Fluctuation Effect of Supply and Demand in the Assembled Property Market: An Empirical Analysis of China from 2001 to 2018

Gangqiang Luo1* and Qin Wang1
1Department of Civil and Construction Engineering, Guangdong institute of Arts and Sciences, Zhanjiang, Guangdong, 524400, China
1Department of Finance and Accounting, Guangdong institute of Arts and Sciences, Zhanjiang, Guangdong, 524400, China
*Corresponding author's e-mail: 1585450383@qq.com

Abstract. This paper established the disequilibrium degree model of effective supply and effective demand in the assembled property market. Based on the statistical data from 2001 to 2018, the paper estimated and tested the parameters of the disequilibrium model of effective supply and demand, and calculated the disequilibrium degree of effective supply and demand in China's assembled property market. The results indicated that China's assembled property market was not effective and equilibrium, but obviously imbalanced and fluctuated. The research results provided strong empirical evidence for revealing that price distortion was one of the important factors causing the disequilibrium in China's assembled property market. In order to develop healthily and improve the level of social welfare, the government should take it as a basic policy in the future to eliminate the disequilibrium of effective supply and demand in the assembled property market.

1. The economic meaning of disequilibrium of effective supply and effective demand in the operation of the assembled property market

1.1. The economic implication of the relationship between the disequilibrium degree and the development of the assembled property market

In the standard equilibrium analysis framework, the price level is generally assumed to be flexible. The price will rise while demand is greater than supply, and the price will fall while demand is less than supply[1]. The immediacy of price adjustment makes the market always in a state of equilibrium between supply and demand. However, in real economic activities, the price level usually has sticky characteristics[2]. The lag of price adjustment makes the market transactions tend to be carried out under the condition of non-equilibrium between supply and demand[3]. The disequilibrium degree can be calculated by the ratio of the difference between effective demand and effective supply in the assembled property market and the actual turnover[4].

The sign of disequilibrium index has three possible values: positive, zero and negative. If the disequilibrium degree is greater than zero, it indicates that the effective demand is greater than the effective supply, and there is excessive demand in the assembled property market[5]. If the disequilibrium degree is less than zero, it indicates that the effective demand is less than the effective supply and there
is excessive supply in the assembled property market. The unbalanced value of the housing market is an objective representation of the degree of excessive supply or demand in the market.

1.2. The disequilibrium model of effective supply and effective demand in the assembled property market

The disequilibrium model of supply and demand in the macro assembled property market can be described as a hyperbolic aggregation equation composed of equations (1), (2), (4). The disequilibrium model of effective supply and demand in the micro assembled property market can be described as:

\[ D_t = f(X_t, Z_t) \] (1)
\[ S_t = g(Y_t, Z_t) \] (2)
\[ Q = \min(D_t, S_t) \] (3)

\[ Q = \frac{1}{2}(D_t + S_t) - \frac{1}{2}\sqrt{(D_t - S_t)^2 + 4D_tS_tr^2} \] (4)

Formula \( D_t \), \( S_t \), and \( Q \) respectively represent effective demand, effective supply and actual transaction volume in the micro-market of phase \( t \). Formula \( Z_t \) is the vector of exogenous variables affecting both effective demand and effective supply, Formula \( X_t \) is the vector of exogenous variables affecting only effective demand but not effective supply, Formula \( Y_t \) is the vector of exogenous variables affecting only effective supply but not effective demand. The exogenous variable vector \( r^2 \in [0, 1] \) is the coefficient of aggregation degree of the market (reflecting the frictional degree of macro-market structure). Equations (1), (2), (3) denote the disequilibrium model of supply and demand in micro-market, and equation (4) denotes the volume of transactions in the form of market aggregation.

1.3. The disequilibrium degree model of effective supply and effective demand in the assembled property market

Assuming that there are \( k \) products, product space \( y \in R^k \). There are \( n \) buyers and \( m \) developers in the assembled property market, the demand vector of the \( E \) buyers is \( d_i = (d_{i1}, d_{i2}, \ldots, d_{in})(i = 1, 2, \ldots, n) \), the supply vector of the \( H \) developers is \( s_j = (s_{j1}, s_{j2}, \ldots, s_{jm})(j = 1, 2, \ldots, m) \), and the disequilibrium degree is expressed as \( Z = (Z_1, Z_2, \ldots, Z_k) \).

