Empirical study of Health development of affordable housing based on Beijing micro transaction data

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Abstract This paper utilises the data in Beijing to examine two problems: (1) whether the affordable housing will adversely affect the nearby real estate markets, i.e. housing market and land market, (2) if yes, how to alleviate this influence. The result indicates that the housing price and land price would both be decreased along with the increase of affordable housing floor area. The decrease range is between 0.08% to 0.7% regarding the housing market and land market. The larger number of affordable housing project in the circle of 2km will lead to a further decrease of land price. Thus, we suggest the government to adopt the mixed income style and the IZ affordable housing style and to avoid the concentration of affordable housing so that a healthy development of both affordable housing and private housing market can be obtained.

Introduction

The urban China has been rapidly developed in recent years, moreover, the urbanisation rate of China has been first beyond 50% reaching to 51.3% in 2011[1] . This phenomenon not only reflects the flourishing development, but also gives an important signal that the demand of urban housing is significantly increasing and the housing price raises because of the demand pressure. Therefore the central government strives to construct a huge number of affordable housing in order to alleviate the social problem, which is that the residents have no sufficient affordability to buy a shelter thanks to the high housing price. Nevertheless the affordable housing may gather the disadvantaged people and this may change the neighbourhood due to the low-educated level, low income and so forth. Thus the affordable housing may have a negative externality to the nearby housing market embodying the decrease of housing price. In this paper, we aim to first investigate how the construction of affordable housing influences the nearby housing market and then explore how to alleviate the adverse influence if exists.

[1]中科院报告：中国城市化率首破 50%

Background

In 1994, the welfare housing distribution system had been switched to the monetization of housing, moreover, the affordable housing system of economical housing was first raised. The affordable housing in China can be defined as the houses, which the government possesses the responsibility to manage and plan, are restricted to the construction standard, selling and rental price standard and suitable user standard so that offer an housing security to the low- and middle- classes families[2].

The 'Affordable housing project[3]' had been implemented from 1995 and this policy was planned to use 5 years to complete 15 million square meters of affordable housing, named 'An Ju Fang[4]'. These 'An Ju Fang' would then be sold to the low- and middle- income families with the cost price. Moreover the people in needs, such as families without house ownership, families owning a dangerous housing and so forth, would be taken in advance and no An Ju Fang would be sold to the high-income families. The State Council noticed in 1998 that in the latter half year of 1998, the housing distribution would be terminated and substituted by the monetization of housing distribution. The new affordable housing system had basically three levels: low-rent housing for the low-income families, the economical housing for the low-to-middle income families and the commercial housing, which was deal under marketization, for the middle-to-high income families[2]. In 2003, the housing market was of excessive marketization, affecting the construction and supply of affordable housing and leading to the absence of affordable housing. However, the former Premier Wen stated that the construction of low-rent housing should be accelerated, the housing problem of low-income people should be aggressively overcome quickly in the reports of the work of the government in 2006 and 2008[2]. The construction of affordable housing was then intensified in 2010. In 2011, the government had stated that the construction should be accelerated and the construction start of 5.8 million sets of affordable housing must be ensured and the actual construction start of affordable housing was 5.9 million sets in 2011. In the four session of the 11st National People's Congress press conference, the national development and reform commission (NDRC) said "In the next five years, 36 million sets of affordable housing

[2]中指报告：保障房专题研究：历史、现状、趋势、策略

[3] 《安居工程》

[4] 《安居房》

should be completed, in other words, 10 million sets completed in this year, 10 million sets completed in next year, 16 million sets completed in the following three years. The NDRC aimed that the affordable housing coverage rate would reach to 20%[5].

In China, there are two common construction mode regarding the affordable housing, exclusionary zoning affordable housing (hereafter EZ affordable housing) and the inclusionary zoning affordable housing (hereafter IZ affordable housing). The latter will contain a certain ratio of affordable housing units in a new constructed or rehabilitated housing project (Fig.1.1). There are four main types of affordable housing. First, the economical housing obtains two characteristics, economy and applicability. The pricing will be guided by the government's standard and the area will also be restricted by the government. The selling price of this type of affordable housing should be afforded by the low-to-middle class families who will have the limited ownership. The housing guarantee object of economical affordable housing is the middle income families. Second, the low-rent affordable housing will only be leased with a relatively low price and not be sold. The ownership of the low-rent affordable housing is belonged to the government or related authority. The housing guarantee object is the lowest-income families. Third, the public rental housing is constructed for the families, who cannot afford to buy an economical housing but fail to fulfil the requirement to apply the low-rent housing. Therefore the housing guarantee object is the middle-to-low income families[5]. Forth, the limited-price affordable housing is basically a commercial housing, however it contains the nature of housing security and its selling price is restricted by the government. The guarantee housing object is the middle income families[6].

