

## The Spatial Characteristics and Supply of Urban Affordable Housing -- An International Comparative Study

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**Abstract:** It is an emerging issue for the supply of urban affordable housing that the spatial distribution marginalization and the separation of workplace and residence lead to socio-spatial problems. This study takes an international comparative approach and analysis the different of spatial distribution characteristics in urban area and the formation mechanism of affordable housing, focusing on cities in developed countries, e.g. Amsterdam, London and Singapore, as juxtaposition to Shanghai, China. Before conducting a transnational comparison, this research reveals the socio-economic characteristics of policy takers under the state context by analyzing the policy objectives of affordable housing in various countries, because of the significant differences in definition of beneficiary and supply mode between countries. Based on that result, this research maps the spatial distribution pattern of affordable housing clusters where the comparable resident groups living at the four case cities, and analysis the socio-economic mechanism behind spatial characteristics. It points out the implicit meanings of affordable housing policy connotation are reflected by urban residents' willingness and proportion to own housing. And, government and market-led intervention also have a profound impact on affordable housing's spatial distribution in the city. Finally, this research argues that the classification standards of the citizen groups are different due to diversity in state institution and cultural context, which further leads to the difference in social justice represented by spatial pattern, comparing these four cities. European cities may be more concerned about the equity of human development opportunities, while cities in East Asia may be more concerned with the equality of household wealth. And these different are presented in terms of spatial features.

**Keywords:** Affordable housing; spatial characteristics, supply mechanism, international comparative

### Introduction

Decent dwellings are one of the most fundamental human rights that guarantee the well-being of people (Tusting *et al.*, 2019), and urban housing usually features the pattern of certain social group in the city (Zhang *et al.*, 2017, Dawkins, 2013), which provide a significant insight into the research of city structure (Zhang *et al.* 2019). Affordable housing plays a special role in urban housing, with the effect of city orientation and policies. Besides, the beneficiary group is mostly the disadvantage in the city, thus underlining the question of social justice in spatial pattern analysis of it.

After a length development took 70 years, contemporary Chinese cities established a dual-housing supply system, with support from both the market and government (Li *et al.*, 2015). While affordable housing is mainly provided by government with dwellings and rent subsidies (Qu and Xiao, 2015). Under the effect of land-based finance and straining land supply, major Chinese cities failed to match the demand for affordable housing (Hu and Qian, 2017), with the existing ones showing problems like distant location, dwellings clustering and spatial

mismatch (Zheng and Zhang, 2010, Song, 2011, Liu and Xing, 2013, Dong and Zhang, 2014, Fang *et al.*, 2015), which is defined as the “typical problematic feature” of Chinese affordable housing (Shi and Meng, 2013). By comparing the spatial pattern of affordable housing in the city, this research tries to understand the location choice of affordable housing in global context, and find out how the differentiated definition of affordable housing and beneficiary group could lead to various spatial pattern.

There has been an extensive research on the spatial pattern of affordable housing, but current essay focus on counties or regions with similar context, and they mainly research on the spatial effect that single policy has on affordable housing. By establishing the perspective of spatial pattern analysis, we run a comparison between Shanghai and other global cities in Europe and Asia, such as Amsterdam, London and Singapore. At first, we stress the diversity of policy context between every country, and by developing the concept of advantage location in the city, we can evaluate the location choice of affordable housing in every country, and we find that spatial pattern of affordable housing between China and other countries show a significant difference. Affordable housing in Chinese context strengthen the idea of basic dwelling for disadvantage groups, while other countries stress opportunities and variety in the city, and difference in definition affect their location choice.

### **Research on the Spatial Pattern of Affordable Housing**

Current literature points out the problematic location of affordable housing in cities, then adapts analytic methodology to examine it. In Chinese context, scholars pay more attention to distant location and large-scale construction (Chen *et al.*, 2015), while spatial clustering of disadvantage groups features more in global context.

