Research on the Problems of Housing Prices in Qingdao from a Macro Perspective
Liu Zhiyuan, Sun Zongdi, Liu Zhiyuan, Sun Zongdi

Abstract—Qingdao is a seaside city. Taking into account the characteristics of Qingdao, this article established a multiple linear regression model to analyze the impact of macroeconomic factors on housing prices. We used stepwise regression method to make multiple linear regression analysis, and made statistical analysis of F test values and T test values. According to the analysis results, the model is continuously optimized. Finally, this article obtained the multiple linear regression equation and the influencing factors, and the reliability of the model was verified by F test and T test.

Keywords—Housing prices, multiple linear regression model, macroeconomic factors, Qingdao City.

I. INTRODUCTION AND LITERATURE REVIEW
Qingdao City is adjacent to the coastline, geographical location and the environment is superior to attract people from all over the country to come here for sightseeing. In recent years, Qingdao’s housing prices have increased year by year, and the rate of housing price growth has exceeded the growth rate of people’s wages [1]. However, the housing vacancy rate is significantly improved, which has a negative impact on people’s housing needs.

Sun Jiguo, Wang Yuanyuan [2], from the perspective of supply and demand, made descriptive analysis on real estate market development of Qingdao City. Cai Lijuan [3], through the analysis of panel data, found the demand for houses has significant influence on housing prices. Yu Yonghu [4], by constructing Tobin Q theory analysis framework, using panel data to study the effect of real estate tax on housing prices, found that there is a significant negative correlation between real estate tax and housing prices. In eastern region, it has the most significant impact; in middle and western regions, the impact is small. Song Chuan [5] took the supply and demand rule as a standard, found that the urban resident population and disposable income level were positively correlated with commercial housing demand. The difficulty of urban resident’ housing mortgage loans has significant negative impact on the demand of housing.

Due to the unique nature of the housing, it is determined that the price mechanism is more complex than other products [6]. Considering Qingdao’s unique geographical location and environment, in addition to include common factors, we also selected other factors, such as the domestic tourism income, foreign tourism revenue, the total import and export volume.

II. MACROECONOMIC FACTORS
Macroeconomic factors affecting housing prices mainly include GDP, total investment in fixed assets, real estate investment, international tourism income, total import and export of foreign trade at the port, the balance of local currency loans of financial institutions, per capita disposable income of urban residents, total number of employees in the unit, home sales [7]. We get the data of these macroeconomic factors from 2000 to 2014 year, as shown in Figs. 1-8.

III. MODEL ESTABLISHMENT
According to the theory of multiple regression analysis, assume that there is a linear relationship between the twelve factors and housing prices [8]. The multiple linear regression model is as:

$$Y = a_0 + a_1X_1 + a_2X_2 + \ldots + a_nX_n + e$$

where $Y$ is the dependent variable (housing prices), $X_1, X_2, \ldots, X_n$ are the independent variables (macroeconomic factors), $a_0, a_1, a_2, \ldots, a_n$ are the coefficients, and $e$ is the error term.
\[ P = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 X_4 + a_5 X_5 + a_6 X_6 + \]
\[ a_7 X_7 + a_8 X_8 + a_9 X_9 + a_{10} X_{10} + a_{11} X_{11} + a_{12} X_{12} + \varepsilon \]  

(1)

\( P \) means housing prices, \( X_i (i = 1:12) \) means the twelve factors, \( a_i (i = 1:12) \) means the regression coefficients, \( \varepsilon \) means random error term.
Fig. 7 The balance of local currency loans of financial institutions

The macroeconomic data of Qingdao City from 2000 to 2014 year were analyzed by MATLAB, using stepwise regression analysis method to determine the impact of variables on housing prices, the preliminary results are shown as Fig. 9.

Fig. 8 Domestic tourism income

Fig. 9 The preliminary results

\[ \text{RMSE} = 44.3334, \quad R^2 = 0.999949, \quad \overline{R^2} = 0.999645, \quad F = 3281.93 \]

The \( t \) test results of the twelve independent variables are shown in Table I.
We can find \( t \) test values of variables \( X_{12}, X_9, X_4, X_5, X_6 \) are very small; therefore, the explanation function is not obvious. After deleting different combinations of variables \( X_{12}, X_9, X_4, X_5, X_6 \), redo multiple linear regression analysis, make statistical analysis of \( F \) test values, the results are shown in Table II.

Analysis of data in Table II, after deleting variables \( X_9, X_4, X_5 \), we can get:

\[
RMSE = 36.5273, \quad F = 6445.84, \quad R^2 = 0.999914, \quad \frac{R^2}{\text{Adjusted } R^2} = 0.999759
\]

At this point, the model effect is the best.

In Fig. 10, variables \( X_9, X_4, X_5 \) shown in red color, means these three variables have been removed, and get the results:

\[
RMSE = 36.5273, \quad F = 6445.84, \quad R^2 = 0.999914, \quad \frac{R^2}{\text{Adjusted } R^2} = 0.999759
\]

The \( t \) test results of the independent variables shown in Table III.

\[
\begin{align*}
X_{12} &: 36.2601, 5369.85, 0.999949, 0.999763, \\
X_9 &: 42.345, 3924.35, 0.999931, 0.999676, \\
X_4 &: 43.4118, 3733.84, 0.999927, 0.999659, \\
X_5 &: 38.9518, 4637.92, 0.999941, 0.999726
\end{align*}
\]

From the overall analysis of the model, the \( F \) test has passed, the complex decision coefficient \( R^2 = 0.999914 \), the adjusted complex decision coefficient \( \frac{R^2}{\text{Adjusted } R^2} = 0.999759 \), and the \( t \) distribution values can properly reflect the relationship among the factors and housing prices. Therefore, we can get the final model:

\[
P = 650.433+0.904X_7-0.292X_5+4.206X_4+145.39LX_6+0.462X_7-0.116X_5-0.072X_4+3.377X_6+0.00012X_7
\]

\[\text{(2)}\]

\[\text{IV. Model Results}\]

According to the multiple linear regression model, the factors which have significant impact on housing prices are: GDP, total investment in fixed assets, investment in real estate development, international tourism income, total import and export of foreign trade, the balance of local currency loans of financial institutions, the per capital disposable income of urban residents, total number of employees in the unit, home sales.
Fig. 10 Final stepwise regression analysis result

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REFERENCES