[5] 中指报告：保障房专题研究：历史、现状、趋势、策略
[6] SouFun: http://zhishi.soufun.com/detail/sanya_4930.html

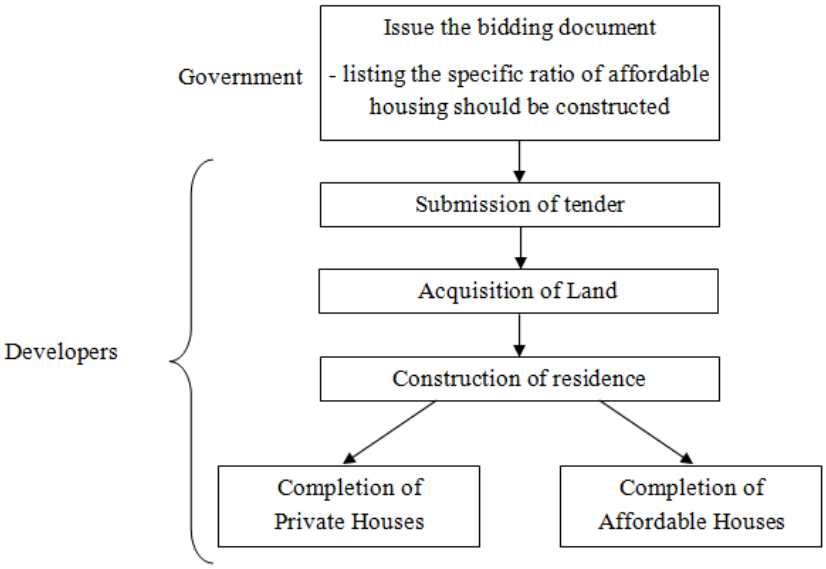

Figure 1.1: Details of inclusionary zoning model

Based on the above discussion, we can acknowledge that the construction of affordable housing is of importance and is now being highly concerned by the government. Nevertheless there are several social problems adhering with the affordable housing if favourable planning and development are missed. For instance, large-scale construction of exclusionary affordable housing (hereafter EZ affordable housing) will result in the increase of social isolation and exclusion, urban slums, low educational level, high crime rate and intergenerational poverty and so forth (Newman, 1996), (Saiz et la, 2006). In general, these problems will lead to a strong negative externality to the nearby housing market and land market, thus, the housing price and land price may fall ultimately. In the international aspects, in United State, the large-scale exclusionary affordable housing gathered a large number of blacks. This brought about the further social isolation (isolation of the blacks and white) and the low living standard to the people who lived in social housing and most of them were black. This situation generated the blacks' antagonism emotion, which can be recognised as the important and direct cause of the 1960s race riot (Li, 2008). Moreover Goujard (2011), discovered that the average housing price will drop approximately 5.5% in which within 350 to 500 meters around the affordable housing projects in Paris. With regard to the situation in China, we can state that the construction of affordable housing mostly adapted the exclusionary, were located at the boundary of the city and lacked of facilities. In Beijing, there are 52 exclusionary affordable housing projects, occupying around 26 million sqm and distributed in the south and north parts of Beijing urban area, 60% of the occupied land was located at the outer bound of 5th ring. The two larger projects, 'Hui Long Guan' and 'Tian

Tong Yuan', are far from the city centre as recorded at least 20 km. in Nanjing, the local government started to develop the super-size affordable housing projects which area can reach to 2-3 million sqm for each project (Saiz, 2006) & (Shan, 2001). According to the case in the Euro and the United State, the exclusionary affordable housing will cause the urban slum. This neighbourhood will finally result in the decrease of housing price and a series of social problem. Therefore, in this paper, we aim to answer two questions. First, will the China experience the similar result happening in foreign countries i.e. whether the affordable housing projects will have a negative externality embodying in the decrease of nearby housing price? Second, if there is negative externality to the nearby private housing, how to alleviate the adverse impact brought to the surrounding housing markets. The final section of this paper will offer some suggestions to the government on the affordable housing construction.

