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# Space as Mirror: Analyzing the spatial justice of the planning practice of shared ownership housing in Shanghai, China

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## Abstract

Justice is a basic and classic theme. Compared with its meaningful connotations in sociology, economics, and legal disciplines, the spatial dimension of justice lacks sufficient attention and exploration. Can we define space as (un)just? Although scholars have endeavored to build up the conception of spatial justice, there remains a theoretical gap between justice philosophy and spatial planning: the transformation from philosophical justice to spatial justice. As spatial planning involves planning practices that (re)produce space, the gap raises the question of how to transfer complicated philosophical theories of justice to spatial planning and the question of how to analyze the spatial justice of certain planning practices. Existing research puts emphasis on the spatial equity of the distribution of social goods, lacking the theory of justice in planning practices. This study focuses on one more specific question: for planning practice aiming at compensating for historical injustices, does it actually promote spatial justice? Taking the planning practice of shared-ownership housing in Shanghai as a case study, this thesis tries to provide an analytic framework for assessing the spatial justice of certain planning practices.

The dissertation is divided into two parts: the theoretical framework for spatial justice and the empirical research on the planning practice of shared ownership housing in Shanghai. In the first part, a theoretical framework for spatial justice reviews mainstreams philosophies of justice (i.e., utilitarianism and intuitionism, liberalism, Marxism and (neo) socialism, discourse ethics, and recognition justice). On the one hand, the two approaches to philosophy of justice–the normative approach and the cognitive approach–build up diversified philosophical frameworks and long-standing contradictions within and among these mainstreams. On the other hand, spatial justice is important because: 1) Spatiality is an inherent element in justice philosophy; 2) Space is an external representation of justice philosophy. However, there is a gap between the complicated philosophy of justice and the discipline of spatial planning. To bridge the gap, this research translates these philosophical thoughts into a pluralist understanding of space: Space is like a mirror, which reflects the plural images of justice philosophy in planning practice. This study does not take one particular philosophy of justice as a benchmark. Instead, it uses a deconstructive approach to analyze which theories of justice are adopted as the principles, means, and institutional contexts for spatial planning projects.

The second part then applies the theoretical framework to the spatial justice of the planning practice of shared ownership housing in Shanghai. This part first analyzes the spatial equity of five basic social goods, and then deconstructs the manifestation of spatial justice in the planning practice. The analysis of spatial equity conducted a horizontal comparison of five basic social goods, including health resources, educational resources, job opportunities, parks, and public transportation. The horizontal comparison refers to four horizontal indicators of one certain resource calculated from various GIS measures to assess the spatial equity, including accessibility, availability, proximity, and affordability. There are three key findings in the assessment methods of

accessibility: 1) The model formula plays a dominant role, which determines the geographical patterns of accessibility maps; 2) The use of geographical weights can change the accessibility results to a great extent, which can also lead to problematic outcomes; 3) The evaluation criteria for accessibility method should be in line with the space reproduction mechanism, including physical space, temporal changes, and user behaviors in order to reflect the relationship between resource supply and population demand. For each resource, the spatial equity in 2010 was taken as the status before the implementation of the planning, while the spatial equity in 2017 was taken as the state after the implementation. Due to the limited data sources, this time comparisons were made for certain health resources, educational resources, and parks. Each resource has distinct characteristics in the four indicators of spatial equity as well as in the temporal dimension and institutional organizations.

The analysis of spatial justice is divided into two parts: vertical comparison and the reflection of justice philosophy in the planning practice. The vertical comparison refers to the comparison across the five social goods and the different status quo of the residents. The results show that: the planning practice hardly changed the spatial structure of resource distribution and implemented different philosophies of justice during the planning practice. Even with specific resource reallocation policies in place, the historical (dis)advantages recorded by space are difficult to change. Residents of shared ownership housing owned better living conditions at the cost of a high-level acquisition of the five basic resources. The planning practice facilitated the inflow of migrants in the city center and population growth in the suburbs, thereby promoting the overall development of the city. Furthermore, there are inconsistencies and blends of spatial justice in the planning practice: the planning practice took overall utility maximization as the planning principles, followed liberalist justice for construction, and built institutional limitations based on post-socialist justice. In this way, the planning practice simultaneously realized the affordable and investment attributes of the shared ownership housing.

This study provides a pluralist analytical framework for spatial justice based on the planning practice of shared ownership housing in Shanghai. There are three major findings: 1) Different justice theories play different roles in the planning practices; 2) the spatial distributions of social goods are related to their corresponding user behaviors; 3) a question that may take precedence over the question of the justice or injustice of spatial planning is: What kind of justice philosophy governs certain planning practices. Spatial justice could be an important reflection of historical (in)justice which records the reproduction of capital, social relations, and institutions in the spatial dimension. The concept of spatial justice can contribute to further developments in the planning theory and practice.

**Keywords**: spatial justice, accessibility, spatial equity, shared ownership housing, planning practices

## DECLARATION

I declare that I have completed the doctoral thesis independently and have not used any sources or means other than those indicated. The work has not previously been submitted as a thesis or an examination paper.

Parts of the thesis have been published as an individual paper in a peer-reviewed publishing platform.

1. Zhang, L. (2021). Trap of weights: The reuse of weights in the floating catchment area (FCA) methods to measuring accessibility. F1000Research, 10(751). https://doi.org/10.12688/f1000research.51483.1

Parts of the python codes applied in this dissertation have been published.

2. Lina Zhang. (2021). Python codes for accessibility and access ratios in the E2SFCA, M2SFCA, 3SFCA methods. Zenodo. https://doi.org/10.5281/zenodo.4890880

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# List of abbreviations

| Abbreviation | Description |
|---|---|
| ABS | Asset-backed security |
| A.D. | Anno Domini, Latin for “in the year of the Lord” |
| ATCM | Administration of Traditional Chinese Medicine |
| CDC | Center of Disease Control |
| DRC | Development and Reform Commission |
| FDA | Food and Drug Administration |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GWR | Geographically Weighted Regression |
| HFPC | Health and Family Planning Commission |
| HPF | Housing Provident Fund |
| HRSS | Human Resource and Social Security |
| KDE | Kernel Density Estimation |
| LISA | Local Indicators of Spatial Association |
| MAUP | Modifiable Areal Unit Problem |
| MCHI | Maternal and Children Health Institution |
| PISA | Program for International Student Assessment |
| PRC | The People's Republic of China |
| POI | Point of interest, the geographic location of certain resources and facilities, i.e., bus station, hospital, and primary school |
| PPP | Public-Private-Partnership |
| QR Code | Quick Response Code |
| Rd. | Road |

| | |
|---|---|
| ROI | Return on investment |
| SPVs | Special Purpose Vehicles |
| St.d. | Standard deviation |
| TVET | Technical and Vocational Education Training |
| FCA | The Floating Catchment Area Method |
| 2SFCA | The Two-Step Floating Catchment Area Method |
| M2SFCA | The Modified Two-Step Floating Catchment Area Method |
| 3SFCA | The Three-Step Floating Catchment Area Method |
| M3SFCA | The Modified Three-Step Floating Catchment Area Method |

## List of symbols

| **Symbol** | **Description** | **Unit** |
|---|---|---|
| A | Area | $m^2$ |
| A | Area | $km^2$ |
| *v* | Speed, kilometers per hour | km/h |
| ¥ | RMB, the official currency of the People's Republic of China | yuan |
| $ | U. S. dollars | dollar |

# 1 Introduction

## 1.1 Background

### 1.1.1 Social Justice and Spatial Planning

Social justice and fairness have been classic topics in planning theory since the 1960s. Many researchers have criticized the fact that many urban policies have enlarged the gap between the rich and the poor, ignoring the disadvantages suffered by the low-income, women, and minorities (Harvey, 1992; Jacobs, 2016; Kohn, 2004; Logan & Molotch, 2012; Swanstrom, 2001; Uitermark, 2009). Since spatial planning involves the reallocation and redistribution of social goods, this public policy attribute of the discipline of spatial planning requires justice and fairness in the spatial dimension. Furthermore, the imbalance between the supply-and-demand of social goods has become a prominent social contradiction, which has hindered its further development.

Many concepts emerged that attempted to link spatial planning and justice, albeit with vague meanings and blurred boundaries. These concepts include distributive justice, spatial equity, environmental justice, the just city, and spatial justice, and involve various subjects and objects. Distributive justice emphasizes the socially just allocation of resources, goods, and opportunities among members of a society and is an integral component constituting the concept of social justice (Rawls, 1971). Spatial equity generally refers to the spatial acquisition of resources and GIS measurement to assess accessibility to resources in urban studies (Neutens, 2015; Talen & Anselin, 1998), which has a large number of case studies. In contrast, environmental justice focuses more on the fair treatment of the natural environment, builds on the conception of justice to nature, and involves the ecological justice including activities of human beings and wildlife (Schlosberg, 2009). The just city plays a role of a theme of the initiative raised by Susan Fainstein to encourage planners and policymakers to emphasizes just and fair ways for cities to develop. Spatial justice has been defined by Edward W. Soja as a way of looking at justice from a critical spatial perspective; however, it remains ill-defined relative to social justice (Madanipour et al., 2021).

These related concepts seem represent various permutations and combinations of different components of social justice and spatial planning. For example, social justice could be divided into several types of justice, such as procedural justice, substantive justice, distributive justice, and others. Whereas spatial planning involves different spatial entities, such as regions, cities, urban facilities, and natural environment, environmental justice combines the nature environment with the concept of social justice. Spatial equity combines urban facilities with distributive justice. The just city combines city development with social justice. In contrast, spatial justice appears to be a combination of the concepts of space and social justice. It is nature that the above concepts should share some common components, such as diversity, democracy, and equity (Agyeman, 2014; Fainstein, 2010; Soja, 2013). It is thus difficult to clarify their theoretical advocates, draw boundaries among them, and apply them to various planning theories and

practices. Although a series of studies have assessed the balance between the supply-and-demand of resources, goods, and opportunities in urban studies (Chen et al., 2019; Delamater et al., 2019; Liang & Zhang, 2017; Talen & Anselin, 1998), there has been a general lack of justice philosophy in the discipline of spatial planning, representing the first research gap addressed by this work.

Spatial-related conceptions of justice often lack the diverse advocates and paradigm standards of different philosophies of justice. Various philosophical schools of justice, including utilitarianism, liberalism, socialism, and recognition justice, have developed divergent perspectives and paradigms of justice. For example, Rawlsian egalitarian liberalism pursues the equal rights and equal opportunity of every individual to basic liberties (Rawls, 1971); Nozick's entitlement theory seeks to maximize individual liberty within the scope of entitlement (Nozick, 1974), and Sen argues that the normative standard of justice is the maximum of individual capability (Sen, 2009).The diversity of the philosophies of justice makes it difficult to transfer their philosophical meaning into spatial planning. Justice-related concepts in spatial planning possess different types of spatial entities as their subjects, including environment, space, and city. Although this subjective difference has led to distinct conceptual frameworks, most of them have attempted to sidestep the question of which justice philosophy they follow. These concepts generally lack a core philosophical understanding of justice.

The second research gap is the lack of justice philosophy in both planning theory and planning practice. This gap stems from the distance between planning theory and planning practices (Fainstein & DeFilippis, 2016). As planning theory aims at certain ideal and abstract objectives, planning practice seems to be realized, for instance in concrete activities. Limited researches in planning theory has focused on the role of justice philosophy in spatial planning (Moroni, 2023), making it further difficult to assess the concept of justice at the level of planning practice. Many studies have adopted various spatial entities as the subject and the just distribution of resources and social goods as the theme (Du & Zhao, 2022), but few studies have focused on the impact of planning practices on spatial justice. For example, Apparicio and Séguin (2006) measured the accessibility of services and facilities for residents of public housing in Montréal; Guzman and Bocarejo (2016) analyzed the relationship between urban form and spatial equity in Bogota, Colombia; and Ortega et al. (2021) examined how urban design had affected walk accessibility. It is difficult to identify the connotations of justice in these empirical studies because they have tended to focus on the equal distribution of social goods and the corresponding supply-and-demand relationship. The lack of justice philosophy in planning theory had further led to its absence in planning practice.