The effects policy has on affordable housing is a common motive in literature, while both nationwide orientation in urban development and specific housing policy will affect the spatial pattern of affordable housing (Alawadi *et al.*, 2018). Under the scheme that housing is market commodify, developers tend to take a conservative attitude towards affordable housing (Ryan and Enderle, 2012), which could lead to problem in project financing. Some policies aimed at encouraging the construction of affordable housing resulted badly in spatial problems like clustering (Ryan and Enderle, 2012, Dawkins, 2013). However, as some literature point out, policies aren't the only aspect affecting the spatial choice of affordable housing, the amount of available stock in urban housing markets, location of occupation and historic district, some, if not all, played a part in the spatial pattern of affordable housing (Park, 2013, Fan *et al.*, 2014, Fang *et al.*, 2015).

Location of affordable housing has effect on the benefit for residents. Compared with the original dwellings, residents in affordable housing acquired improved housing condition (Park, 2013), however the spatial mismatch between occupation and residency in distant located housing could lead to an overall loss of social benefits. Besides, large-scale affordable housing construction, displayed as the clustering of disadvantage groups, marginalizes and segregates residents inside. (Oakley and Burchfield, 2009, Allen and Goetz, 2010, Kontokosta, 2015)

Scholars have responded to these problems: Chen *et al.* (2015) adopted spatial analytic model and proposed a research framework for the spatial pattern of affordable housing; Ding (2012) taking transportation, land price and infrastructure into consideration, propose a guideline for the location choice of affordable housing. Aside from that, emphasizing the mix between job and dwellings instead of simply mixing social group, Transit oriented development (TOD), higher density of street could partially soothe the wounds (Kostourou and Karimi, 2017, Palm and Niemeier, 2017).

After a thorough review of the literature, we find that researches on spatial pattern of affordable housing has two distinct frameworks in Chinese and global context. Foreign scholars tend to treat location as the spatial presentation of policy effects, and their researches are usually based on certain policies, while most Chinese scholars propose the spatial problem of affordable housing first, with policies as their background.

## Data and Methodology

In this research, authors adopted a global comparison perspective, and proposed a research framework for spatial pattern of affordable housing in global context. The methodology consists of three progressive parts.

Because of diversity among countries, there is no standardized definition of affordable housing, which is subdivided into several policies and housing types in different countries, thus in the research, identification of affordable housing in global context is needed. Urban housing subsidy is usually realized in two forms: dwelling and rent, and this research mainly focuses on the dwelling aspect, which could be further categorized into rental and sold affordable housing. After establishing research subject, we build up a database for affordable housing in each city with open data, then apply GIS into analysis procedure.

The mere spatial pattern of affordable housing in the city could not provide sufficient result in global context, however by comparing it with location dominance within the city, the characteristics of affordable housing is revealed. Therefore, the authors define “advantage area” in the city, which is district with denser population and richer infrastructure, known as CAZ (Central Activities Zone) in some countries. Because of the special policy background of affordable housing, its residents are usually disadvantage groups in the city, the location choice of affordable housing relate to their ability to obtain opportunities (Oakley and Burchfield, 2009, Li *et al.*, 2013), there is need for affordable housing to be located inside advantage area. By mapping affordable housing in the city, one can find its relationship to the city, paving the road for spatial comparison.

When defining advantage area in each city, different strategies must be applied to identify the specific area. For Shanghai and London, the research area extend to the whole metropolitan boundary, thus showing a significant core in the city, both recognized as CAZ, while in Amsterdam and Singapore, considering the relatively smaller land area, property price acts as market tool to assess supply and demand, in this research we used it to identify advantage area in both country.

Existing literatures recognize spatial clustering of affordable housing as the cause of some negative social effects, such as segregation of minor social groups. Therefore, we adopted a tract-level analysis to identify the clustering of affordable housing clustering in the city. Anselin (1995) suggest that the value of certain attribute is not only significant in itself, but also related to the same attribute of nearby areas. This theory works as an extension of Tobler’s “first rule of geometry” (Tobler, 1970), and is extended to the Explorative Spatial Research Analysis (ESRA), in which LISA model and Local Moran’s I is used to identify the high and low value clustering(Oakley and Burchfield, 2009).

### Spatial Pattern of Affordable Housing in Global Context

Global metropolis is faced with housing problems, normally in the form of declining social housing, rising price for urban housing and shortage for affordable housing, therefore most megacities pay special attention to housing affordability in the city.