Data & methodology

Data

As the externality of affordable housing is our concern, four large sets of data are utilised, the housing transaction data, the land transaction data, the details of affordable housing including the EZ and IZ affordable housing projects and the controlled group data. The first data set is provided by one of the largest housing agencies 'Wo Ai Wo Jia', the second and fourth data sets are offered by the China Real Estate Index System. The rest data is obtained from the Institute of Real Estate Studies, Tsinghua University.

The housing and land transaction data acquired includes the houses physical attributes, location attributes and transaction details, for instance, area, number of living room, washroom and bedroom, floor, decoration level, direction, age, district, transaction date, land area, floor area ratio and so forth. The effective ordinary housing transactions and land transactions sample size were 3,829 and 1,079. The affordable housing data set can be basically divided into two sub-sets, which are the data regarding the EZ affordable housing and the data regarding the IZ affordable housing. These data sets contain the details of 47 EZ affordable housing projects and 12 IZ affordable housing projects, involving the year of construction start, area, districts, natures and so forth. The controlled group data, having 62 housing projects, is basically the private housing projects' details including the date of presale and location attributes, in which their locations are near to the affordable housing in order to make the comparison while conducting the regression.

Figure 2.1 reveals the spatial distribution of affordable houses, including EZ and IZ affordable houses and the controlled group, private houses. From the figure, we can acknowledge that the private houses are very near to the affordable housing in order to make an effective comparison. Moreover table 2.1 lists the details of affordable housing and controlled group, for instance, the area of affordable housing within one housing project. The '0' of 'area of ah' represents that the residential project contains no share of affordable housing, known as the private houses. The definition of variable 'ratio' is that the 'area of ah' divided by the total floor area of the residential project. In other words, if 'ratio' is within 0 to 1, the residential project includes specific share of affordable houses, known as the IZ affordable housing project and if the 'ratio' is equal to 1, the residential project includes no share of private houses, known as the EZ affordable housing project.

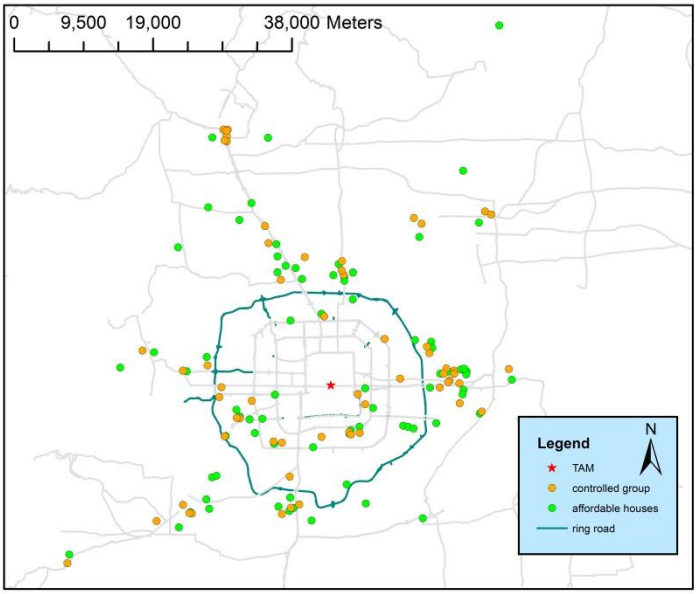

Figure 2.1: Spatial distribution of affordable houses and controlled group

Table2.1: summary of affordable housing projects and controlled group

Variable	Obs	Mean	Std. Dev.	Min	Max
area_of_ah	143	106180.3	178463.1	0	1190417
ratio	143	.4764496	.4889977	0	1
dist_tam_ah	143	18623.51	8859.308	3878.47	54343.2
dist_sub_ah	143	2398.472	3112.823	43.33	24639.02

The figure 2.2 and figure 2.3 represent the spatial distribution of housing projects and land respectively. Moreover the table 2.2 and table 2.3 list the details of housing project and land.