Can we consider planning practices (and even certain space entities) to be just (or unjust)? This simple question is surprisingly difficult to answer. The meaning of social justice encompasses multiple philosophical schools and complex connotations. It is hard to navigate the relationship between those philosophical schools of justice, and even harder to transfer the philosophy of justice into the discipline of spatial planning. The question must cross both gaps above: from philosophy of justice to spatial

planning, and from planning theory to planning practice. Since other related concepts are limited by the scope of their spatial subjects, spatial justice has the greatest potential to bridge the gap between justice philosophy and spatial planning as well as the gap between planning theory and planning practice. Therefore, this study chose spatial justice as the core concept with which to construct an analytic framework for the just evaluation of planning practice.

### 1.1.2 GIS methods for Assessing Spatial Equity

Spatial equity has been a crucial concept in the spatial dimension of justice, which refers to justice and fairness in the spatial distribution of urban facilities and social goods. Since Talen and Anselin (1998) compared four different GIS methods for playground accessibility calculations, more and more studies have used GIS methods to measure spatial equity (Cascetta et al., 2020; Maroko et al., 2009; Zhao & Cao, 2020). However, the evaluation and suitability of GIS methods have posed a difficulty in assessing spatial equity (Delamater, 2013). The difficulty lies in three aspects: indicator, model, and evaluation criteria.

Regarding the indicator of spatial equity, there are multiple indicators when it comes to the spatial equity of different resources and social goods. In health research, Penchansky and Thomas (1981) defined five indicators – accessibility, availability, accommodation, affordability, and acceptability – to describe the relationship between health facilities and patient utilization. Kronenberg et al. (2020) analyzed the availability, accessibility, and attractiveness of urban green space. Delbosc and Currie (2011) applied Lorenz curves and the Gini coefficient to assess public transport equity.

Among various indicators, accessibility has been one of the most prevalent in assessing spatial equity. Accessibility, which refers to the supply-and-demand relationship of social goods (Luo & Wang, 2003), has been applied in assessing the spatial equity of various urban facilities and social goods, such as health services (Apparicio et al., 2008), primary schools (Marques et al., 2021), and high-speed railways (Cascetta et al., 2020). Bunel and Tovar (2013) identified the importance of GIS models in assessing job accessibility, finding that different models led to significantly different empirical results. Various accessibility models have been applied in assessing spatial equity, such as the buffer model, the isochronous model, the space-time integration measures (Kwan, 1998), the cumulative-opportunity model, the Kernel Density Estimation (KDE) model, and the Floating Catchment Area (FCA) models (Neutens, 2015).

The variety of GIS methods has raised the problem of evaluation criteria. The suitability and accuracy of certain GIS methods are hard to identify when assessing spatial equity. Some scholars have used the realized data to measure accessibility to avoid the problem of evaluation criteria (Guagliardo, 2004). For example, Zhao and Cao (2020) analyzed the transit smart cards, which had recorded actual public transport routes, to detect commuting equity in Shanghai. In the contrast to realized data, the potential approach which calculates the potential opportunities for certain social goods. This work focuses on the potential approach to assessing spatial equity because of the

absence of actual utilization data and the meaningfulness of opportunities, since potential opportunities might reflect the spatial distribution of social goods regardless of personalized features.

Other factors, such as the level of spatial scope and socioeconomic focus are important in forming the GIS methods to assess spatial equity. For example, the level of spatial scope, such as regional-, city-, district-, or house-level might also differ from the GIS method. Spatial equity at the regional level might not focus on equity issues in certain aspects but aim instead to access the overall spatial structure of inequity (Kunzmann, 1998). In contrast, spatial equity at house-level might emphasize the walking route and neighborhood environment (Omer, 2006). Other research had focused on the difference in social groups' spatial equity, and has applied the Local Indicators of Spatial Association (LISA) method to relate certain socio-economic indicators to accessibility (Xiao et al., 2017).

A third research gap pertains to how to measure the spatial equity of resources, social goods, and opportunities properly and accurately. This gap includes the choice of measurement indicators, GIS models, and the corresponding evaluation criteria for models. Because this study attempted to provide an analytical framework for the just evaluation of planning practice, it was critical to assess the spatial equity of resource distribution affected by certain planning practices. Although land use and planning processes also play important roles in planning practices, this study tended to focus on the spatial equity of social goods affected by certain planning practices.

### 1.1.3 Shared Ownership Housing in Shanghai

As China has urbanized, soaring house prices in metropolitan areas have reflected a shortage of housing over the past two decades. Since 2009, the state has introduced a nation-level affordable housing policy to solve the housing problems of low- and middle-income groups. The Chinese real estate industry has formed two types of housing supply systems: commercial housing (market-oriented housing products) and affordable housing (restricted housing products).

So-called affordable housing refers to housing provided by the government with limited living conditions, limited housing prices or limited rents for low- and middle-income people. Affordable housing in China includes four major categories: 1) low-rent housing, which is owned by the government and leased to residents who qualify for the subsidy; 2) public rental housing, which is also owned by the government and is rented to migrants, such as young working people and university graduates; 3) reconstructed resettlement housing, which refers to resettlement housing for residents whose original housing has been demolished due to certain government projects; and 4) shared ownership housing, which is owned by residents and the government, exhibits prices lower than the general level, and is suitable for middle- and low-income people to purchase. Because affordable housing is a nation-level policy, specific treatment measures vary from place to place.

In 2010, Shanghai launched a series of shared ownership housing policies to provide basic housing security and alleviate the unbalanced development of urban areas. As of 2017, there were six batches of shared ownership housing applications in Shanghai. Shared ownership housing has been planned, constructed, and delivered through a series of large-scale residential area planning in the suburbs. During this process, the planning practice of shared ownership housing has produced a series of spatial and physical effects, including the relocation of low- and middle-income families, the reconfiguration of social goods, and the construction of large-scale residential communities in the suburbs. Shared ownership housing in Shanghai exhibits three features. First, the prices of shared ownership housing are only part of the market price of commercial housing with the same conditions. Second, the distribution of shared ownership housing in Shanghai is mainly located in the suburbs, which are located more than 10 km from the city center. Third, shared ownership housing has been combined with resettlement housing in large-scale residential area planning. For example, Feng Xian Banqiao's large residential community covers an area of approximately 10.64 km², and approximately 0.31 km² of the land has been used for shared ownership housing.

Current research regarding affordable housing has focused more on the economic effects from the perspective of policy analysis than its spatial impacts. Yates and Wulff (2000) estimated the shortage of low-cost private rental stock in Australia, Lizarralde and Massyn (2008) emphasized the importance of user participation in the performance of low-cost housing projects in South Africa, and Govender et al. (2011) associated the structural living conditions of certain low-cost housing settlements with the health conditions of the inhabitants in the City of Cape Town. Chinese scholars have also placed emphasis on the efficiency, costs, and effects of affordable housing policy on the housing market (Huang, 2004; Yin & Hu, 1999). This study chose the planning practices of shared ownership housing in Shanghai as a case study for three reasons.

First, as a global center for finance, innovation, and transportation, Shanghai is one of the most highly populated metropolises in the People's Republic of China, with a population of 24.20 million in 2017 (Statistics, 2018). During its rapid urbanization, social inequality has been a severe problem (Li & Wu, 2008), and has caused a gap in the distribution of various social goods between urban and rural areas (Li, 2022; Xiao et al., 2017). Taking Shanghai as a case study provides a reference for the spatial inequity and affordable housing construction in a metropolis. Second, the contextual background of the Shanghai housing market has been changed from a socialist approach to a marketing oriented socialist approach. This change provides an empirical basis with multiple ideologies for the analytic framework for spatial justice. It then leads to a suitable case for multiple philosophies of justice to transfer their connotations to spatial planning. Moreover, Shanghai's large-scale residential area planning has caused significant numbers of residents to relocate and has played a role in compensating for historical injustices in housing provision. The implementation of shared ownership housing has affected not only spatial entities but also social aspects, including housing construction, deliberate processes, and public participation. The practical impact of this compensating housing could provide an empirical supplement for the

theoretical gap. As mentioned previously, the role of justice philosophy in planning practice could then receive a broad discussion in this case.

Taking Shanghai shared ownership housing as a case study, this study focuses on a more specific question, namely whether planning practices designed to compensate for historical injustice promote social justice in a spatial dimension. This research involved two parts. The first part is a theoretical framework for spatial justice, attempting to bridge the gap between the philosophy of justice and the discipline of spatial planning. The second is the empirical study of the Shanghai case, including the distribution of social goods and the status comparison of the residents of shared ownership housing. This work then tries to provide a possible analytical solution for how to analyze the spatial justice of planning practice.

## 1.2 Research Objectives and Questions

### 1.2.1 Research Objectives

As discussed above, there are two major research gaps: 1) the lack of justice philosophy in both planning theory and planning practice; 2) proper GIS methods to measure spatial equity of social goods, including indicators, models, and corresponding evaluation criteria. Therefore, the overarching goal of this study is to provide an analytical framework for assessing the spatial justice of certain planning practices. Taking the planning practice of Shanghai shared ownership housing as a case, this research aims to compare how spatial equity of social goods has been affected by the planning practice and analyze what kind of spatial justice the planning practice has implemented. To bridge the two major research gaps, this study has two specific objectives:

(1) To build up a possible theoretical framework for spatial justice, which transfers the philosophical connotations of justice into the discipline of spatial planning, that is, the bridge over the gap between justice philosophy and spatial planning; to conduct a practical analysis method of the spatial justice of Shanghai shared ownership housing planning practice, including its impact on the allocation and redistribution of social goods; and to conduct a comprehensive analysis of the spatial justice of shared ownership housing, which can link justice philosophy and empirical planning practice to realize the theoretical framework for spatial justice.

(2) To figure out the proper GIS measurement of the spatial equity of resource distribution, including the analysis of the existing GIS methods, the indicators, and corresponding models to assess the spatial equity of resource distribution, and the evaluation criteria for GIS methods; to compare how the planning practice of shared ownership housing has changed the spatial equity of five basic social goods, i.e., health resources, educational resources, job opportunities, parks, and public transportation.