Where, \( Z_h = \left(\sum_{i=1}^{n} d_{ih} - \sum_{j=1}^{m} s_{jh}\right)/q_h, h = 1, 2, \ldots, k \), \( Z \in R^k \), and \( Q = (q_1, \ldots, q_k) \in R^k \) are transaction vectors.

On the premise of meeting the short-side rule, defining \( D_t \) and \( S_t \) as effective demand and effective supply of the assembled property market in a certain year, we can express the disequilibrium vector \( Z \) of effective supply and demand of the assembled property market as follows:

\[ Z_t = \frac{DEM_t - SUP_t}{Q_t} \] (5)

2. Measurement of effective supply and demand disequilibrium in the assembled property market

2.1. Data sources and preprocessing

The empirical analysis of this paper collected the relevant historical data of China's assembled property market from 2001 to 2018. The data on sales area of assembled property and sale price of the assembled property mainly came from the compilation of 50-year statistical data of New China, the statistical yearbook of China[6], the Statistical Bulletins of national economic and social development, and the
annual and monthly reports of national real estate development statistics. Among them, the per capita disposable income and per capita gross domestic product of urban households adopted the constant price value based on 2001 respectively. The total investment in urban assembled property development was reduced by the fixed asset investment price index based on 2001. The average selling price of assembled property was released only in 2008. The assembled property price index was reduced by using the consumer price index of urban residents in 2001 as the base period.

2.2. Construction of the disequilibrium model of effective supply and effective demand in the assembled property

Through the analysis, the main factors affecting the supply of the assembled property market were the price level of the assembled property, the development cost of the assembled property, the industrial policy, the expectation of the developers to the market, etc. The main factors affecting the market demand of the assembled property market were the price level of the assembled property, the income level of the residents, the size of the city and so on. Urban population, the expectation of the main body of assembled property -buying to the market, etc. Considering the above factors and the availability of existing statistical indicators, we set specific variables for the formulas (1) and (2). The equations of the disequilibrium model of supply and demand of assembled property are as follows:

Effective demand equation for assembled property:

\[ D_t = \beta_1 \times PINC_t + \beta_2 \times CPOP_t + \beta_3 \times HP_t + \alpha_t + \mu_{dt} \]  

Effective supply equation of assembled property:

\[ S_t = \beta_1 \times PGDP_t + \beta_2 \times INV_t + \beta_3 \times HP_t + \alpha_t + \mu_{st} \]  

Assembled property trading volume equation:

\[ Q_t = \frac{1}{2}(D_t + S_t) - \frac{1}{2}\sqrt{(D_t - S_t)^2 + 4D_t S_tr^2} \]

In the above equations, \( D_t \) is total effective demand for the assembled property, \( S_t \) is total effective supply of the assembled property, \( PINC_t \) is the per capita disposable income of urban households, \( CPOP_t \) is the proportion of total urban population, \( HP_t \) is the average selling price of the assembled property, \( PGDP_t \) is the per capita gross domestic product, \( INV_t \) is the total investment of assembled property development, \( Q_t \) is the total amount of assembled property transactions (measured by total sales area); constant terms \( \alpha_t \) and \( \beta_t \) are parameters to be estimated, \( \mu_{dt} \) and \( \mu_{st} \) are random error terms (representing factors such as industrial policies, main body expectations), \( r \) is the degree of market aggregation coefficient, \( t = 2001, 2002, \ldots, 2018 \).

2.3. Estimation and test results of parameters of the disequilibrium model of effective supply and effective demand in the assembled property market

The relevant data of the assembled property market from 2001 to 2018 are substituted into the disequilibrium model. According to the basic process of parameter estimation and test, the parameters estimation and test results of each model are obtained by using Eviews 8.0 measurement software. The sample resolvable coefficient of the model is 0.963. The model fits the sample well (which can also be observed directly from Figure 1). The D.W test, S.D., AI.C, SC and other statistical test indicators meet the requirements. From the t-test value, the significant level of regression coefficients is above 95%, which indicates that each variable has strong explanatory power to the effective supply and demand of the assembled property market.