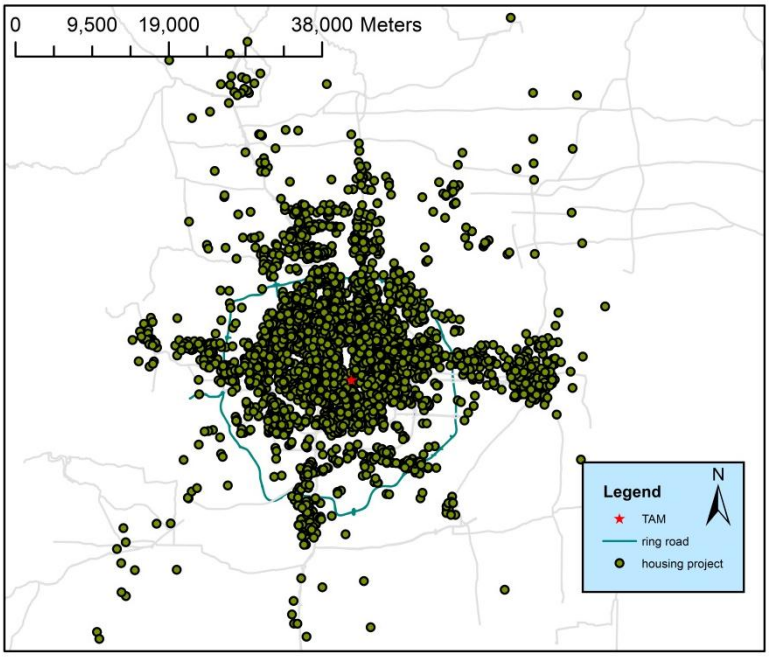

Figure 2.2: Spatial distribution of housing projects

Table2.2: summary of housing projects

Variable	Obs	Mean	Std. Dev.	Min	Max
hp	3829	12042.81	4598.668	1030.928	36030.83
dist_tam	3829	11053.12	5445.487	1096.717	28329.96
dist_sub	3829	1276.807	1128.565	67.75301	9030.588

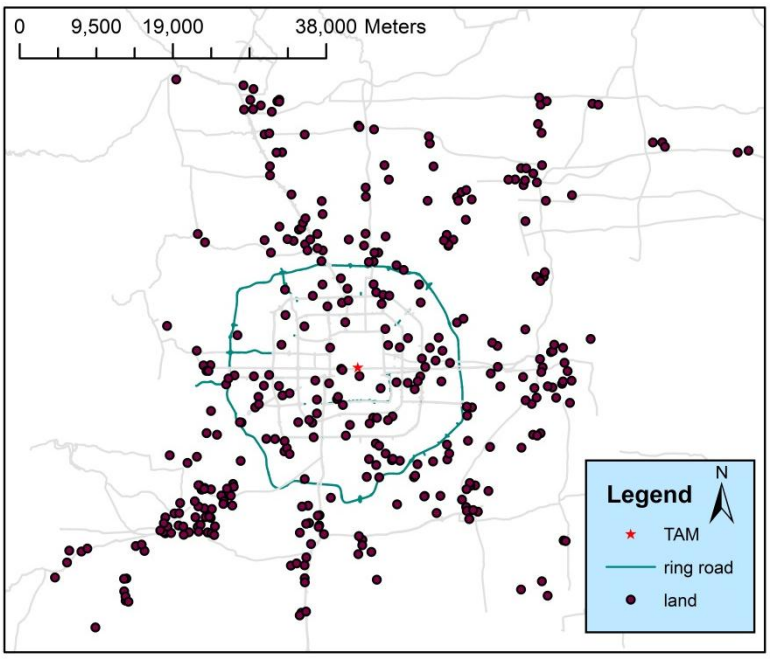

Figure 2.3: Spatial distribution of land sale

Table2.3: summary of land sale

Variable	Obs	Mean	Std. Dev.	Min	Max
lp	1079	4744.429	3093.741	1034	18014
dist_tam	1079	16350.95	8429.434	1940	45640
dist_sub	1079	1863.955	1709.099	96.73	15142.18

Methodology

This empirical analysis would be started by matching the housing projects to the affordable housing projects and the controlled group in spatial dimension. We emphasize on the impact on the private housing market by the event that 'construction of affordable housing', embodying in the housing price or the land price. Difference in differences model is adopted to investigate how the affordable housings' externality influences the residents' and the developers' willingness to pay so that the housing price and land price increase or decrease. Through controlling other factors, we can extract the impact from 'the construction of affordable housing' on the private housing. Basically, the housing price and land price is determined by the following equation:

$$HP=f(\text{physical attributes}, \text{location attributes}, \text{time trend}) \quad (1)$$

LP=f (physical attributes，location attributes，time trend) (2)