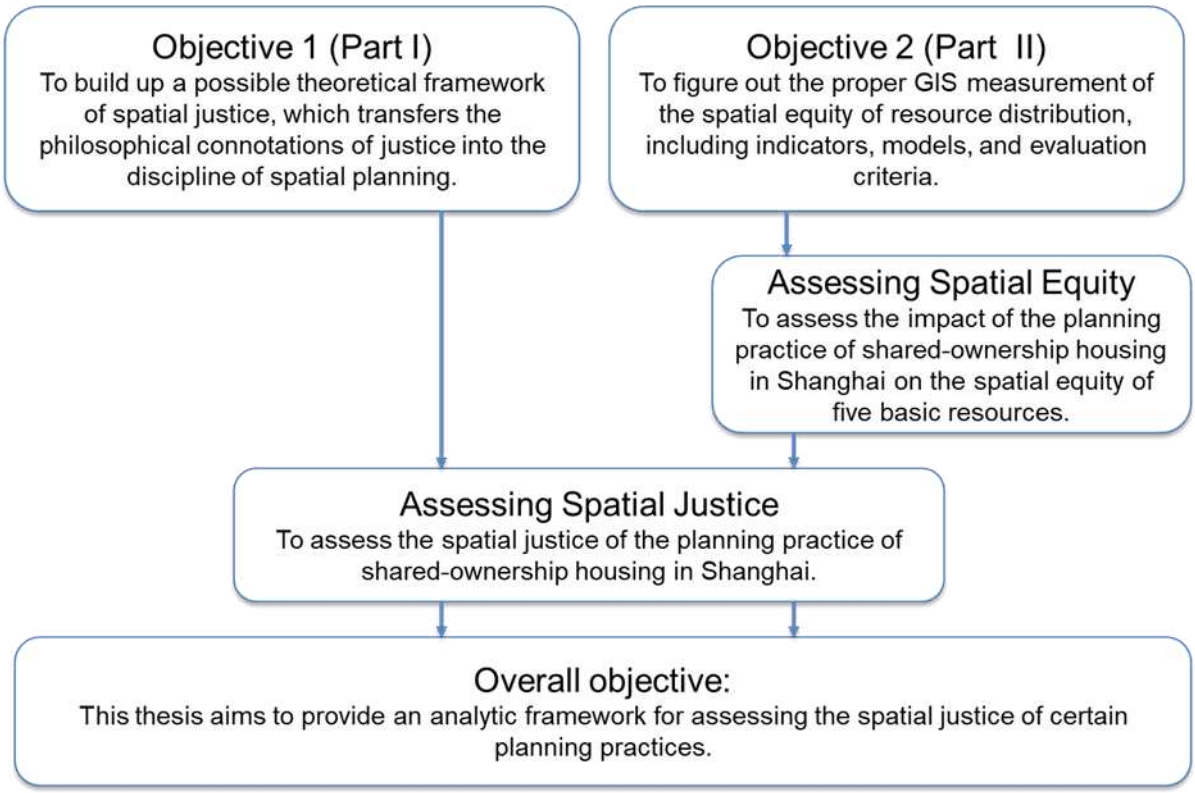



Figure 1.1 Research objectives

Figure 1.1 illustrates the research objectives of the thesis. The two specific objectives correspond to the structure–the two parts–of the thesis. Based on the theoretical framework for spatial justice and GIS measurements of spatial equity, an analytic analysis of the spatial justice of the planning practice of shared ownership housing in Shanghai was conducted to achieve the overall objective.

### 1.2.2 Research Questions

According to the research gaps and objectives, this study focuses on the main research question: can planning aimed at compensating for historical injustice promote social justice in a spatial dimension? Large-scale residential area planning in Shanghai has promoted the delivery of shared ownership housing, providing housing security for the low- and middle-income families. Even with rapid urbanization and economic development, these families lack the ability to own commercial housing and cannot meet basic living conditions. This planning practice of shared ownership housing then has provided the housing with basic living conditions and limited housing prices to compensate for historical injustice. However, it is hard to assess the degree of spatial justice promoted by such planning practices. Specifically, the main research question consists of two key questions:

(1) How to transfer the philosophical meaning of justice into spatial planning, that is, the theoretical framework for spatial justice?

This first question asks about the connotation of spatial justice and its corresponding practical realization. The difficulty lies in transferring the various schools of justice

philosophy into the discipline of planning. This study chose the concept of spatial justice because of its combination of justice and space. However, its theoretical framework is left to be conducted, including differences from other similar concepts such as environmental justice and spatial equity and the bridge between justice philosophy and spatial planning, was left to be determined. It required not only the examination of the relationships among various schools of justice philosophy but also the transfer of that complicated relationship into spatial planning. It then needed a theoretical framework for spatial justice.

For empirical research regarding shared ownership housing in Shanghai, another difficulty lies in transferring the theoretical framework for spatial justice to the evaluation of empirical planning practice. Planning practice includes local historical background, social institutions, reallocation of social goods, planning design, and planning process. It is also crucial to analyze how the planning practice changes the acquisition of social goods for residents of shared ownership housing. The analysis of spatial justice should then also involve the connotation of justice philosophy, GIS measurement of the distribution of social goods, and geographical background. Therefore, the theoretical framework for spatial justice needs to be revised in the case of Shanghai.

(2) How to properly measure the distribution of basic social goods, that is, spatial equity?

One important component of spatial justice in this study is spatial equity. Spatial equity refers to the degree of justice and fairness in the spatial distribution of resources and social goods. Since the discipline of spatial planning has the attribute of public policy, this study selected basic social goods as the research objects. Since this study takes the planning practice of Shanghai shared ownership housing as a case study, how the planning practice changed spatial equity, that is, the distribution of social goods, is crucial. To measure how the planning practice has affected the distribution of social goods, it is critical to measure the distribution of social goods properly and accurately. This process requires a systematic analysis of existing measurements, including the indicators, the models, and evaluation criteria for the models. Due to the lack of realized data (actual usage of social goods, e.g., the number of patients per day in a hospital), this study could only analyze the potential opportunity for the utilization of five basic social goods, namely, health resources, educational resources, job opportunities, parks, and public transportation. To identify the impact of the planning practices, this study compares spatial equity in the temporal dimension, that is, before and after the planning practices, when the original data was available.

## 1.3 Methodology

### 1.3.1 Qualitative Methods

Accessing the spatial justice of shared ownership housing planning practice needs to analyze two critical aspects: how to assess spatial justice theoretically and practically. Qualitative methods are used in two specific aspects, which further leads to two

outcomes: a theoretical framework for spatial justice and an empirical study of shared ownership housing in Shanghai.

In the theoretical framework part, literature research and document analysis are utilized to build the theoretical framework for spatial justice. Related philosophies of justice, such as utilitarianism and liberalism, have been studied to explore the philosophical meaning of spatial justice. The theoretical framework for spatial justice is based on the collection and analysis of viewpoints in previous literature. In addition, the concept of social justice in the discipline of planning has also been studied. The theoretical framework for spatial justice tries to bridge the gap between justice philosophy and spatial planning and to deal with the complicated relationship between schools of justice philosophy in the spatial dimension. The theoretical framework also tries to reveal the importance of spatial justice and transfers the philosophical meaning of justice into the discipline of spatial planning.

In the empirical study part, the planning of Shanghai's shared ownership housing has also been studied. The aims, principles, and implementations of the planning are important criteria for detecting its impact on spatial justice. Moreover, the qualitative methods in the case study part includes field research and planning study. It studies the contextual background, historical development, planning standards and design of the shared ownership housing in Shanghai. Literature research has also been carried out to study the practical problems and challenges faced by Shanghai's shared ownership housing policy.

### 1.3.2 Quantitative Methods

Quantitative methods are mainly applied to assess the impact of shared ownership housing on the spatial equity of five basic social goods. The applied software includes ArcGIS, QGIS, python and Navicat for MySQL, which constitute the holistic process of the quantitative analysis of spatial equity. The process consists of data collection, data processing, data analysis, and data visualization. The data collection includes the population as the demand for social goods, the road network, and Point-of-Interest (POI) of the five basic social goods, i.e., health resources, educational resources, job opportunities, parks, and public transportation. This study collected the above data sources of two time points: before the implementation of the plan in 2010 and during the implementation of the plan in 2017. Certain sites of shared ownership housing will be chosen to access how the spatial equity of the five basic social goods has been changed after the implementation of the policy. ArcGIS and QGIS process raw data, including clearing duplicate and wrong data. Due to the huge amount of calculation, QGIS, python and Navicat for MySQL generate the distance matrices between the geometric center points of the population unit and the health facility points, and then calculate the corresponding indicators of the spatial distribution of the five basic social goods.

### 1.3.3 Methodological Triangulation

Methodological triangulation is used of at least two, usually qualitative and quantitative to address the same research problem (Morse, 1991). This study is comprehensive research that requires both qualitative and quantitative research, using methodological triangulation to combine those two methods. The core value of triangulation is to apply different research perspectives to a problem. A classic diagram of triangulation, including constructionism, empiricism, and realism, could be the three polar positions in triangulation (Olsen, 2004). To apply the different research perspectives, this study consists of five-phrases integrated research process (Figure 1.2).

The first stage is theoretical research, which aims to achieve the first research objective and is belonged to “Part I From Philosophy to Planning: Towards Spatial Justice” of the thesis. Through the literature search and document analysis, combined with normative research, the theoretical research framework for spatial justice is carried out. The second and third phases, that is, normative and positive research are parallel in “Part II Empirical Study: Shanghai Shared Ownership Housing” of the thesis. On one hand, positive research is conducted through quantitative analysis to identify the spatial equity of five social goods during the implementation of the planning practice of shared ownership housing in Shanghai. On the other hand, qualitative methods of spatial justice based on the theoretical framework for spatial justice conduct a normative analysis of the case study. The conclusion section combines qualitative and quantitative analysis to conclude the analysis of spatial justice of the planning practice of shared ownership housing in Shanghai.

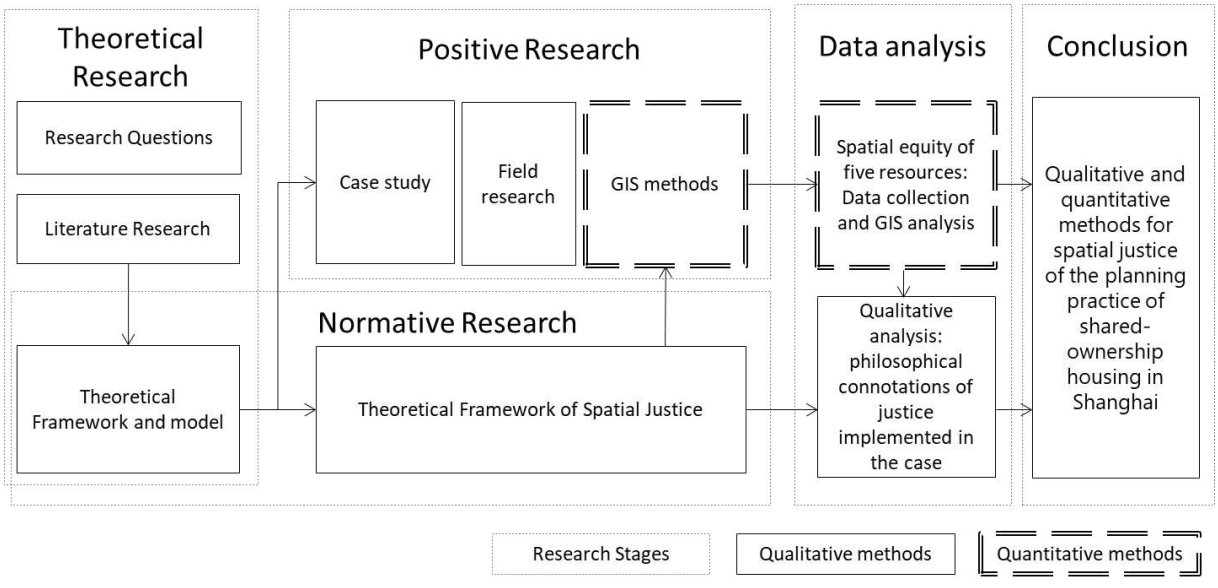



Figure 1.2 The integrated research process

## 1.4 Structure of the Dissertation

There are two parts of this thesis: the theoretical framework for spatial justice and the empirical study of the Shanghai case.

The first part consists of Chapter 2 and Chapter 3. Chapter 2 introduces the main streams of justice philosophy, including utilitarianism and intuitionism, liberalism, Marxism and (neo) socialism, discourse ethics, and recognition justice. Chapter 3 transfers the justice philosophy to spatial planning and builds up a possible ideal theoretical framework for spatial justice.

The second part begins with an overview of the research objects in Chapter 4. Chapter 4 introduces the contextual background and development of the planning practice of Shanghai shared ownership housing, the study objects, and the measurements of resource distribution. Chapter 5 analyzed the spatial equity of five resources, i.e., health resources, educational resources, job opportunities, parks, and public transportation, by four indicators, that is, accessibility, availability, proximity, and affordability. Furthermore, there is a before and after comparison of the planning practice if the data is available. Chapter 5 conducts a horizontal comparison within each resource, while Chapter 6 assesses spatial justice beginning with the vertical comparison. The vertical comparison consists of the different distributions across resource types and the different statuses of shared ownership housing residents across different decisions. Chapter 6 then analyzed the reflections of different justice philosophies in the planning practice.

