An Empirical Study of the Housing-Price-to-Income Ratio of Some Typical Cities

On the Basis of Purchase Installment Payment Model

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Abstract—**In recent years housing price has fluctuated violently, which aroused great social concern. The government introduces some regulatory measures to inhibit the growth of housing price. This paper tries to discuss the housing affordability of residents, which is based on Housing-price-to-income Ratio(HPIR) and Purchase Installment Payment Model. After the calculation the reasonable HPIR interval is 3 to 8 in China. It's obviously that the HPIR of First-tier cities and Second-tier cities exceeds the reasonable interval, while the HPIR of Third-tier cities and Fourth-tier cities lies the reasonable interval.**

Keywords-housing-price-to-income ratio ; income level ; housing affordability；housing markets

I. PREFACE

Since the reform of urban housing system in 1998, the real-estate market of our country has developed quickly, the moderately loose monetary policy has promoted the rapid development of the national economy. At the same time the price of the national commercial housing market went up higher and higher, especially residential commercial housing price, which rose from 1854 yuan per square meter in 1998 to 4725 yuan per square meter in 2010, and the average annual increasing rate was 10.54%[1].Although the residential income increased a lot as much as the increasing of CPI, the life pressure of residents increases. According to the survey which was carried out among the urban depositors in the 50 cities of People Bank of China in 2011, over 70% of urban residents believed that the current residential commercial housing price remained high. There is no doubt that the high price restrained the purchase consumption of residents, which also affected the improvement of housing and living standard.

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[1]Calculated in accordance with the CEInet statistical database data

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II. LITERATURE REVIEW

Housing-price-to-income ratio is an important index which measures the ability that residents can afford to the house. The domestic scholars generally believe that the housing-price-to-income ratio is affected by housing price and income level. The former has positive effects, while the latter is negative. Li Ai-hua(2006) showed that housing-price-to-income ratio could be considered as an index of residents purchasing ability through empirical analysis, but should not be the only indicator.[1]Some scholars focused on the calculating method as well as the improvement of housing-price-to-income ratio. Li Wei(2004) argued that the selection of the data of the housing price and residential income should be classified by the different housing markets and income levels, then calculating the housing-price-to-income ratio with the different weigh.[2]Xue Li-wei(2010) discussed the related factors which influenced the housing-price-to-income ratio. They thought that all of the financial variables, economic structure variables, population structure variables, city construction variables and city public facilities variables can affect the housing price and the income level, finally affecting the housing-price-to-income ratio. So the government should concentrate on the change of this five kind of factors through Macro-control.[3]Chen Jie(2008) argued that the study should be evolved from traditional static housing-price-to-income ratio to the housing-price-to-income ratio on dynamic.[4]Other scholars analyzed the housing markets of different areas. Liu Lin(2006) found out that the housing-price-to-income ratio in Chengdu was high and the purchase ability of urban residents continuously decreased through the empirical analysis.[5]Ge Yang(2010) drew the conclusion that the housing purchase ability of Yangtze River Delta cities was at a low level.[6]Qi Xin(2011) believed that the housing-price-to-income ratio of Beijing was too high and the government should strengthen the construction of security houses.[7]

From the research results in recent years, the standard which is used as judging the family housing affordability is not uniform among domestic scholars. This paper basing on the limitation of personal repayment proportion which is regulated by the China Banking Regulatory Commission,

tries to build installment purchase model to analyze the trend of housing price and dweller income level.

III. HOUSING-PRICE-TO-INCOME RATIO FORMULA BASED ON THE PURCHASE INSTALLMENT MODEL

Diagnostic Index of the first to use the housing-price-to-income ratio as the affordability of housing is Weicher (1977), he identified housing-price-to-income ratio as each set of new home sales in the ratio of median housing price and median annual household income [8]. United Nations Human Settlements (Habitat) also used the housing-price-to-income ratio to measure the purchasing power of houses and affordability among urban families, and housing-price-to-income ratio in the "Urban Indicators Guidelines" gave a clear definition: if the housing-price-to-income ratio is between 3 and 6, it is normal, if more than 6[9], it shows the high pressure of family housing purchase ability.