With regard to the factors affecting the housing price and land price, location attribute is one of them, for instance, the distance to the city's centre i.e. distance to Tian An Men, subway station, primary school, secondary school, shopping centre, employment centre and so forth. These mainly reflect the convenience level. Second is the physical attributes, such as the direction, age, decoration level, floor and so forth regarding the housing price and the land area, floor area ratio, distance to Tian An Men and so forth regarding the land price . The third one is the time trend, which can be achieved by adding the time control variables. However, the equation (1) and (2) cannot be utilised to investigate the influence on housing price and land price due to the 'construction of affordable housing' event. Therefore another specialised model should be established. After analysis on the data sets, we have defined four important variables as shown in the equation (3) and (4): START, NEAR, START_NEAR and START_NEAR_ratio. 'START' means that whether the transaction happens within a specific period after the affordable housing construction start. 'NEAR' means that whether the distance to the affordable housing is within a specific distance, in our study, distance from the affordable housing and the controlled group to the housing project or land is less than 800m. 'START_NEAR' is the cross term of START and NEAR. 'START_NEAR_ratio' is the cross item of 'START_NEAR and 'ratio', which is defined as the affordable housing floor area divided by the total floor area. In other words, the ratio should be zero for the controlled group, one for the EZ affordable housing and larger than zero but smaller than one for the IZ affordable housing. The coefficient α_4 can directly reflect how the 'construction of EZ affordable housing or IZ affordable housing' brings influence to the nearby private housing market.

$$\log(HP) = \alpha_0 + \alpha_1 START + \alpha_2 NEAR + \alpha_3 START\_NEAR + \alpha_4 START\_NEAR\_ratio + controlled\ variables \quad (3)$$

$$\log(LP) = \alpha_0 + \alpha_1 START + \alpha_2 NEAR + \alpha_3 START\_NEAR + \alpha_4 START\_NEAR\_ratio + controlled\ variables \quad (4)$$

The controlled variables include ln(house area), floor, square of floor, number of living rooms, number of rooms for equation (3), ln(land area), floor area ratio, square of floor area ratio for equation (4). The common variables are ln(distance to 3A hospital), ln(distance to city centre), whether there is an elementary primary school within 3km, whether there is subway station with 800m, district and time dummy.

Empirical result

The empirical study can be basically divided into two parts: (1) the influence made by the ‘construction of affordable housing’ to the nearby housing market, and (2) to the nearby land sale market. First of all, we have checked whether there is a negative externality of affordable houses, revealed in table 3.1. The time period of this regression is about one year, which is half year before and half year after the ‘event’ happens. The negative sign of ‘START_NEAR_ratio’ embodies that if there is the construction start within 800m, the housing price would decrease. Therefore, we can conclude that the share of affordable houses would determine the range of the decrease of housing price. In order words, the EZ affordable housing would bring the largest negatively impact to the nearby housing market. The EZ affordable housing and the IZ affordable housing project, in which ratios reach to 1 and 0.63, would make a approximately 0.7% and 0.08% decrease of housing price respectively.

Table 3.1: Result of the influence brought by affordable housing to the private housing market

	(1)
VARIABLES	lnhp
NEAR	-0.0113
	(0.0318)
START	-0.0102
	(0.00931)
START_NEAR	0.0990***
	(0.0171)
START_NEAR_ratio	-0.168***
	(0.0249)
yearly fixed effect	yes
district fixed effect	yes
controlled variables	yes
Constant	9.556***
	(0.130)
Observations	3,829
R-squared	0.546

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The second part of our empirical study is the influence brought from the affordable housing to the land market. The time period of this regression is about two year, which is one year before and one year after the ‘event’ happens so that we can ensure the sufficiency of sample. Table 3.2 shows the result. The first column of table 3.2 is used to examine how the

share of affordable housing affects the land deal price. From the table, we can know that the EZ affordable housing would lead to 0.44% fall of land price. Furthermore, the IZ affordable housing with the average ratio, 0.476 would lead to 0.18% fall of land price. The second column of the table is added a new variable named 'START_NEAR_freq', which is the cross item of 'START_NEAR' and 'freq'. The 'freq' means how many affordable housing projects are located within 2km for a specific residential project. This item can embody the housing price difference that whether the residential project surrounded by affordable houses. From the coefficient, if the residential project is surrounded by two EZ affordable housing projects, the housing price would decrease 0.62%, which fall 0.09% more comparing with the residential project having only one EZ affordable housing project nearby. To conclude, not only the share of affordable houses would negatively affect the land price, but also the number of affordable housing projects nearby would sufficiently affect the land price.