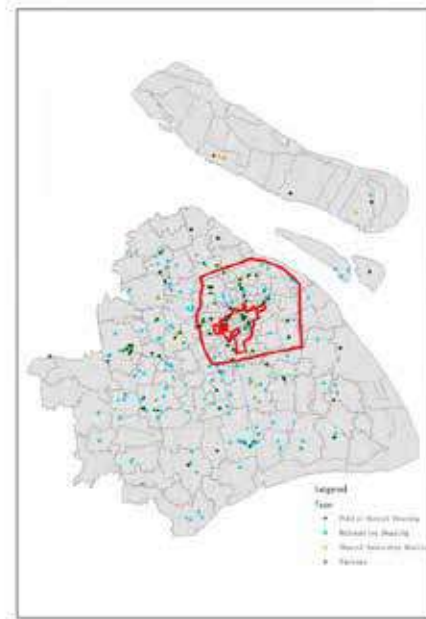
Variety in global housing policy attached importance to the introduction of every city’s housing policy and advantage area. Based on introduction, the mapping of affordable housing is overlapped with advantage area. Moreover, we used spatial clustering model to examine whether there is congregation of affordable housing in tract-level.

### *Shanghai*

Before 1990s, housing in Shanghai has not yet been commodified, citizens resided in government-owned or subsidized dwellings (Huang, 2013). Reform of urban housing scheme in 1990s posed severe impact on the role of affordable housing in China. During this period, Cheap Rental Housing was first announced. As the

commodification of urban housing intensifies, the status of affordable housing was lowered and did not return to urban housing scheme until 2007 (Qu and Xiao, 2015) In China, central government issued the guideline of affordable housing, and local governments are in charge of construction and management.

Affordable housing in Shanghai started in the 1980s (Li,2011), while almost 40 years of development brought us to the result of diverse in housing types. According to Shanghai (2017), there are currently four types of affordable housing in Shanghai: Cheap Rental Housing (CRH), Public Rental Housing (PRH), Shared-ownership Housing (SOH) and Relocation Housing (RH). The former two types are for rentals, while the latter for sold, which is mainly aimed at residents with *hukou* (residency register status).



*Figure 1 Spatial Pattern of Affordable Housing Points in Shanghai*

The structure of Metropolitan Shanghai can be divided into three parts with central core area. The most inner part consists mostly historic district and is defined as CAZ, while between CAZ and the outer ring there is inner city of Shanghai, and the large peri-urban outer Shanghai. Metropolitan Shanghai is rather centralized, with the intensity of land use and infrastructure decay as the distance to city center increases.