Finally, Chapter 7 summarizes the main findings, conclusion, discussion, and limitations of this work.

# Part I From Philosophy to Planning: Towards Spatial Justice

Justice is an initial and ultimate theme crossing multiple disciplines, i.e., law, economics, sociological, and political science (Arrow, 1973b; Barry, 2010; Davis, 1976). As the development of computer technology enables the precise calculation of resource distribution, the spatial dimension of justice has gained proliferated attention (Smith, 1994). Spatial planning – a discipline taking space as the subject – studies a series of related key concepts: spatial equality, spatial equity, distributive justice, environmental justice, and procedural justice. Among them, the empirical measurements of how resources (especially social goods) distribute have become a classic research topic (Cheng et al., 2020; Mao & Nekorchuk, 2013; Smoyer-Tomic et al., 2004; Taleai et al., 2014; Wolf et al., 2021).

Yet justice is essentially a philosophical question. Before we ask the question how resources distribute, there are several more questions ahead:

- ***What is justice?*** Or what is the philosophical approach to justice?
- ***What is spatial justice?*** How to ***link justice philosophy with spatial planning*** in the concept of spatial justice?

These series of questions stem from two sides: 1) the complexity of justice philosophy; 2) the gap between justice philosophy and spatial planning discipline. The first is a native feature of justice philosophy, while the second is the gap between philosophical theories and practical discipline. As the saying goes: “justice has many faces (Mascareño, 2012).” The role, understanding, and realization of justice in society show great diversity in multiple philosophy schools. This diversity leads to a pluralism in defining spatial justice, as well as, analyzing what kind of justice has been realized in specific planning practice. The gap between justice philosophy and planning discipline includes not only the gap between theory and practice but also the missing of justice understanding. If we want to figure out what kind of justice has been pursued in planning, either in planning theories or planning practices, it is mandatory to understand the main streams of justice philosophy schools. That is, the answers to the above questions require the comprehension of justice philosophy as a whole and the fulfilment of the gap between justice philosophy and spatial planning.

Part I aims to link justice philosophy and spatial planning discipline by conducting a theoretical framework for spatial justice. The first part discusses various philosophy schools of justice: how justice is defined in divergent ideologies. The second part tries to transfer the philosophical meanings of justice to planning discipline, regarding social, economic, and geographical contexts.

# 2 Philosophy of Justice

We will recognize many faces of justice in the intertwined schools of thought in Chapter 2. There are a series of philosophical schools of justice, including utilitarianism, intuitionism, liberalism, contractarianism, Marxism, socialism, communitarianism, feminism, recognition justice, and cultural justice (Pereira et al., 2016; Smith, 1994). Accordingly, many famous scholars and philosophers have endeavored on the philosophy of justice, including Brian Barry, G. A. Cohen, John Stuart Mill, John Rawls, Jürgen Habermas, Robert Nozick, Ronald Dworkin, and Iris Marion Young. The differences in the academic propositions of the philosophy of justice not only exist between schools but also within the viewpoints of the same school.

However, there are two main philosophical approaches towards justice: the **normative** and **cognitive** approaches (Mascareño, 2012). These two approaches answer the same question: "What is justice?" in two different ways. If we regard that the normative approach follows Kantian philosophy, then the cognitive approach to justice follows Hegelian philosophy. The normative approach emphasizes the legitimacy of justice: how to define justice in the right/good way. Theories in this normative approach–from John Stuart Mill to John Rawls, from Robert Nozick to Friedrich August von Hayek, from Kenneth Arrow to Amartya Sen–all pursue the only rightful **universal** justice theory no matter how complicate/systematic their definition of justice is. The cognitive approach stems from Hegelian philosophy and focuses on the understanding of justice: how do we recognize justice. The way we understand justice is closely related to how we recognize who we are. The cognitive justice could be seen as an extension of Hegel's "the struggle for Recognition". In the struggle for cognition, individuals seek their own personalized features and identification valued by others and society. Therefore, the cognitive approach is connected to personalization concepts, including social groups (i.e., feminist, and homosexual groups), social inclusion/exclusion, and cultural background.

Table 2.1 lists key philosophy schools of justice in this study, including their guiding principles and the key authors, which are prerequisites for forming the concept of spatial justice. This study chose the philosophy of justice based on two aspects: the importance of the philosophical school and its relevance to the theme. The selection standard of key philosophies is that, on the one hand, they are the most widely discussed issues in spatial equity and distributive justice, especially utilitarianism, intuitionism, and liberalism (Lucas et al., 2015; Pereira et al., 2016). On the other hand, there are philosophical understandings of justice cannot be neglected when applied to the study case of Shanghai. Since the overarching goal of this study is to provide an analytic framework for assessing the spatial justice of certain planning practices, the three prevalent philosophical schools–utilitarianism, intuitionism, and liberalism–were chosen for their relevance to the just distribution of social goods. Marxism and socialism were chosen due to their close tide with the contextual background of the Shanghai case. Discourse ethics and recognition justice were chosen because of their representation and importance.

Table 2.1 Summary of key theories of justice

| Philosophical approach | Justice school | Justice of what? | Guiding principle | Key authors |
|---|---|---|---|---|
| Normative approach | Utilitarianism and Intuitionism | Different "whats", for example, resources (food, money, etc.), services (health, education, etc.), Welfare, well-being, utility, capability | Each group applies to different principles of justice (rights, deserts, needs, success, expectations, procedural justice, etc.)<br>The greatest good for the greatest number, happiness, maximum in individual capability | Brian Barry, David Miller, John Stuart Mill, Amartya Sen, Martha Nussbaum |
| | Liberalism | Egalitarian liberalism:<br>Basic liberties<br>Opportunities<br>Primary goods | Equal right to basic liberty & the greatest benefits of the least advantaged | John Rawls |
| | | Ultra-liberalism:<br>Basic rights and liberties | Self-ownership/ individual liberty, freedom of market transactions/ the entitlement theory | Friedrich August von Hayek, Robert Nozick |
| | Marxism and Socialism | Surplus value<br>Sphere of justice | Labor theory of value<br>Distribution by labor<br>Reject to fair distribution | Marx and Engels, David Harvey, Michael Walzer |
| | Frank school | Communicative rationality | Equal access to communication in decision-making | Jürgen Habermas |
| Cognitive approach | Recognition (cultural justice) | Human dignity & Respect<br>Participatory equality, includes economic justice, culture justice | Three spheres: personal identity, namely love, equal treatment.<br>Participation in public realm | Iris Marion Young Nancy Fraser, Axel Honneth |

*Adapted from Pereira et al. (2016).

Therefore, this research focuses on five main schools of justice philosophies: utilitarianism and intuitionism, liberalism, Marxism and socialism, Frankfurt school, and recognitive justice. The first four follow the normative approach to justice, while the last one takes the cognitive approach. The normative approach refers to setting up relatively objective standard of justice. For example, the situation that everyone owns equal access to basic education resources can be regarded as distributive justice. The normative standards of justice must be achieved to be regarded as justice. In the meantime, the cognitive approach does not pursue certain standards suitable for everyone but aims at individual cognition. In the cognitive approach, standards of justice are not the key point. The focal point turns out to be how different social groups are identified and treated in public activity. We will start from the basic theory schools of the normative approach: utilitarianism and intuitionism.

## 2.1 Utilitarianism and Intuitionism

### 2.1.1 Utilitarianism and Intuitionism as two intertwined ribbons

Utilitarianism and intuitionism are two prophase theories of justice, which provides fundamental thought for those developed later, i.e., liberalism and socialism justice. The most famous justice theory–Rawls's "Justice as Fairness"–takes these two theories as cornerstones to find a path which encompasses the theoretical rigor of utilitarianism and the value variety of intuitionism without their disadvantages (Wolff, 2016). Although these two theories have different indicators and normative principles, they build up the theory framework more or less intuitively and share a systematic similarity. Justice, as one moral value, owns transcendence as its inherent feature. We cannot conclude that the morality of modern society is superior to that of his ancestor. This transcendence makes theories of justice inevitably dependent on personal intuition, but intuitionism also has its drawbacks. We will analyze each theory in detail first, then summarize the criticisms against them, and finally discuss their similarity.

Utilitarianism takes utility as the evaluation standard of justice, while the definition of utility has a degree of randomness and intuition. Mill (1966) defines utility as "grounded on the permanent interests of man as a progressive being" in his classical utilitarianism. His theory argues that a person, being in his/her rational mind, will try to achieve his/her greatest interests. Dworkin (1981a) argues that a person's welfare is determined by whether his success in fulfilling his preferences takes individual success as utility/welfare. Similarly, Sen (2005) developed the capability approach and argues that it is the maximum of personal capability plays as a key indicator in distributive justice. Utilitarian theories share rational reasoning when comes to various outcomes. The intuitive definitions of utility build an obvious linkage between utilitarianism and intuitionism.

A common danger in various utilitarian theories is that collective utility will override the right to individual freedom. Classical utilitarianism asks: why would this person not peruse his/her greatest interests in a society? Therefore, classical utilitarianism concludes that social institutions should peruse the maximum overall utility, as the only moral. It seems justice that certain individual rights could be sacrificed in some conditions for the benefit of all. A typical case would be the application of internet technology. During the Covid-19 period, China government implicated Quick Respond (QR) Code for individual permission to public service and public space. Even though QR Codes are an efficient application in smartphones, it has created utilization barriers for the old, especially those without enough education level, to adapt this development and use this technology. The QR code protected the health condition of the public while preventing vulnerable groups from accessing certain public services and spaces.

One solution is to take the maximum of average utility, rather than the overall utility, as the indicator (Mill, 1966; Wicksell, 2013). In the average utility principle, the amount of utility does not accumulate with the increased number of people. The rights of individuals are somehow relatively protected compared to classical utilitarianism. However, average utilitarianism fails in establishing an integrated target system to assess its

utility. On the one hand, it is because of individual preferences and differentiate concepts of the good. On the other hand, even in a society of preference homogeneity, average utilitarianism cannot avoid the question: which factor should be involved in the assessment and how to measure this utility? And classical utilitarianism also faces this question. Therefore, average utilitarianism could be seen as merely taking an average view of classical utilitarianism.

However, there are two strengths of utilitarianism: theoretical rigor and support for liberty. Because of its rational derivation, numerous brands of utilitarianism share the common theoretical rigor. The claims of utilitarianism are clear and strict. It is good for justice principles to be transferred into reality. And the other strengths lie in its strong support of liberty. Mill argues three reasons for utilitarianism's agreement on liberty. First, liberty can develop individual potential and power, and strong vitality. Secondly, liberty is a must for individuals to achieve their goals as their different preferences. Thirdly, Mill believes that human beings prefer living in liberal institutions.

One criticism against utilitarianism lies in the subjectivity of utility. If an approach can maximize the average/overall utility, at the expense of some people's interest, then utilitarianism might support this approach. Taking utility as the subject, man becomes an instrument to the accumulated utility. This normative judgment is against Kant's "**Man as an end, not a means**." In this way, utilitarianism has been criticized as a teleological theory, instead of a deontological theory (Rawls, 1971). It also leads to a **justice dilemma between utility and liberty.** If we take the equal liberty of individuals as a prerequisite, we will find various and dispersed individual desires in society. Even though we take the social corporation as the main approach to how society operates, dismissing conflicts and competition, there is no reason that equal liberty will lead to maximum of utility. The dilemma works in this way, if we keep equal liberty as a justice principle, then it is impossible to achieve the maximum utility.