Table 3.2: Result of the influence brought by affordable housing to the land market

	(1)	(2)
VARIABLES	lnlp	lnlp
NEAR	0.217***	0.226***
	(0.0727)	(0.0727)
START	-0.0355	-0.0363
	(0.0227)	(0.0227)
START_NEAR	0.0577	0.296**
	(0.0826)	(0.128)
START_NEAR_ratio	-0.499*	-0.519**
	(0.259)	(0.259)
START_NEAR_freq		-0.0882**
		(0.0362)
yearly fixed effect	yes	yes
district fixed effect	yes	yes
controlled variables	yes	yes
Constant	8.898***	8.869***
	(0.287)	(0.286)
Observations	1,079	1,079
R-squared	0.714	0.716

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robustness test

The empirical analysis in chapter three reveals that the central government strives to construct a huge number of affordable housing in order to alleviate the social problem,

nonetheless, the construction of affordable housing brings about another problem, which is the change of neighbourhood, and ultimately the average housing price and land price of the will decrease. However, this deviation may be affected by other latent factors.

The first possible existing problem is that the time period of our empirical analysis is quiet long, which one year for housing market and two years for land market. Although we have controlled a number of variables, the result may be influenced by other factors. Therefore, more severe test has been conducted shown in table 4.1- table 4.2. The time period is reduced to half years for housing market and one and half years for the land market i.e. from the three/nine months before the event happens to the three/ nine month after the event happened. The tables reveal that the robustness test results are all robust and consistent with our result in chapter three.

Table 4.1: Robustness test of the influence on the housing market

	(1)
VARIABLES	lnhp
NEAR	-0.0587
	(0.0545)
START	-0.0197
	(0.0137)
START_NEAR	0.125***
	(0.0286)
START_NEAR_ratio	-0.188***
	(0.0400)
yearly fixed effect	yes
district fixed effect	yes
controlled variables	yes
Constant	9.549***
	(0.198)
Observations	1,675
R-squared	0.535

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.2: Robustness test of the influence on the land market

VARIABLES	(1) lnlp	(2) lnlp
NEAR	0.230***	0.232***
	(0.0845)	(0.0844)
START	- 0.113***	- 0.113***
	(0.0273)	(0.0273)
START_NEAR	0.184*	0.445**
	(0.107)	(0.186)
START_NEAR_ratio	-0.543**	-0.621**
	(0.264)	(0.268)
START_NEAR_freq		-0.0832*
		(0.0486)
yearly fixed effect	yes	yes
district fixed effect	yes	yes
controlled variables	yes	yes
Constant	8.899***	8.869***
	(0.335)	(0.335)
Observations	719	719
R-squared	0.721	0.722

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

In this paper, we aim to answer two questions: (1) is there a negative externality from the affordable housing embodying the decrease of housing price, and (2) how to alleviate this impact.

First of all, we have discovered that the housing price and land price would both be negatively affected by the share of affordable housing and the number of affordable housing projects nearby. To be simply, the more share of affordable houses in one project and larger number of affordable housing projects nearby would lead to a greater negative impact to the real estate market. This is because the isolation or the gathering of the disadvantaged people may first change the neighbourhood and ultimately cause the defence community in the future. This change of neighbourhood would then repress the willingness to pay of the potential buyer. As a result, the government should explore how to effectively construct affordable housing including the location, externality and sustainability.

The construction of affordable housing may cause large or small negative impact to the nearby real estate market, which actually depends on the spatial distribution. The high concentration of affordable housing within one residential project or within one specific area, i.e. a circle with the radius of 2km, would cause large adverse impact. In this case, we should minimize the adverse change of neighbourhood so that affordable housing will not be the factor repressing the buyers' willingness to pay. To achieve this, we recommend two possible suggestions, (1) the mixed income style and (2) the IZ affordable housing style.

Regarding the mixed income style, there will be a ratio of low- or low-to middle- income families, arranged to live in one housing project with the middle-to-high or high income families. Newman (1996) stated that the maximum units of mini neighbourhood are 24 for one site because of his research result, discovering that the crime rate will increase along with the number of units. Moreover, the IZ affordable housing in China is constructed by regulating the developer to build a specific amount of affordable houses defined by the government. The government should adopt this method rather than the EZ affordable housing. By doing in these way, the 'ratio' can be kept at low level, thus the real estate price should not fall greatly due to the affordable housing. Moreover, the distribution of affordable housing should be evenly located at city-level. The concentration of affordable housing in one area would also cause the great decrease of real estate price, indicated by START_NEAR_freq in table 3.2.

Some social problem can be avoided by using the mixed income style and IZ affordable housing style, for example, the formation of slum area. Therefore, these two are of effectiveness in terms of real estate economy, real estate health development, people's livelihood and social harmony.

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