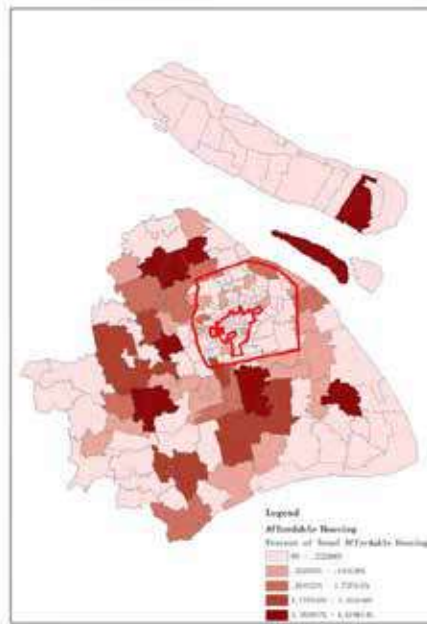


Figure 2 Affordable Housing Ratio in Census Level

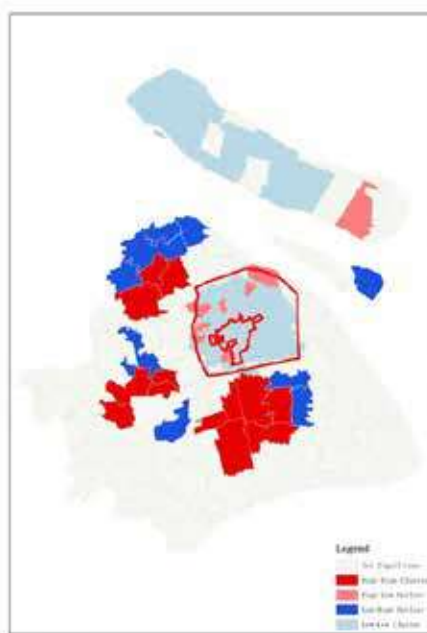


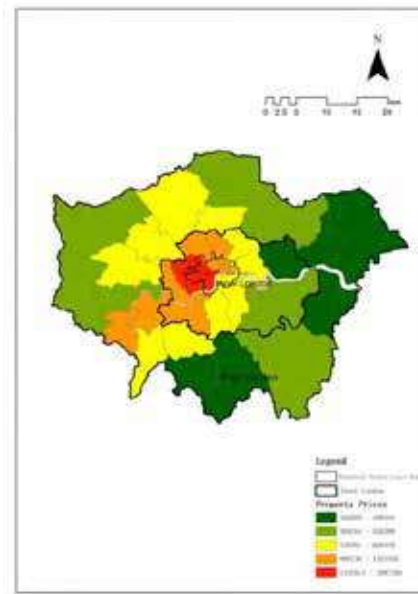
Figure 3 Spatial Clustering of Affordable Housing in Shanghai

Currently, there are 402431 affordable housing units in Shanghai, with Relocation Housing taking up the most part, who are mainly located in peri-urban area. By spatially joining to census level, its spatial pattern significantly marginalized, with almost no affordable housing units in CAZ. Few affordable housing units are situated in the inner city, most of which are Public Rental Housing, taking up 9.8% of total units, as much as single large-scale community distantly located takes. In spatial correlation, affordable housing in Shanghai shows low-low cluster in inner city and high-high cluster besides several large-scale communities like Pujiang, South Songjiang and North Jiading. The result show that affordable housing in Shanghai doesn't located in advantage area in the city, with construction focused on peri-urban area surrounding the outer ring.

## London

London is faced with severe shortage of housing supply, with housing privatization leading to rising property price, urban housing become less affordable for citizen, the price of market-oriented rental housing is hard to control, it is in dire need for affordable housing (Mayor of London, 2018).

Aside from some minor projects, affordable housing in Greater London is supervised by Great London Authority (GLA). As London recognize variety as the fundamental aspect behind economy booming, there are no restriction on affordable housing applicants, open to London, Great Britain and other part of the world.



*Figure 4 Spatial Structure and Property Price in London*

Mayor of London (2018) suggest that the housing crisis could be solved by providing more housing for Londoners, therefore three types of affordable housing come up: homes based on social rent levels (which includes London Affordable Rent); homes for London Living Rent ; homes for London Shared Ownership, and is open to other affordable housing types. According to Ministry of Housing, Communities & Local Government (DCLG), as of 2018, Great London area possesses 310029 units of affordable housing, taking up 8.9% of all dwelling units.