Different from utilitarianism, **intuitionism** develops a path that **lacks theoretical rigor** but is **abundant in value diversity**. Human intuition owns an innate mystery and transcendental justification. While justice, as one moral value, owns transcendence as its inherent feature. The morality of modern social humans can be hardly regarded as superior to that of the ancestor. The shared transcendence of justice and intuition leads to the many constitutive judgments and value diversity regarding justice in daily life. Justice principles derived from intuitions have a wide generality of its rationality, and a variety of priorities according to individuals and social groups. A typical example would be that specific social groups, such as ethnic minorities, feminists, and homosexual communities, call for protection for their group entitlements based on intuitions. Intuitionism is deontological as it takes man as the end. Yet, the intuitionist doctrines have various faces as they value diversity.

Figure 2.1 shows two principles of intuitionism: first to produce the most goods for the greatest satisfaction, and second to distribute satisfactions equally. Case a indicates the aggregative-distributive dichotomy, which refers to the inversely proportional relationship between equality and total welfare. The Line I and II are the accumulation of

points A and B. From an objective perspective, it seems Line II is always better than Line I. However, case b involves the influence of individual perceptions. The dashed lines are the opinion of people who take total welfare more important than equality, while the solid lines represent people's perspectives who take equality prior to total welfare. The former would argue that point D is much better than C, while the latter would think both points are at the same level.

The problem of intuitionism lies in its failure to generate a stable and universal criterion system based on multiple values. One critical problem is that: between these intuitive principles, there is no expressible ethical conception that underlies the weights of principles (Rawls, 1971, p. 34). There are many types of intuitionism, focusing on different aspects and weighing different priorities. As Figure 2.1 shows, controversy and opposition are inevitable during the categorization of different values. It is also the reason why contextual-based justice principles are rejected in this study. If the different understandings in contexts can affect justice principles, it is impossible to produce universal criteria for justice. If justice principles exist and are moral choices, then they should be the best choices in all moral situations. Flexibility in justice principles would destroy the priority of justice in social values.

Here, we introduce two prevalent utilitarian theories: Arrow's ordinalist-utilitarian and Sen's capability approach. Arrow put forward the famous 'voting paradox' and built up the social choice theory, which forms his ordinalist-utilitarian norm of justice. Based on Arrow's theory, Sen construct the capability approach, which won massive discussions and applications in numerous theoretical and practical studies. To understand the capability approach requires the understanding of Arrow's ordinalist-utilitarian, which is an early stage of the justice theory in social choice and will be discussed as follows.

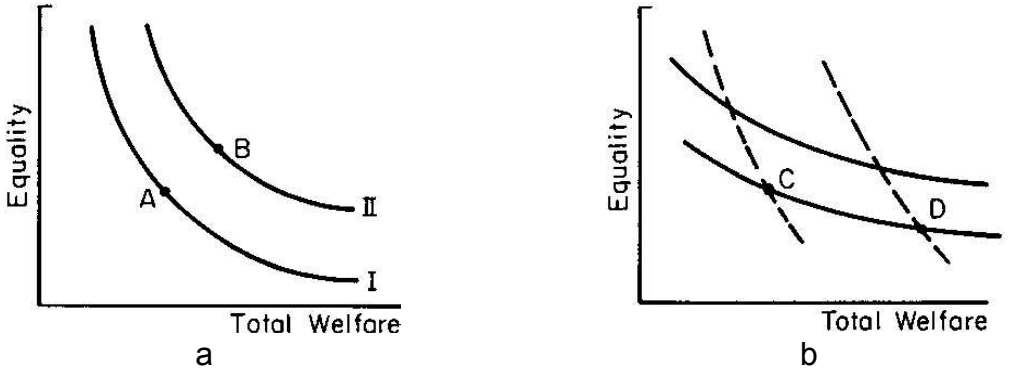



Figure 2.1 Two cases of intuitionism based on the aggregative-distributive dichotomy (source: Rawls, 1971, P33)

### 2.1.2 Social Choice: Arrow's Ordinalist-Utilitarian Notes

Arrow forms his ordinalist-utilitarian notes of justice in the way of criticizing John Rawls' theory, which mainly follows the logic of social choice theory. Economic reasoning is the main method in his evaluation of Rawls's theory, especially in his brilliant rebuttal to the just saving principle (Arrow, 1973a). On the basis of logical economic reasoning, he critiques Rawls's theory as ordinalist-utilitarian as the second principle setting priority to the least advantaged (Arrow, 1973b). We will introduce the distribution norm of welfare in Rawls's theory first, then focus on Arrow's critiques, and finally the basics of social choice theory, which leads to Sen's capability approach.

John Rawls's theory has two "Justice as Fairness" principles, and Arrow's critiques mainly focuses on the second principle. The first principle is the expounding of each person's equal liberty, and the second principle describes in which condition inequalities are acceptable. We will discuss every detail of Rawls's theory in the liberalism part. But now the "**maximin criterion**" (Rawls, 1971; Rawls, 1974) in his second principle is quite crucial in Arrow's theory and will be introduced in advance. The "maximin criterion" refers to that social inequalities are acceptable only when the greatest benefit of the least advantaged has been achieved.

The gain-and-loss table (Table 2.2) can interpret the maximin criterion well. In Table 2.2, Group A, B, and C represent the situations of the least advantaged, middle class, and the greatest advantaged. In each decision, three groups gain and lose different numbers of utilities. In moderate conditions, there are distinct but common gaps between each decision. The maximin rule will promote D3 as its justice choice for the best gain of the least advantaged. It means the sum utility and the average utility, which might be the criteria for utilitarianism, of all three groups are not justice criteria. Rather, the best situation of the least advantaged will be the criterion of justice. Social inequalities maximizing the utilities of the least advantaged can be considered as justice according to the maximin rule.

The maximin criterion seems simple and clear in this way, while there are implicit problems. First, the probabilities of each decision affect the justice choice and are hard to modify and determine. The following example comes from Harsanyi (1975). Imagine two job offers for you to choose from: one is well-paid, and your favorite works but thousands of kilometers away, the other is in your living city but with a very low salary and boring working content. For the former, you will have to take a flight and there is a probability of an air crash. Would people choose the second job for avoiding the probability of an air crash? It could happen to people having flying phobia or aviophobia. Yet, of the extremely small probability of an air crash, most people will choose the first job for an opportunity for a better life. Back to Table 2.2, the probabilities of the linkage between decisions and results remain unknown. Speculation that takes some risk, aiming at profits, is not uncommon in real life. However, contracting parties in the veil of ignorance refuse speculation to avoid the probability problem. Lacking an objective basis of society, contracting parties cannot judge probabilities of decisions and consequences and will rather hold a relatively conservative position.

Table 2.2 The gain-and-loss table in moderate condition (Rawls, 1971)

| Decisions | Group A | Group B | Group C |
|---|---|---|---|
| D1 | -7 | 8 | 12 |
| D2 | -8 | 7 | 14 |
| D3 | 5 | 6 | 8 |

Table 2.3 The gain-and-loss table in extreme condition (modified from Harsanyi, 1975)

| Decisions | Group A | Group B | Group C |
|---|---|---|---|
| D4 | 10 | 1000 | 9000 |
| D5 | 11 | 11 | 11 |

Another issue is the distribution of utility allocation. Table 2.3 shows an extreme allocation between D4 and D5. The total utility in D4 is several times greater than D5. If people are determined not to be in Group A, they will choose D4 for maximum gains. Even in the ignorance of position, the majority probably will choose D4 as 2/3 probability of not-being Group A. This rebuttal case derives from classic utilitarianism. Meanwhile, the expectations of gains in Table 2.3 are still invalid as in Table 2.2. Expectations and their risks are both untrue because of the impossibility of the overall evaluation system of utilities. The gain-and-loss in Table 2.2 and Table 2.3 cannot be calculated in social life because of the absence of a total welfare indicator system. And it is also impossible to establish a fixed linkage between decisions and welfare. These two reasons make the maximin criterion an idealized guideline for the pavilion in the air.

Arrow's criticism over the maximin criterion is a genuine and powerful rebuttal using Rawls' own logic. The decisions in Table 2.3 creates a difficult situation for the application of the difference principle. In Decision A, there is an imbalanced distribution of income between different groups. This situation can be extended, in that some groups may have dozens of times more benefits than less advantaged groups. At the same time, these benefited groups create dozens of times more welfare for the whole society. Rawls admitted that in such conditions, decisions resulting in dozens of times welfare, such as A, may be chosen. However, he refused the existence of decision A using the concept of close-knitness.

Rawls's close-knitness refers to a transfer effect of welfare between different social groups (see Rawls, 1973, p. 70-72). Especially, the welfare of the poorest/least advantaged is linked to the welfare of people with a higher status than the group. There will be no situation where the low-level people only increase by one dollar, while the middle-level people increase by 1,000 dollars as in Table 2.3.

Arrow retorted that if there is close-knitness, which will produce the same effect of increasing the welfare of the richest and the lowest, then there is no need to adopt the maximin criterion. Because it is the same to increase the benefits of the richest as long as close-knitness will increase the similar amount of benefits of the poorest (Arrow,

1973b). In this way, we could see one key point of Arrow's criticism over the difference principle is the refusal of close-knitness.

The problem is: does this close-knitness exist? My answer to this question is half positive and half negative. The existence of close-knitness is a statistical problem. Two empirical instances for the positive side. Zhao and Cao (2020) analyze 81 million trips data from public transit cards to assess commuting inequity in Shanghai. Their results identify that a trade-off between housing and travel costs of local residents, who tend to own a flat/house far away from the city center with low housing prices and high travel costs. This choice of local residents surprisingly enables migrants to rent a flat in the city center with low travel costs. In this case, the behavior of local residents moving from the city center to the suburban area in Shanghai is driven by their own benefits, that is, an increase in personal living conditions with limited costs. Thess increased benefits for local residents have led to vacancies in city center properties, and then the migrants naturally fulfil the vacancies under the market mechanism. This process is a typical case of close-knitness between the benefits of the local residents and the migrants in Shanghai.

Another instance is the transfer benefits of public housing consumption. Public housing residents tend to sub-let their public housing to people with a higher income than them (Bertaud, 2018). Figure 2.2 illustrates this close-knitness in the consumption of public housing. The two graphs below show the relationship between household income and number of households, while the upper refer to the level of housing consumption and household income. The below graph shows the planned situation and the actual situation of public housing provision in the relationship. In the planned situation, the households within the dark blue block are the target group of the public housing, whose incomes are between q and n. The upper limit n is to ensure that they belong to the disadvantaged group, while the lower limit q means that they have some financial means to be able to afford the expenses of public housing. Because of the limited provisions of public housing, limited qualified households can live in the public housing. However, in practical terms, these public housing populations tend to sub-let their accommodation to the light blue group, the actual potential beneficial subletting population. This is because that public housing provides improved housing conditions (the red lines in Figure 2.2) at the same level h1 as those of higher income households h2. Some households benefiting from public housing will try to cash these potential profits of high living conditions by subletting their public housing apartment. This close-knitness is not rare since public housing policies in general prohibit this kind of subletting.