In China, the calculation of statistics data are based on the price per square meter and residential area, so it is difficult to get the price of residential sales, and our housing-price-to-income ratio calculation is applied to the ratio as below.

Housing-price-to-income ratio=$\frac{\text{the average price of a set of residential housing}}{\text{average annual household disposable income}}$ (1)

For the majority of urban households, they must apply for loans to buy a house. The purchase installment model bases on the equivalent annuity discount, annually discounting the outstanding loans to the current, then calculates in accordance with the current level of price and bank lending rates in established house prices and the proportion of loans under the premise of the town family to take the ratio between the years the amount of their annual income. Assume that the down payment ratio is K, the price of per capita living space of commercial housing is P, household per capita annual disposable income is Y, bank loan interest rate is I, the loan period is N years and the ratio of annual loan repayments accounted for the average annual family income is M, so the Mortgages model is:

$$R = \frac{P}{y} = \frac{m}{1-k} \frac{(1+i)^n - 1}{i(1+i)^n}$$ (2)

$$m = \frac{(1-k)p}{y} \frac{i(1+i)^n}{(1+i)^n - 1}$$ (3)

According to formula (1) and formula (2), we can get the housing-price-to-income ratio formula based on the purchase installment model:

Equation (3) shows that the housing-price-to-income ratio R is proportional to the repayment to income ratio M, the larger M is, the greater the household income for the purchase of house is, of course, the housing-price-to-income ratio is high. The housing-price-to-income ratio and the repayment period has also become a positive correlation, the shorter the repayment period is, the stronger the ability of the family to repay the loan is, and thus explains the relatively low housing-price-to-income ratio.

IV. THE DETEMINATION OF REASONABLE HOUSING-PRICE-TO-INCOME RATIO

In July 7, 2011 the People Bank of China announced that the latest over five-year lending rate is 7.05%. The relevant ministries of the State in September 2010 regulated that the first repayment for loans to buy commercial house should not be less than 30%. For simplicity, we take bank loan interest rate as 7% and down payment ratio as 30%, then according to formula (2), we calculate the housing-price-to-income ratio in the case of the urban households in different repayment income ratios M and different repayment periods N. As the Table 1 indicates:

TABLE I. HPIR BY DIFFERENT M RATIO(I=7%、K=30%)

m	n=5	n=10	n=20	n=30
80%	5	8	12	14
70%	4	7	11	12
60%	4	6	9	11
50%	3	5	8	9
30%	2	3	5	5

The commercial bank real-estate lending risk management guidelines released by the China Banking Regulatory Commission in 2004 sets forth that the loan which is provided to individuals by the Commercial Bank, should control the ratio of monthly real-estate expenditure and income of each housing loan under 50%(including 50%). Clearly, financial institutions thought that if the monthly repayment to income ratio is over 50%, it will give their own lending potential risk.

When we conducted a questionnaire survey in the completion of Fund for Renmin University of China (11XNI011), we found out that of the population of the purchase for first homes, more than 80% can accept 20 years as the maximum repayment period. Reference to the provisions of the China Banking Regulatory Commission, when the repayment to income ratio of the family is 50%, the housing-price-to-income ratio can be up to 8, and it indicates that the value is the upper limit of the price price-to-income ratio which can be accepted by average family. From the analysis of the Table 1 combined with our survey data, we can draw the following judgment:

1) Housing-price-to-income ratio below 3 is the "happy zone", then the family has sufficient ability to purchase its geared to income house, it would not have any impact on the other consumption.

2) Housing-price-to-income ratio between 3-6 is the "security zone", families are free to choose the repayment period and amount, it does not have much influence on the other consumption.

3) Housing-price-to-income ratio between 6-8 is the "pressure zone", families need to adjust repayment methods or type of house according to their income levels, it would have a certain influence on the other consumption, but still can withstand.

4) Housing-price-to-income ratio between 8-12 is the "warning area", and the housing-price-to-income ratio is high, at this time even if the family extends the loan period,

the repayment of its annual income is also very difficult, seriously affecting the other consumption.

5) Housing-price-to-income ratio above 12 is a "danger zone", the normal annual income of the family is almost used to repay the loan.

