 0166-0462. DOI: https://doi.org/10.1016/S0166-0462(01)00103-X.

[8] Federal Reserve Bank of St. Louis. (2020). Okun's Law: A Meaningful Guide for Monetary Policy? Retrieved from https://files.stlouisfed.org/files/htdocs/publications/es/12/ES_2012-06-08.pdf

[9] E. Davis. (2021). 2020 Census Shows Fastest-Growing States. Retrieved from https://www.usnews.com/news/best-states/slideshows/these-are-the-10-fastest-growing-states-in-america?slide=12

[10] D. Singh. (2019). States Where Home Prices Increased The Most and Least in 2019. Retrieved from https://money.yahoo.com/states-home-values-202956281.html