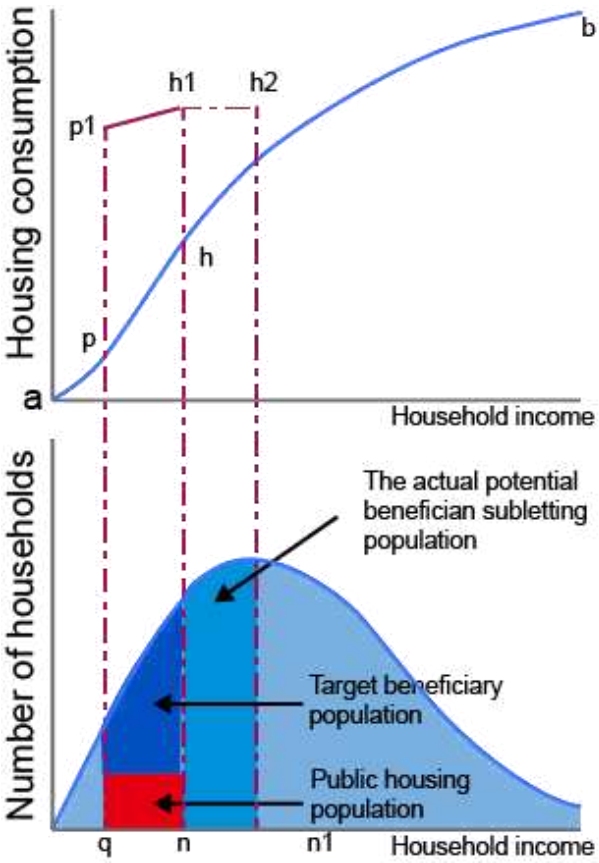


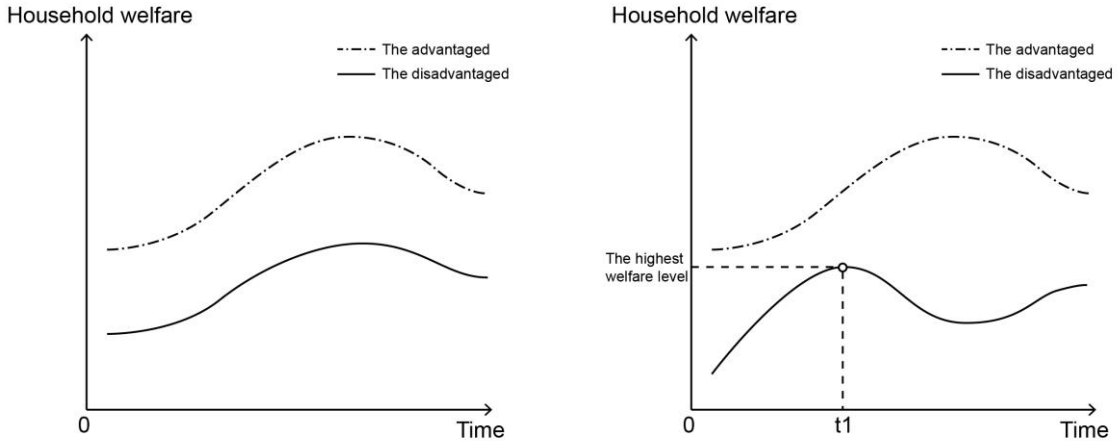

Figure 2.2 The close-knitness in housing consumption of public housing.(modified from (Bertaud, 2018, p. 265))

The refusal of the concept of close-knitness is the existence of social inequalities. The uneven distribution of household income is itself a favorable refutation of the close-knitness. The close-knitness promotes the tight transmission effects between interests and benefits of different social groups, which is not likely to cause an uneven distribution of incomes.

The key issue lies in the probability of transferring benefits between social classes. Rawls's close-knitness could happen in certain conditions, while its probability is uncertain, dynamic, and unpredictable. The mysterious mechanism of benefits and burdens distributions leads to various situations of distributive justice. Extremely unequal benefits, such as Decision D4 in Table 2.3, might also take place. However, it does not mean that the difference principle is invalid in this case. The problem is how to define the greatest benefit of the least advantaged.

Figure 2.3 shows two types of the close-knitness concept. The left figure (a) could be seen as a realization of Rawlsian ideal close-knitness, that the advantaged and the disadvantaged have a linking relationship of welfare level. On the contrary, the revealed close-knitness might have an unstable correlation in the right figure (b). In the long river of time, there may be periods of positive and negative correlations between the household welfare level of the advantaged and the disadvantaged. In this study, it is the longitudinal comparison of one certain social group instead of a horizontal comparison between different groups that the Difference Principle aims at. In Figure 2.3,

the greatest benefit of the disadvantaged, which could be regarded as the fairest situation, is the t1 time point with its highest welfare level throughout the time. Therefore, the greatest benefit should also take the relative status and returns into consideration.




(a) the ideal close-knitness (b) the revealed close-knitness

Figure 2.3 The difference between the ideal and revealed concepts of close-knitness

Back to Table 2.3, its situation can be seen as a case prototype of Arrow's impossibility theorem in social choice theory. Arrow argues that it is impossible to have a social choice mechanism that converts personal preferences into social choices through the majority vote rule. If there are at least three alternatives, the social ordering voted by the social members must be either imposed or dictatorial (Arrow, 1950), that is, the social choice must depart from some individual preference. Table 2.4 shows the “voting paradox” as one simple example of the impossibility theorem. There are three voters with different individual preferences for three candidates, *x, y,* and *z*. If we apply the ‘majority rule’ in this electoral process, there will be a circle result: $x > y > z > x$. This means that we cannot arrive at a reasonable order of social preferences according to the majority rule. Arrow proves that there is no voting scheme that simultaneously achieves efficiency and respects individual preferences, in a manner like “axiomatization” in mathematics. However, Arrow’s impossibility theorem, along with the voting paradox, has been somehow solved by Sen’s theory. We will discuss Sen’s solution to this impossibility theorem in the following subsection.

Table 2.4 The “voting paradox” as a simple example of the impossibility theorem

| Voters | Individual Preference/Ordering |
|---|---|
| Person I | x > y > z |
| Person II | y > z > x |
| Person III | z > x > y |

Although Arrow uses his impossibility theorem to criticize Rawls's social choices of justice principle in the veil of ignorance, it seems to be a rigorous and refined interpretation of the formation of the disadvantaged. In the case of Table 2.4, the final decision will be Decision D4 through an electoral system, which applies the majority rule. This outcome of collective choice, as Arrow argues, must be imposed or dictatorial to Group A, who later becomes the disadvantaged social group. What Arrow and Harsanyi describe as justice from the perspective of utilitarianism in welfare economics, such as the maximum of utilities in Decision D4, is a natural and irresistible process of collective behaviors and social choices. Another missing point in this discussion is the influence of numbers. In Table 2.4, we do not take the number of people in the group into consideration. If there are one million people in Group A, while thirty people in Group B and C, then Decision 4 might not be chosen from a utilitarian perspective because of the relatively weak utilities of Group B and C.

The outcome of a voting system and social choices cannot be perceived as the standard of justice. The key point is to realize the difference between social choices and justice principles. If Decision D4 is chosen in Table 2.3, it is not because of its accordance with the principles of justice but due to its generation from the social choice system. It is important to recognize its injustice to the disadvantaged and compensation should be made up in such a situation.

### 2.1.3 Sen's Capability Approach

Based on Arrow's theory, Sen has solved multiple problems in the process of aggregating individual preferences into social choices and developed the capability approach by comparing the difference between Rawls's egalitarianism and Arrow's social choice. We will first go through the capability theory and the solutions to the aforementioned difference, and then review the critiques of the capability approach.

A prerequisite for understanding competence theory is to first understand Sen's significant contribution to social choice theory. Sen's solution to the voting paradox, that is, the non-linear order in Table 2.5, is to reach a consensus that a certain choice is not the best choice. If we assume that choice *x* in Table 2.5 is not the best, then *y* will be the final and best choice (see Table 2.6).

Similarly, Sen's solution to Arrow's impossibility theorem follows a binary comparative approach. Sen (1977) reveals that interpersonal comparability is not involved in Arrow's theorem. In all choices, x, y, and z, the interests of voters are not mentioned. For clarity, I adopted Sen's division example of a cake (100 units) among three identical persons (Sen, 1977). As Table 2.6 shows, there are two situations of cake divisions among the three voters. In situation 1, Person I has the majority of the cake while Person II and III share a minor part of the cake. However, for Person II and III, their preference orders will be $z_1 > y_1 > x_1$. In situation 2, Person II and III share almost half of the cake, while Person I enjoys the very minor part. However, the preference orders of Person II and III remain the same as in situation 1: $z_2 > y_2 > x_2$. This example reflects that **the choice order is not equal to interpersonal comparability**. Different distributions

of personal interests have limited influence on the choice order. If there are weak interpersonal comparisons, such as extended sympathy, then Arrow's 'impossible' result can be overcome (Sen, 1999).

Although the interpersonal comparison in the social choice theory seems irrelevant to social justice, it is an entry point of Sen's philosophy of justice. Sen comments on Rawls's theory as transcendental institutionalism because of its two features (Sen, 2009, p. 5). The first feature, which he argues, is that 'Justice as Fairness' peruses a prefect state of justice and lacks **relative comparisons** of justice and injustice. The second feature is that **social institutions are the subject of justice** in Rawls's theory, while 'the actual societies that would ultimately emerge' has been neglected. I have a hard time agreeing with either of these features. The difference principle itself contains the idea of relative comparison by defining certain conditions of injustice as justice. We could find Rawls's discussions on actual societies regarding private properties in Chapter 5 Distributive Shares in 'A theory of justice'. Taking the institution as a justice subject does not mean that the institution is the only concern. It is due to the priority position of institutions over actual distributions. Since the two features are the foundation of Sen's justice philosophies, we will leave it here and continue his advocacy.

To fulfill the gap between institutionalism and actual societies, Sen introduces the concept of a **comparative framework** (Sen, 2009, p. 102), which includes pairwise comparison as a further development of his interpersonal comparability. The pairwise comparison refers to a binary ordering of two distributions, instead of a 'totalist' rank of distributions. This binary ordering refuses to peruse a perfect state of justice and leads to an incompleteness in social justice. For example, if there are twenty kinds of distributions among five social groups, Sen's approach is to compare the justice levels of any two kinds of each time, that is, pairwise comparison, instead of choosing one best distribution among the twenty. As the counterpart to transcendental institutionalism is the realization-focused comparison, the incomplete comparability is set opposite to Rawls's transcendent, and the capability approach is the opposite of institutionalism.

Table 2.5 Sen's solution to the voting paradox

| Voters | Individual Preference/Ordering |
|---|---|
| Person I | y > x > z |
| Person II | y > z > x |
| Person III | z > x > y |

Table 2.6 Sen's division of a cake to identify interpersonal comparability (1977)

| Situations | Choices | Dividing a cake (100 units) | | |
|---|---|---|---|---|
| | | Person I | Person II | Person III |
| Situation 1 | Choice $x_1$ | 98 | 1 | 1 |
| | Choice $y_1$ | 96 | 2 | 2 |
| | Choice $z_1$ | 94 | 3 | 3 |
| Situation 2 | Choice $x_2$ | 6 | 47 | 47 |
| | Choice $y_2$ | 4 | 48 | 48 |
| | Choice $z_2$ | 2 | 49 | 49 |

The capability approach focuses on what people are actually able to do and to be, as a major affiliation with the realization-focus comparison. Nussbaum (2001) adopts ***a principle of each person's capability****, based on the principle of each person as an end,* and develops the concept of sex equality and feminism. Although we could discuss this sex equality in the capability approach, it is a reversal of Rawlsian theory in that the subject of justice changes from institutions to human capabilities. In Sen's discussion of the relationship between human rights and capabilities, he wrote:

> Capability concentrates on the opportunity to be able to have combinations of functioning (including, in this case, the opportunity to be well-nourished), and the person is free to make use of this opportunity or no. A capability reflects the alternative combinations of functioning from which the person can choose one combination. It is, therefore, not being suggested at all that being well-nourished is to be seen as a freedom. The term freedom, in the form of capability, is used here to refer to the extent to which the person is free to choose particular levels of functioning (such as being well-nourished), and that is not the same thing as what the person actually decides to choose. (Sen, 2005, pp. 5-6)

It is likely to cause a misunderstanding that the capability approach takes the opportunity as the material of justice (Pereira et al., 2016). However, this opportunity here is not the same meaning as in Rawls's theory. In Sen's theory, it is a substantive opportunity in the assessment of capabilities, which includes more concrete and actual achievements and processes (Sen, 2009, p. 287). Taking Sen's example, Alex plans to spend the whole day at home on Sunday, and there are three situations. In Situation A, he achieved his plan and relaxed at home. In Situation B, a group of robbers stormed his house and threw him into a small river ditch. In Situation C, these robbers, for whatever reason, did not allow him to go out and confined him to his house. It is obvious that Situation B is unfortunate and injustice. Sen argues that even though Situation C and Situation A achieve the same outcome, that Alex spends his day at home, Situation C was an injustice because individual freedom was forbidden through the process. This example illustrates that Sen's comparative framework is focused on the **practical possibilities of competence** from an individual perspective. Therefore, it is capabilities as the subject of justice and minimum level of basic capabilities as the fairest status (Table 2.1).