To sum up, considering a combination of factors, we believe that when the housing-price-to-income ratio of Chinese residents is over 8, all levels of government should be concerned about changes in the real estate market, and suppress the increasing housing prices through market intervention.

V. THE EMPIRICAL ANALYSIS OF THE HOUSING-PRICE-TO-INCOME RATIO OF TYPICAL CITIES

We learn from the four levels of Chinese division which is divided by the Chinese Academy of Social Sciences, Finance and Trade Economics Institute. First-tier cities: Beijing, Shanghai, Shenzhen, Guangzhou; Second-tier cities: Suzhou, Wuxi, Chengdu, Chongqing, Wuhan, Nanjing, Hangzhou, Shenyang, Qingdao, Dalian, Ningbo, Xiamen and other parts of municipalities, part of the provincial capital cities and planned cities with independent; Third-tier cities: Jinan, Changsha, Zhengzhou, Xi'an, Harbin, Changchun, Wenzhou, Foshan, Dongguan and other parts of the provincial capital cities and coastal areas than the developed cities; Fourth-tier cities: Kunshan, Jiangyin, Changshu, Zhangjiagang, Yiwu, Luoyang, Liuzhou, Zhuzhou and other economically strong county-level cities and inland prefecture-level city in general. We selected 13 typical cities for comparative analysis. Table 2 shows the changes in the residential real estate sales prices between 2000 and 2010 in these cities. Table 3 reflects the growth in per capita disposable income of residents from 2000 to 2010.

TABLE II.   THE HOUSING PRICE OF 13 TYPICAL CITIES BETWEEN 2000 AND 2010(YUAN PER SQUARE METER)

Year	First-tier cities				Second-tier cities			Third-tier cities			Fourth-tier cities		
	Beijing	Shanghai	Guangdong	Shenzhen	Wuhan	Chengdu	Hangzhou	Xi'an	Jinan	Changsha	Luoyang	Zhuzhou	Liuzhou
2000	4557	3326											
2001	4716	3658	4047	5507	1745	1648	2624	1849	1858	1736			
2002	4467	4007	3995	5267	1916	1775	3197	1930	2068	1649			
2003	4456	4989	3999	5893	2023	1908	3657	1921	2307	1786			
2004	4747	5761	4356	6385	2463	2224	3884	2394	2831	1775			
2005	6162	6698	5041	6996	2986	2870	5454	2686	2993	2089	1527	1243	1848
2006	7375	7039	6152	8848	3535	3499	5867	3073	3319	2431	1800	1598	2004
2007	10661	8253	8439	13370	4516	4198	7432	3215	3720	3191	2197	1796	2531
2008	11648	8115	8277	12823	4681	4778	8212	3768	4155	3201	2471	1850	2725
2009	13224	12364	8988	14389	5199	4864	10613	3749	4790	3533			
2010	17151	14290	10615	18954	5550	5827	14259	4341	6100	4322			

Source: the the CEInet database and China Yearbook network and Publication library

TABLE III.   THE RESIDENTIAL INCOME OF 13 TYPICAL CITIES BETWEEN 2000 AND 2010(YUAN)

Year	First-tier cities				Second-tier cities			Third-tier cities			Fourth-tier cities		
	Beijing	Shanghai	Guangdong	Shenzhen	Wuhan	Chengdu	Hangzhou	Xi'an	Jinan	Changsha	Luoyang	Zhuzhou	Liuzhou
2000	10350	11718											
2001	11578	12883	14694	22760	7305	8128	10896	6705	9565	8704			
2002	12464	13250	13380	21914	7816	8232	11432	7184	10094	8868			
2003	13883	14867	15003	23906	8520	8823	12892	7749	11013	9943			
2004	15638	16683	16884	25865	9564	10394	14542	8544	12005	11029			
2005	17653	18645	18287	28665	10850	11359	16602	9628	13578	12434	9720	11230	9556
2006	19978	20668	19851	32009	12356	12789	19027	10905	15340	13924	10982	12455	11002
2007	23029	23623	22469	33593	14358	14849	21689	12662	18005	16153	12770	14503	12866
2008	26049	26675	25317	26729	16712	16943	24104	15035	20802	18282	14672	15911	14474
2009	28165	28838	27610	29245	18389	18659	26864	16560	22722	20004			
2010	30665	31838	30658	32381	20806	20835	30035	18404	25321	22284			

Source: the CEInet database and China Yearbook network and Publication library

A. The Housing-price-to-income Ratio of Typical Cities

According to the information released by the Ministry of Housing and Urban-Rural Development, at the end of 2009 per capita residential area of Chinese urban areas is about 30 square meters. So when we calculate the housing-price-to-income ratio of typical cities, we use 30 square meters as the household per capita housing area, and according to equation (3)we can get the results. For details, see the Table 4.