Therefore, we can get the following logarithmic form of the econometric disequilibrium model of effective supply and effective demand in the assembled property market:

Effective demand equation of the assembled property market:

\[ LnD_t = 3.692 \times LnPINC_t + 1.361 \times LnCPOP_t - 2.148 \times LnHP_t + 4.531 \]
Effective supply equation of the assembled property market:
\[ \text{Ln}S_t = 1.237 \times \text{LnPGDP}_t + 1.183 \times \text{LnINV}_t + 0.921 \times \text{LnHP}_t - 8.655 \]  
(10)

Trading volume equation of the assembled property market:
\[ \text{Ln}Q_t \leq \min(\text{Ln}D_t, \text{Ln}S_t) \]  
(11)

According to the econometric disequilibrium model equation (9), (10) and (11) of effective supply and effective demand in the assembled property market, the actual sales volume and simulated transaction volume of the assembled property market in China from 2001 to 2018 are obtained as shown in Figure 1.

3. Analysis of estimation results of effective supply and effective demand disequilibrium model in China's assembled property market

From the parameter estimates of the above equation, it can be seen that there is the following relationship between effective supply and effective demand of China's disequilibrium assembled property market and the relevant variables.

3.1. From the point of view of demand

The elasticity coefficient between effective demand of the assembled property market and per capita disposable income of urban households is 3.692, which indicates that effective demand of the assembled property market rises sharply with the increase of residents' income level; the elasticity coefficient between effective demand of the assembled property market and the average selling price of assembled property is -2.148, which shows that the decline of house price can significantly improve effective demand of assembled property, and the role of price mechanism in regulating demand of assembled property is very obvious. The elasticity coefficient between effective demand of the assembled property market and the proportion of urban population is 1.361, which indicates that the rising proportion of urban population in the rapid urbanization process is constantly giving birth to a large quantitative proportion of assembled property effective demand.

3.2. From the point of view of supply

The elasticity coefficient between effective supply of the assembled property market and the per capita GDP is 1.219, which indicates that the development of national economy has a significant impact on effective supply of the assembled property; the elasticity coefficient between effective supply of the assembled property market and the investment in the development of the assembled property is 1.183, which indicates that the assembled property market has a significant impact on effective supply of the assembled property. Increasing investment in property development can continuously increase effective
supply of the assembled property market; the elasticity coefficient between effective supply of the assembled property market and the average sale price of the assembled property is 0.921, which indicates that the rise of housing prices can significantly improve effective supply of the assembled property market.

4. Measurement and analysis of effective disequilibrium of supply and demand in assembled property market

Empirical study on the disequilibrium degree between effective demand and effective supply in the development of China's assembled property market by using the model of disequilibrium degree of supply and demand of the assembled property market established previously (\(Z_t\) for disequilibrium degree of the assembled property market, \(D_t\) for estimated effective demand, \(S_t\) for estimated effective supply, \(Q_t\) for estimated market intersection). Using the disequilibrium econometric model of the assembled property market, effective supply and effective demand and the disequilibrium degree of the assembled property market are calculated.

According to the estimated results of effective supply and demand in China's assembled property market, we can get the fluctuation trend charts of supply and demand imbalance in China's assembled property market from 2001 to 2018 (as shown in Figure 2) and the sketch charts of effective supply and demand in China's assembled property market from 2001 to 2018 (as shown in Figure 3).

![Figure 2. Fluctuation trend of effective supply and demand disequilibrium in China (2001-2018)](attachment:image.png)
In the 18 years from 2001 to 2018, it can be found that the effective supply of the assembled property market in no one year is exactly equal to the effective demand of the assembled property market, which shows that the effective supply and demand of the assembled property market in China presents an obvious unbalanced state of development. The disequilibrium of China's assembled property market shows four characteristics: (1) The effective demand of buyers is often greater than the actual turnover (14 years, as shown in Figure 4); (2) The effective supply of developers is often greater than the actual turnover (11 years, as shown in Figure 4); (3) The number of years in which the effective demand is greater than the effective supply and the effective supply is greater than the available supply. The number of years of effective demand is equal (9 years, as shown in Figure 3); (4) The number of years in which the estimated volume is greater than the actual volume is less than the number in which the actual volume is greater than the estimated volume (8 years and 10 years, as shown in Figure 1).