There are three main critiques of Sen's capability approach. The first is whether the comparative framework is a unique feature of the capability approach. The second is whether individual perspective could be a dominant element in justice philosophy. The third is how to deal with historical injustice in the capability approach.

For the first point, the questions are: should we pursue "a perfect state" of justice? Is there no comparative thought in other justice theories, i.e., "Justice as Fairness"? I would argue that the answers to both questions are negative. As the second principle in Rawls's theory begins with 'social and economic inequalities are to be arranged…', it identifies in these typical situations that inequalities are acceptable. The following detailed situations and conditions of this acceptance do not describe a perfect situation of justice, but rather a broad and wide liberal justice. Consequently, the maximin criterion takes the comparative benefits of the least advantaged as the indicator, which is based on comparative thought. It is the comparative framework as the essence of the justice concept. Similarly, the concept of equality derives from comparison. Without comparison, there is no chance to know in which decision a person gets more benefits or whether he/she obtains the same welfare as the rest. I do not intend to conduct an interpersonal comparison and fully aware of its impossibility. As Robbins (1997) quotes W. S. Jevons's words: "Every mind is inscrutable to every other mind, and no common denominator of feeling is possible." However, it is this comparative psychology that has given birth to the need for justice. The importance of comparative framework lies in its relationship with justice connotation instead of its unperfect pursuit or individual perspective.

For the second concern, the individual perspective–which may lead to individual preference for welfare and benefits–needs an examination of its theoretical position from a macro perspective. Would the concept of individual "capability" become the new "utility/success" in the past utilitarianism theory? To what extent may individual capability exceed personal happiness/welfare/liberty to be the one (and the only one) life pursuit of each person? Moreover, from the perspective of spatial planning as a discipline, to what extent can personal capabilities overcome spatial barriers? Slum dwellers share the same geographical condition despite of their individual differences, including their differentiate intelligence, physical conditions, and cultural perceptions. However, can these individual differences provide them with better living conditions? It is possible that some slum dwellers with high mobility can have quicker access to medical and educational resources than others, while it is unlikely for them to gain those high-quality medical and educational resources, which are provided in gentrifying communities. Empirical planning projects have definite spatial boundaries. These real and invisible borders, which limit the mobility of the inhabitants and the appropriation of resources, require enormous personal socio-economic advancement to be broken down.

Table 2.7 shows John Rawls's detailed explanations of the two key phrases, "equally open" and "everyone's advantage", in the first version of the Second Principles.

> Social and economic inequalities are to be arranged so that they are both (a) reasonably expected to be to everyone's advantage, and (b) attached to positions and offices open to all. (Rawls, 1971, p. 60)

The subject of the phrase "equally open" can either be individual career or fair opportunity. While Sen's capability approach is somehow in the middle of these two subjects, that is the opportunity to develop individual careers. Similarly, the phrase "everyone's advantage" has two kinds of understandings: the principle of efficiency and the difference principle. The principle of efficiency refers to Pareto optimality, which means the condition of everyone's advantage is the most efficient distribution of resources. A free-market system might take the principle of efficiency/the Pareto optimality as an end of its objective. The difference principle refers to the different benefits/interests of various social groups. In Justice as Fairness, the difference principle is the greatest benefits of the least advantaged.

Rawls's reason for choosing the difference principle, rather than the principle of efficiency, and choosing fair opportunity, rather than the careers, origins from the same perspective: the refusal of the inequalities brought from the natural endowment. Natural aristocracy determines resource distribution according to one's origin, which is a prevailing opinion in a feudal society and lacks moral legitimacy. Natural liberty promotes individual careers and Pareto optimality. However, individual career development depends on one's talents, which is also one kind of natural endowment. Liberal equality replaces careers with fair opportunities so that everyone could obtain an equal chance to open offices and positions. However, the application of the principle of efficiency cannot avoid situations in which the interests of some groups are legitimately sacrificed for the maximum well-being of the whole. As Rawls words: "the most obvious injustice of the system of natural liberty is that it permits distributive shares to be improperly influenced by these factors so arbitrary from a moral point of view (Rawls, 1971, p. 72)."

Table 2.7 Four interpretations of two phrases in the Second Principle (Rawls, 1971, p. 65)

| "Equally open" | "Everyone's advantage" | |
|---|---|---|
| | Principle of efficiency | Difference principle |
| Equality as careers open to talents | System of Natural Liberty | Natural Aristocracy |
| Equality as equality of fair opportunity | Liberal Equality | Democratic Equality |

Although Sen's capability approach has been developed for a long period, it still applies the principle of efficiency. Rawls was aware of Sen's application of the efficiency principle, as he wrote: "There are expositions of this (efficiency) principle in most any work on price theory or social choice (Rawls, 1971, p. 66)." Sen's individual comparison, either in the name of career or opportunity, has already been considered and rejected in Rawlsian theory. What principle of efficiency promotes is a hypothesis that efficiency is equity. In that case, Pareto optimality, which means improving the situation of some persons (at least one) without decreasing the others', own the moral legitimacy of social goods distribution. Following Rawlsian refusal of natural endowments, this study also rejects the principle of efficiency and the hypothesis of efficiency as equity.

The third concern in Sen's capability, historical consideration, refers to the treatment of historical injustice. Surprisingly, there are few discussions of the historical influence in Sen's capability approach. The difference in individual capability is affected not only by congenital conditions (i.e., IQ, talents, and physical condition) but also by acquired conditions (i.e., education, work experience, and nationality). Even though the advantages brought from the congenital conditions can be admitted as legitimate in a market-free system, is it also fair to admit the advantages brought by acquired conditions? If I am the only person who is capable of playing the piano, do I have the right to own the private property rights of the last piano? What if I have already owned ten pianos to acquire my super playing ability? From this perspective, the capability cannot be regarded as an **incomplete** ethical theory for its limited focus (Martins, 2011).

## 2.2 Liberalism

Liberalism is among the most extensive and systematic schools of justice philosophies. If we regard utilitarianism and intuitionism as a thatched cottage of justice theory, then liberalism will be the Pantheon. The liberalism theory of justice is affluent, systematic, and world-wide prevalent. Although equal human liberty is the core concept of liberalism, its branching theories reach a numerous amount. For example, Kymlichka advocates that justice should be ambition-sensitive and endowment-insensitive. However, here we focus on the two most famous liberalism theories: Rawls's "Justice as Fairness" and Nozick's entitlement theory. These two were regarded as two controversial theories with opposite claims. However, we will find out that these two plausibly opposite theories promote the same framework for justice, which are the two sides of one coin.

### 2.2.1 John Rawls's Egalitarian Liberalism

Taking utilitarianism and intuitionism as the frame of reference, Rawls's theory of justice tries to achieve a sufficiently strict and universal criterion for the basic structure of society, to maintain the possibility of diversity of values, and to expel possible personal sacrifice. The purpose of his ambitious plan is to revive the Kantian path of political science. We will first compare Rawls and Kant, then analyze the three versions of Rawls's two core principles, and finally one critical feature of Rawlsian theory.

#### 2.2.1.1 Rawls and Kant: Man is an end, not a means.

Rawls's revival of Kant's philosophy bases on the social contract. The social contract asserts that it is a process of mutual unity for individuals to be integrated into society. During this mutual process, individuals follow common rules and accept the corresponding obligations to protect themselves from violence and harm. This situation is "the state of nature". It is inevitable that social cooperation exists in the social contract. Or in other words, the basic structure of society aims to arrange one scheme of cooperation. And the social contract needs principles to form the scheme of cooperation.

Rawls sublimated the conception of justice into a primary role of the social contract principles. In his hypothetical contract, Rawls put up the original position and the veil of ignorance as two hypothetical scenarios to argue for the primacy of justice. The original position aims to provide a fair procedure, while the veil of ignorance aims at the content of basic principles in forming the social contract. In the veil of ignorance, no one knows his fortune, social status, and his intelligence and abilities. In Rawls's argument, people, with ignorance of economic, political, and cultural information, will choose justice as the first basic principle of running their society. After the determination of the two justice principles, people will then decide on the constitution and the basic form of society.

Besides, the hypothetical reasoning, including the original position and the veil of ignorance, realizes the Kantian theory. Rawls argues that it is a mistake to emphasize the generality and universality in Kantian ethics. Its real validity lies in ethics as rational choice, characteristics of ethical principles, and his conception of autonomy. And the original position corresponds to the individual autonomy in Kant's conception:

> Kant held, I believe, that a person is acting autonomously when the principles of his action are chosen by him as the most adequate possible expression of his nature as a free and equal rational being. The principles he acts upon are not adopted because of his social position or natural endowments, or in view of the particular kind of want. To act on such principles is to act heteronomously. ⋯The original position may be viewed, then, as a procedural interpretation of Kant's conception of autonomy and the categorical imperative. (Rawls, 1971, p. 252, 256)

More importantly, Kant sees ethical principles as **the object of rational choice**. In other words, ethical principles are no longer divine, objective, natural value, or the way of discovery. It is the reason why people in the veil of ignorance negotiate to ***choose*** certain moral principles as the basis of the social contract. And these ethical principles have two characteristics, that they are not only acceptable to all but also public. The two characteristics of ethical principles set the tone for the social contract, which has been also realized in the veil of ignorance.

However, "Justice as Fairness" includes not only the Kantian philosophy but also other philosophies, which leads to theoretical controversies. For example, Rawls' involving Hume's circumstances of justice may be problematic. When do we need justice?

Rawls concludes Hume's circumstances (Hume, 2003) into two kinds: objective and subjective prerequisites. The objective prerequisite refers to moderate resource scarcity. In such a situation, the similarity in individual abilities keeps that no one could overpower anyone, and everyone is susceptible to being reasonably prevented by others. Justice will not be an issue with abundant resources, as is everyone's satisfaction. While extreme scarcity may result in a situation where everyone is against everyone. And the subjective prerequisite is people's mutual indifference or disinterest in others' interests. If people care about each other, there would not be conflicts and people would not need justice to strive for their respective interests.

It seems contradictory to involve this justice circumstance based on human nature within the veil of ignorance. If people do not know their social state and wealth, why would they know that social resources are moderately scarce and they should be indifferent to others' interests? Sandel and Anne (1998) questioned in these circumstances whether human selfishness might be the first value. The contradiction between the circumstance of justice and the priority of justice originates from the tension between Hume's empiricism and Kant's deontology. Other controversies, such as the assault from social choice theory and whether basic liberties include ownership of the means of production, will be discussed in the criticisms of Rawls's theory.

By comparisons, we could find that Kantian philosophy occupies an unparalleled place of importance in Rawls's theory. Man is an end, not a means, which forms the most important basis in "Justice as Fairness". It keeps the deontological nature of the theory, fulfills the revival of Kantian philosophy, and protects the legitimacy of this theory. Even for the numerous criticisms over "Justice as Fairness", their critiques are based on the use of Kantian philosophy but never on the point of "man as an end" itself.

#### 2.2.1.2 The two principles of "Justice as Fairness"

There are three visions of the two principles in Rawls's "A theory of justice" (see Table 2.8). This section first reviews the evolutionary process of principle interpretations to figure out the key points and metaphors in each vision. It is then followed by relevant discussions and theories, especially criticisms of the second principle. Lastly, the second vision will be chosen as instructive principles in this study with specific reasons.