TABLE IV.   THE HPIR OF 13 TYPICAL CITIES BETWEEN 2000 AND 2010

Year	First-tier cities				Second-tier cities			Third-tier cities			Fourth-tier cities		
	Beijing	Shanghai	Guangdong	Shenzhen	Wuhan	Chengdu	Hangzhou	Xi'an	Jinan	Changsha	Luoyang	Zhuzhou	Liuzhou
2000	13.2	8.5											
2001	12.2	8.5	8.3	7.3	7.2	6.1	7.2	8.3	5.8	6.0			
2002	10.8	9.1	9.0	7.2	7.4	6.5	8.4	8.1	6.1	5.6			
2003	9.6	10.1	8.0	7.3	7.1	6.5	8.5	7.4	6.3	5.4			
2004	9.1	10.4	7.7	7.4	7.7	6.4	8.0	8.4	7.1	4.8			
2005	10.5	10.8	8.3	7.3	8.3	7.6	9.9	8.4	6.6	5.0	4.7	3.3	5.8
2006	11.0	10.2	9.3	8.3	8.6	8.2	9.4	8.5	6.5	5.2	4.9	3.8	5.5
2007	13.9	10.5	11.3	11.9	9.4	8.5	10.3	7.6	6.2	5.9	5.2	3.7	5.9
2008	13.4	9.1	9.8	14.4	8.4	8.5	10.2	7.5	6.0	5.2	5.0	3.5	5.6
2009	14.1	12.9	9.8	14.8	8.5	7.8	11.9	6.8	6.3	5.3			
2010	16.8	13.5	10.4	17.6	8.0	8.4	14.2	7.1	7.2	5.8			

B. The Repayment of Income Ratio of Typical Cities

We do not consider the sources of down payment of residential real-estate fund. Assuming that down payment is 30%, repayment period is 20 years, per capita area of one household is 30 square meters and interest of bank loans is 7%. According to equation (2) we can get the results. For details, see the Table 5.

TABLE V.   THE REPAYMENT OF INCOME RATIO OF 13 TYPICAL CITIES BETWEEN 2000 AND 2010(%)

Year	First-tier cities				Second-tier cities			Third-tier cities			Fourth-tier cities		
	Beijing	Shanghai	Guangdong	Shenzhen	Wuhan	Chengdu	Hangzhou	Xi'an	Jinan	Changsha	Luoyang	Zhuzhou	Liuzhou
2000	87	56											
2001	81	56	55	48	47	40	48	55	39	40			
2002	71	60	59	47	49	43	55	53	41	37			
2003	64	67	53	48	47	43	56	49	42	36			
2004	60	68	51	49	51	42	53	56	47	32			
2005	69	71	55	48	55	50	65	55	44	33	31	22	38
2006	73	67	61	55	57	54	62	56	43	35	32	25	36
2007	92	69	74	79	62	56	68	50	41	39	34	25	39
2008	89	60	65	95	56	56	67	50	40	35	33	23	37
2009	93	85	65	97	56	52	78	45	42	35			
2010	111	89	69	116	53	55	94	47	48	38			

C. Big Cities went into Warning Area, Small and Medium-sized Cities were in Security Area

1) The housing-price-to-income ratio of First-tier cities continued high. Since 2000, the housing-price-to-income ratio of four cities is on the edge of the reasonable interval, especially after 2007, the housing-price-to-income ratio of four cities is over 10. The repayment of income ratio of four cities is more than 50%, and increases fast. In other words, according to the analysis of statistics panel data, if the house buyers in these cities take loans to purchase the house, more than half of the ordinary household income must be used to pay bank loan, and they are veritable "house slaves"; Pay attention to 2010, the repayment amount of urban residents in Beijing and Shenzhen is more than their income.