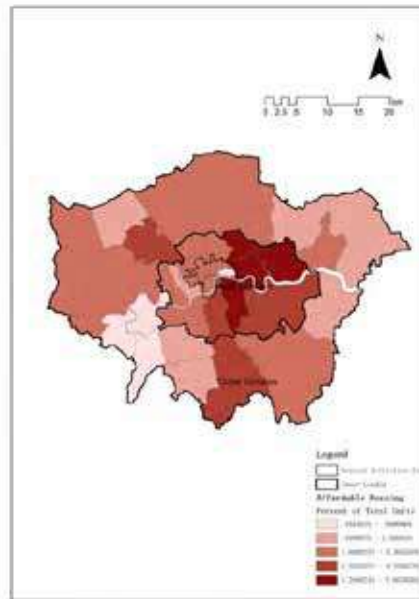


Figure 5 Affordable Housing Ratio in Borough Level

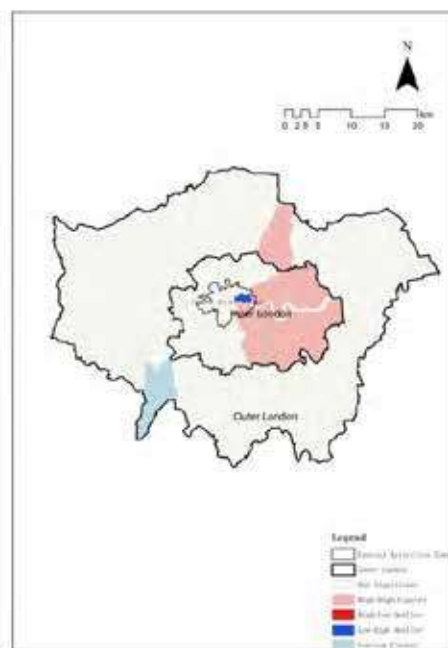
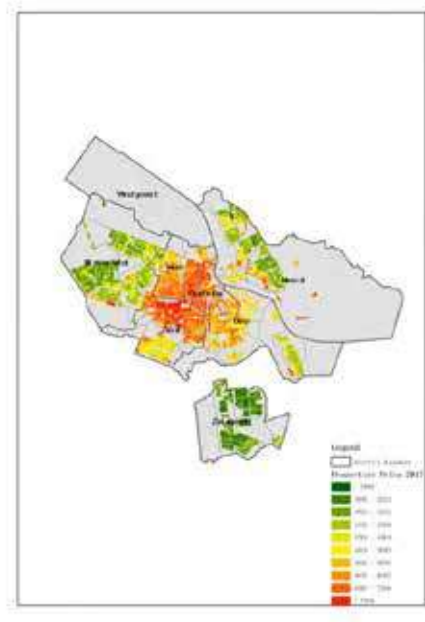


Figure 6 Spatial Clustering of Affordable Housing in London

Affordable housing in London shows its concentration with advantage area in the city, but failed to deliver fair amount of affordable housing in the highest priced borough in the city like Westminster. The spatial structure of London is similar to that of Shanghai, with CAZ in core area, ringed by inner and outer London. The concentration of housing price shows similar result, though slightly offset western in the core area. Spatially joined in borough level, we find that most affordable housing located in Inner London, the concentration pattern resembles property prices. In clustering aspects, Boroughs eastwards CAZ, such as Southwark, Tower Hamlets and Hackney shows high-high cluster, affordable housing units in these Boroughs take up much as 29.1% of total units.

## *Amsterdam*

Affordable housing scheme in Amsterdam is different from any other country in our research. The supply of affordable housing construction stopped since 1990s, and since 2015, affordable housing units in Amsterdam are totally managed by Housing Association, without the intervention from government. Housing Associations are non-profit group that stress the importance of public rental housing in urban housing scheme, and is governed by AFWC (Amsterdamse Federatie van Woningcorporaties), housing units under their management mounting to 43% of all dwellings in the city. There is no solid affordable housing in Amsterdam, the price of rental housing is limited through a “threshold price”.



*Figure 7 Figure 7 Property Price in Amsterdam\*

In 2017, there are 52% of total population in Amsterdam that is not Netherland background, with 53% of which are single-dwelled, and non-European residents shows clustering outside the core area (AFWC, 2017). Therefore, Amsterdam stress the importance of diversity in its affordable housing scheme.