5. Conclusion
The disequilibrium of effective supply and demand has long been an important feature of China's assembled property market. The existence of disequilibrium will inevitably lead to the reduction of the operating efficiency of the assembled property market and the level of residents' social welfare. The
greater the degree of disequilibrium, the lower the efficiency of the assembled property market and the lower the level of residents' social welfare\textsuperscript{[10]}. Based on the above research, we can get the following conclusions:

(1) There is a very serious imbalance of effective supply and demand in China's assembled property market. Based on the historical data of assembled property market in China, the result shows that the imbalance of effective supply and demand is quite high. The research results provide strong empirical evidence for revealing that the assembled property market in China is not an effective supply-demand equilibrium market, and put forward the view that price distortion is one of the important factors that cause the effective supply-demand imbalance in the assembled property market, and the effective supply-demand imbalance effect is one of the cruxes that cause the ineffective operation and failure of the assembled property market in China.

(2) With the development of national economy and the starting and deepening of the process of housing marketization, the intensity of the disequilibrium of effective supply and demand in the assembled property market has been reduced, and the market supply and demand forces tend to be balanced on the whole, but this process also has obvious gradual characteristics. Due to the strong monopoly characteristics of the housing industry itself and the increasing concentration of the assembled property market, the market structure has changed from non-equilibrium to equilibrium. The difficulty is increasing, so the regulation and guidance of housing industry regulation policy to supply and demand forces still need to go through a quite long period of difficulty.

(3) To some extent, the rigidity of housing price and the lack of residents' income can explain the intensity and direction of the unbalanced development of effective supply and demand in recent years. Obviously, under the unbalanced operation of the market, the buyers are in an absolutely passive position. Although the effective supply provided by the developer as the market supplier will not deviate from the effective demand of the majority of residents seriously, because the housing price level is much higher than the housing willing to pay price and the actual affordability of the buyers under the condition of balanced supply and demand market, when the housing price keeps rising, the effective demand of the residents is actually decreasing sharply compared with the effective supply. The "three highs" phenomenon of high supply, high house price and high vacancy has historically appeared in China's assembled property market, which is contrary to the common sense of economics. The "sighs of people looking for houses" once became the real portrayal of the unbalanced fluctuation effect of supply and demand at present. To some extent, this explains why in recent years, the macro-control policy has been tightening while the imbalance of effective supply and demand in China's assembled property market has changed in intensity and direction.

Acknowledgments
This research project was supported by the Special Funds for Education Development at Guangdong Provincial Level in 2019 (Development Direction of Private Education), the Science and Technology Tackling Project of Zhanjiang and the Innovation and Strong School Project funding of Guangdong institute of Arts and Sciences. Financial support was gratefully acknowledged. All errors were the sole responsibility of the authors. The authors wished to thank Professor Shidong Hao (Dean of Guangdong institute of Arts and Sciences), Professor Xiaohuo Li (Vice Dean of Guangdong institute of Arts and Sciences), Chuansheng Luo, Xianying Hu, Anxing Wang, Changli Li for their helpful comments and suggestions. The authors also wished to acknowledge assistance and encouragement from colleagues of the department of civil and construction engineering.

References
[1] Zhang, S.Y., Li, W.J. (1995) Research on the regulation mechanism of imbalanced micro-market. Journal of Systems Engineering. Commun., 10: 74–83.
[2] Bo, H., Zhang, H.D. (1996) Research on imbalanced market system. Journal of Management Engineering. Commun., 10: 212–213.
[3] Wang, J.Y., Liu, X.L (2014) Residential fundamental value, bubble component and regional
spillover effect. China Economic Quarterly. Commun., 4: 1283–1302.

[4] Zhang, S.Y., Sun, J. (1996) Research on the regulation mechanism of imbalanced macro-market. Systems Engineering Theory and Practice. Commun., 16: 1–10.

[5] Liang, Y.F., Xing, C.S. (2012) An application research on dynamic factor model of housing prices fluctuation: based on 26 cities in China. Mathematics in Practice and Theory. Commun., 24: 7–16.

[6] National Bureau of Statistics of China. (2018) China Statistical Yearbook. http://data.stats.gov.cn/easyquery.htm?cn=C01.

[7] Li, Y.N. (1998) Imbalanced Chinese economy. Guangdong Economic Publishing House, Guangzhou.

[8] Liang, Y.F., Gao, T.M. (2007) Empirical analysis on real estate price fluctuation in different provinces of China. Economic Research Journal. Commun., 8: 133–142.

[9] Yi, D.H. (2008) Data analysis and eviews application. China Renmin University Press, Beijing.

[10] Yuan, Z.G., (2007) Non Valla equilibrium theory and its application in China's economy. Shanghai People's Press, Shanghai.