2) The repayment pressure of home buyers in second-tier cities is great. The housing-price-to-income ratio in second-tier cities is basically in the 3-8 range, but wandering on the upper edge of range. Repayment-income ratio of these cities is mostly between 50% and 60%, showing repayment pressure, and the residents in these cities also entered the "house slaves" queue. Specially, second-tier cities are in different regions and have different levels of economic development, which leads to the difference of the housing-price-to-income ratio.

For example, as the representative of coastal second-tier cities, the housing-price-to-income ratio of Hangzhou exceeded 9 in 2005 and even more than 14 in 2010, catching up to the standard of first-tier cities, as well as the repayment-income ratio.

The level of urban development and the comprehensive economic strength of first-tier cities and second-tier cities are at the forefront of the country. Increasing population of these cities makes a huge demand for housing, which becomes a factor pushing up the housing price. The land use of these cities is almost saturated, and the market operation with supply scarcity pushed up land prices, finally contributing to the rising of housing prices. Loose monetary policy in recent years which is carried out by the government also stimulates the rapid expansion of credit scale, then pulling up the prices.

3) The housing-price-to-income ratio of third-tier cities grows slowly. The housing-price-to-income ratio of Xi'an, Jinan, Changsha is in the upper level of the reasonable interval. Repayment-income ratio in these cities is less than 50%, in addition to such larger cities like Xi'an, which is hovering around 50 percent, home buyers' repayment pressure is in the acceptable range. When the control efforts strengthened in first-tier and second-tier cities, real estate investment is bound to transfer to these cities, the housing-price-to-income ratio rises, which is drived by investment demand.

4) The market supply and demand of Fourth-tier cities is reasonable. The housing-price-to-income ratio of Luoyang, Zhuzhou, Liuzhou is in the lower level, and repayment-

income ratio is between 20% -40%, which is in a reasonable level.

VI. CONCLUSION

Economic development of first-tier and second-tier cities is rapid and the income level is relatively high. The common of the commercial housing market in these cities is that the demand is from young home buyers and middle-aged which improve their living conditions, coupled with the influx of hot money and development suppliers of speculation, which drives prices climbing, and makes ordinary citizens suffering immensely. To make the housing-price-to-income ratio of these cities achieve a reasonable level, the only way is to inhibit investment and speculative demand, then make the price dropping to the right price. In accordance with the income level in 2010, the housing-price-to-income ratio is about 8, ordinary middle-income families of first-tier cities can afford the price between 8000 and 9000, as well as second-tier cities is about 5000 to 6000. The government in first-tier and second-tier cities should use financial and tax policies to encourage young people to be first-time home buyers, and guide middle-aged to improve demand, finally limit investment and speculative hype. In order to promote the healthy development of the residential real estate market and to ensure the equitable distribution of resources, the first-tier and second-tier cities should establish inter-regional statistical information platform on the basis of the improvement of the real estate registration, and collect real estate ownership tax as soon as possible.

The third-tier and fourth-tier cities must make the balance between supply and demand of residential real estate firstly to ensure price stability. Secondly they should improve household income through a variety of ways. With the regulation and control policy implementation of second-tier cities, there will be investors who transfer funds to third-tier and fourth-tier cities. How to use these funds to develop the local economy as well as safeguard the stability of the residential housing market is challenging the wisdom of the local government.

The residency right is the most basic human rights, and the government played a key role in solving the housing problem. Whatever the society develops, there is always the low-income population in urban area, and the housing-price-to-income ratio is far more than 8. It is the duty of the government to build some protection of house for the low-income people. In addition, to achieve the healthy development of the residential market through the control method is the concrete manifestation of governing for the people by the Government. Only should the government solve the housing problems of urban and rural residents fundamentally can finally achieve the harmony and stability of the society.

Absolutely there are still many drawbacks in this paper. Firstly, although this paper divided housing market into four levels according to the level of urban economic development, there are still big differences in each level. So it is necessary to subdivide the housing market in the next study. On the other hand, the collection of data also needs improving, for example, the lack of data in fourth-tier cities made the trend of housing price and income unclear. So the further study is essential.

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