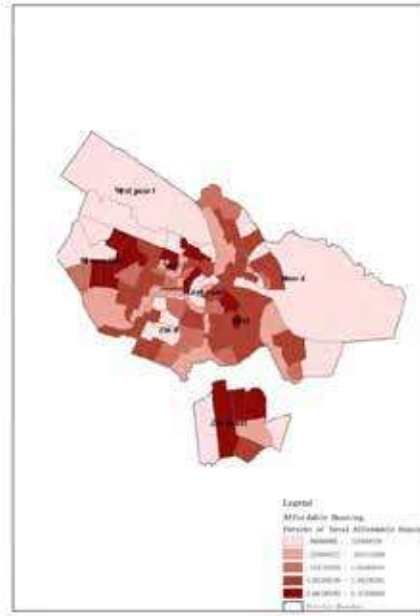


Figure 8 Affordable Housing in Quarter Level

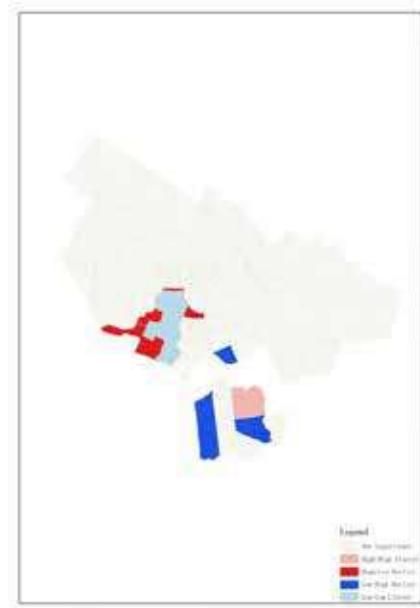


Figure 9 Spatial Clustering of Affordable Housing in London

Amsterdam provides denser amount of affordable housing in the city, while maintain a decent number of affordable housing in advantage area, though not the highest-valued ones. With an area of 219 km<sup>2</sup>, the city of Amsterdam is centralized in form of advantage area, as shown in the property price mapping, the highest priced properties located in central area. There are 192120 units of affordable housing as of 2017 in Amsterdam, the number of units in each area are inversely related, and a significant drop is detected in the highest-priced area, showed as low-low cluster.

## Singapore

The reaction Singapore has to urban housing problems in a highly dense urban area is well-known. Faced with huge demand for urban housing and scarce land supply, Singapore's provision of HDB flats suggest an ideal way of government-oriented development of affordable housing (Jia *et al.*, 2019). According to HDB, as of 2018 there are 81% citizens of Singapore live in HDB flats, making it the affordable housing for the majority groups.

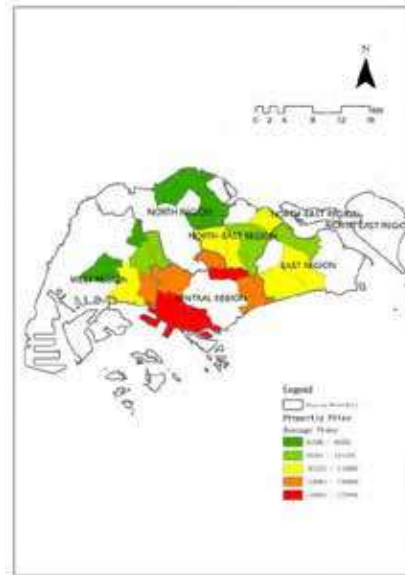


Figure 10 Property Price in Singapore

Housing and Development Board (HDB) is in charge of the planning, construction and management of all affordable housing in Singapore, with the help of land use control from government. HDB flats are constructed in towns, mainly aimed for sell, while a certain amount goes to rental market.

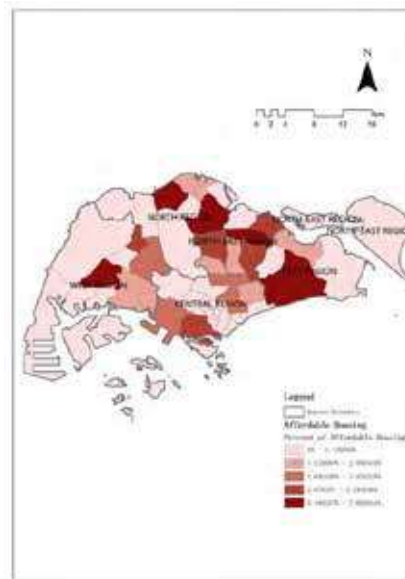


Figure 11 Affordable Housing Ratio in Town Level

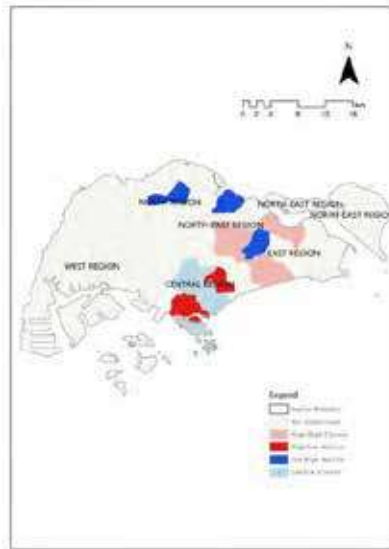


Figure 12 Spatial Clustering of Affordable Housing in Singapore

The amount of HDB flat in 2018 Singapore is, 1047695 and the largest researched countries. Due to the large scale of single HDB flat program, spatial pattern of affordable housing in Singapore is dense and clustered. Taking advantage area into consideration presented by resale price in each town, we find that the number of affordable housing units is usually higher where resale price is lower, though there has seen an exclusion in Bukit Merah and Toa Payoh, where resale price is higher with greater number of HDB flats.

## Result and Discussion

Table 1 Summary of Affordable Housing in Four Countries

Location	Shanghai	Amsterdam	London	Singapore
Municipal Area	6,340 km <sup>2</sup>	219 km <sup>2</sup>	1572 km <sup>2</sup>	782 km <sup>2</sup>
Population	26.32 million	1.6 million	8.83 million	5.80 million
Involvement of Government	Y	N	Y	Y
Affordable Housing Types	Sold & Rental	Rental	Sold & Rental	Sold & Rental
Affordable Housing Units	402431	192120	310029	1047695
Unit per km <sup>2</sup>	63	877	197	1340
People Share One Unit (Average)	65.4	8.3	28.5	5.5

Table 1 show an overall comparison of affordable housing in four researched countries. Judging only from the numbers, Singapore provides its citizens with most affordable housing units in a compact area, while Shanghai's supply of affordable housing is severely lacking compared with other countries.

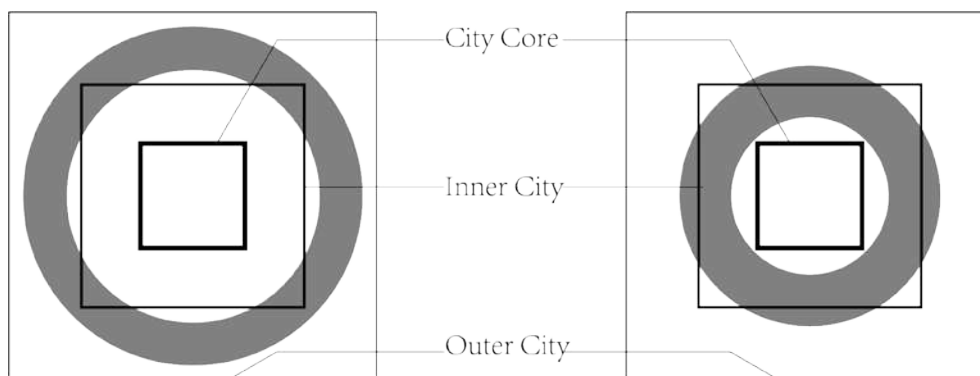


Figure 13 Location of Affordable Housing and City Structure (Left: Shanghai, Right: Other Researched Area)

The spatial pattern of affordable housing shows a distinct picture in Shanghai and other researched cities, as most of Shanghai's affordable housing is located outside the inner city, into the peri-urban area, and away from advantage area in the city. However, there is no clear distinction between other three cities while London, Amsterdam and Singapore all located decent amount of affordable housing in advantage area. Furthermore, we find that all four cities failed to provide many affordable housing units in the most advantage area, such as the city core, as the historic city center is now compact and densely dwelled.

The distinction of affordable housing spatial pattern in the city is likely the results from difference in definition of affordable housing in China and global context. Global metropolis like London, Amsterdam and Singapore argue that a variety of social groups is fundamental to a vital urban development, by providing affordable housing with high quality and subsidized through policy-making process, they guarantee the opportunities for citizens less advantage in the city (Mayor of London, 2018, HDB, 2018). Therefore, affordable housing in cities of these countries provide fair amount of affordable housing open to various social group. However, the strict definition of affordable housing in Shanghai and China suggest that affordable housing aimed at disadvantage groups in the city, and the standards of affordable housing is lower than commodified ones (Shanghai, 2010). Poor location choice of affordable housing under the background of land-based finance could lead to the segregation and marginalization of certain social group.

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