The first vision sets up a general framework of the two principles. ***First Principle*** refers to the equal liberty of each person, while ***Second Principle*** tries to define in which conditions social and economic inequalities are justice. The first principle is lexical prior to the second principle. The second principle, the fair equality of opportunity is prior to the difference principle. This means that when checking certain institutions or policies, the first principle's content has to be checked first, then is the fair equality of opportunity, and finally comes the difference principle. This order of principle later will be later transferred into the assessing framework of this study.

The first principle ensures the background of liberalism and the egalitarian position. According to Rawls, the basic liberties include: political liberty and freedom of speech; liberty of conscience and freedom of thought; freedom of the person with the right to

hold personal property; and freedom from arbitrary arrest and seizure. Every citizen occupies an equal position for basic liberties. And these basic liberties are later connected with a conception of social primary goods. In his final general conception, the subject is all social primary goods that should be distributed equally:

> All social primary goods ─liberty and opportunity, income and wealth, and the bases of self-respect ─are to be distribute equally unless an unequal distribution of any or all of these goods is to the advantage of the least favored. (p.303)

This general elaboration reveals that Rawlsian theory, which is first based on liberty theory, then exceeds the limit of liberty and extends its focus on all social primary goods. However, one critical issue lies in the definition of the right to personal property in economic justice. Its importance in this study lies in the provision type of shared ownership housing. Is private property a basic natural right? Do the least advantaged obtain the right to ownership or rent of private housing? Does the occupation of housing defend others' liberty? These questions are correlated with the definition of the right to personal property. The rights to public goods and social goods seem to be less problematic. Compared to other basic liberties, the right to personal property faces more discussions. And Rawls's definition of the right to personal property implies a strong impact from the contractarian (social-contract) theory.

There are two kinds of liberties in "Justice as Fairness". One is the right to choose an occupation, including freedom from slavery and forced labor, and freedom to choose and change jobs. The other is the right to hold and use private property exclusively including some form of fixed property, such as residence and private land. But two rights to property are specially excluded from basic liberties (Rawls, 2001): specific types of property ownership (and means of production) and freedom of contract as understood by laissez-faire theory. The exclusion of the right to means of production is in accordance with Rousseau and Locke's opinion. Rousseau holds the opinion that the world does not belong to anyone, and he is also against private property. Lock argues that as long as people's labor contributes to the natural resources then natural resources can be obtained. The Lockean two proviso includes conditions of private property. One is the sufficiency proviso, and the other is the spoilage provision. Both cannot be established. But they recognize the negative effect from private property on the non-property owner. The exclusion of the rights of means to production reflects that Rawls does not entirely agree that the right to property is one of the natural rights, in this way, he refuses the entitlement theory of Nozick. And he also refuses the unfettered gap between rich and poor, which might be generated by the free market.

In the evolution of the first principle, it is the system of liberty plays an important role. Basic liberties are not absolute and can be restricted only for the sake of itself. It is also the ground for the priority of the first principle. The total system of equal basic liberty was served to all. Everyone occupies a similar position in the system of liberty. In this way, the equal right is not a comparable term but an overall description.

Table 2.8 Three visions of the two “Justice as Fairness” principles (Rawls, 1971)

| | First Vision | Second Vision | Third Vision |
|---|---|---|---|
| First Principle | Each person is to have an equal right to the most extensive basic liberty compatible with a similar liberty for others. (p.60) | Each person is to have an equal right to the most extensive ***total system of equal*** basic liberty compatible with a similar ***system of*** liberty for **all**. (p.250) | Each person is to have an equal right to the most extensive total system of equal basic liberty compatible with a similar system of liberty for all. (p.302) |
| Key Points | | System of liberty;<br>Liberty can be restricted only for the sake of liberty itself. | |
| Second Principle | Social and economic inequalities are to be arranged so that they are both (a) reasonably expected to be to everyone’s advantage, and (b) attached to positions and offices open to all. (p.60) | Social and economic inequalities are to be arranged so that they are both (a) ***the greatest benefit of the least advantaged***, and (b) attached to positions and offices open to all. (p.83) | Social and economic inequalities are to be arranged so that they are both (a) the greatest benefit of the least advantaged, consistent with ***the just saving principle***, and (b) attached to offices and positions open to all ***under conditions of fair equality of opportunity***. (p.302) |
| Key points | | Maximin Principle | Procedure justice<br>The just saving principle (fair equality of opportunity) |

Compared to the first principle, the revisions in the second principle are merely stylistic (Rawls, 2001, p. 63). The fair equality of opportunity could be a substitute for equal liberty in the difference principle. And its meaning will be discussed below with the capability approach. This part focuses on one major controversy of the revisions of the second principle: the disadvantaged position the just saving principle. The disadvantaged position refers to the priority of the least advantaged in welfare acquisition. The just saving principle tries to solve the intertemporal issues of justice allocation crossing generation.

The main problem is whether disadvantaged positions can be turned into privileged rights. Nozick criticizes that the second principle is due to human jealousy that stems from the poor against the rich. Weakness is not equal to justification. Others question whether the second principle set the overall development goal of society as the benefits

of the least advantaged and the justice standard is set from the standpoint of vulnerable groups. And both criticisms have been responded to by Rawls (1974). Citizens are equal and free persons, and the second principle is to serve as a public principle for all. The intention is not to substitute the interest of vulnerable groups for the goal of an entire society but to keep natural variations and social justice at the same time.

Besides, the privileged rights of vulnerable groups do not definitely result in their benefits. There is a huge gap between intention and result. One example will be the COVID-19 vaccination. Even since the elder has the vaccine priority, there are cases of death because of their severe underlying diseases. The naturally weak physical conditions of the elder can influence the effectiveness of vaccination. Whereas there are also cases of effective vaccines and predictable deterioration of the elder without the vaccine priority. Therefore, this study adopts the maximin principle to avoid a relatively worse situation.

While the second principle has kept its position in justice philosophies, the just saving principle (JSP) has not survived various critiques (Paden, 1997). Intergenerational justice maintains just institutions over time by passing the disadvantaged position from the current generation to their descendants. Among all the critiques, one of the strongest rebuttals is Arrow's logical interpretation using economic formulas. Arrow (1973a) argues that JSP would lead to zero saving in every generation for the first generation would be worse off than any of their successors. JSP, as an intergenerational difference principle, might probably lead to generational injustice instead.

To sum up, this study adopts the second version of two principles, including the system of liberty and the maximin principle. For the just saving principle, this study excludes its content for three reasons. First, it remains a question of whether justice has an intergeneration dimension. To be more exact, the time dimension of a justice institution is not equal to the intergeneration dimension. Multi generations exist at the same time. The lasting of justice institutions over time may not lie in their past over generations but in their own operation over time. Secondly, it remains problematic whether it is saving that pass over generations. I would argue it is not only the public nature of the inheritance system but also social institutions that keep justice over generations. Thirdly, the economic tendency of JSP inevitably encounters asset appreciation issues, which is not the focus of this study.

#### 2.2.1.3 The "unbearable" arbitrary

One of the most thought-provoking and controversial aspects of Rawls's theory is his tendency to equality. Although the two principles do not require the equality of asset allocation but seek to mitigate the influence of social contingencies and natural fortune on distributive shares (Rawls, 1971, p. 63). One example of social contingencies is the natural aristocracy. The aristocracy is an arbitrary social attribute that may not lead to a favourable social starting point. It is legible and comprehensible that social advantages born of coincidence, such as peerage, should not be deserved.

However, the problem lies in whether social advantages derived from personal conditions are deserved or not. It seems reasonable that the higher the intelligence, the more assets the person acquires. But Rawls argues that intelligence, along with talent and ability, is also one of natural fortune and arbitrary. And the distribution of natural fortune is one of the common assets, whose profits should be shared by all. In other words, personal assets acquired by natural fortune are not individual entitlements and should be shared by all. The difference principle applies the maximin principle to avoid establishing social distribution on various arbitrary factors.

This deliberate avoidance of arbitrariness stems from an inherent notion of justice. Different justice conceptions will agree on one point of view, that is, institutions can be regarded as just when no arbitrary distinctions are made between persons when assigning basic rights and duties. This equality without arbitrariness leads to a crucial question: what kind of arbitrariness must we personally bear? And what kind of arbitrariness can be compensated for and balanced by the arrangements of the social system?

Different theories clarify the answer to these two questions from different perspectives. Now, we must first review the standard of the personal desert to figure out Rawls's answer. He refuses those distributive shares should be in accordance with moral worth, individual contribution, and effort. Rather, it is the notion, legitimate expectation, should be the standard of distributive shares. Although the conclusions seem to defy common sense, there is still rigorous philosophical reasoning that infers these conclusions. First, the value of moral virtue does not lead to the legitimate expectation of personal share. There is a difference between moral desert and legitimate expectation. Secondly, individual contribution and productivity might be related to the supply-demand relationship in the market. If the legitimate expectation of a person does not depend on his/her moral worth, nor should it depend on his/her productivity. There is a difference between efficiency and justice. Thus, by analogy, individual effort is affected by his/her own talent and the given circumstance. Therefore, efforts should not be the standard of just distributive shares. Instead, legitimate expectations are set by publicly recognized rules (principles of justice) that are required of each other. When people do what the system encourages them to do, they are entitled to demand certain things.

The refusal of arbitrary factors' influences on distributive resources constructs a reflective legitimacy in distributive justice. It is somehow counter-intuitive when we regard the advantages/benefits brought out by natural endowments, such as luck or one's origin, as injustice. On the contrary, it is quite a rigidity that unfortunateness brought out by natural endowments is regarded as an injustice of destiny. The question here is: if we take disadvantages brought from arbitrary factors as unfair, how could we regard those advantages brought from the same arbitrary source as fair? Why ought arbitrary factors lead to human happiness? Therefore, the refusal of arbitrary fortunateness remains the same logic as the refusal of arbitrary unfortunateness, which is a reflective legitimacy of arbitrariness. Rawlsian refusal of arbitrariness completes the rationality of justice theory by building up this reflective legitimacy.

### 2.2.2 Nozick's Entitlement Theory

Nozick's entitlement theory is another systematic liberalism justice, which is quite the opposite of Rawls's "Justice as Fairness". Rawls's theory takes substantive justice as the normative standard, while the standard of Nozick's entitlement theory is in the form of procedural justice. Rawls takes social institutions as the subject of justice, while individual self-ownership is the heart of Nozick's theory (Pereira et al., 2016). Rawls takes a top-down approach, describing a blueprint of how social resources just distributed, while Nozick follows a bottom-up approach, describing a procedure of how a person can just acquire resources.

If we describe Nozick's entitlement theory in one sentence, it will be that justice is the maximum of individual entitled liberty. The core idea of Nozick's theory is the entitlement to individual liberty, which is intrinsic. Any governance, control, and limit of individual liberty/ownership harms the market mechanism and generates injustice. In other words, the unlimited market fully admits as much individual entitlement as possible and is the right way to justice. Spatial planning following the entitlement theory must focus on avoiding market failures, aiming for resource efficiency, and allowing as many freedoms as possible (Hartmann, 2018, pp. 571-575).

Although the above arguments seem extreme, Nozick's entitlement theory is based on restricted logical thinking and forms a systemic ideology. There are four basic entitlement principles defining the way how people are entitled to a holding and then set up the standard of just distribution (Nozick, 1974, p. 151) ：

> (1) The principle of justice in acquisition: a person who acquires a holding in accordance with the principle of justice in acquisition is entitled to that holding.
>
> (2) The principle of justice in transfer: a person who acquires a holding in accordance with the principle of justice in transfer, from someone else entitled to the holding, is entitled to the holding.
>
> (3) The principle of rectification of injustice: a person who acquires a holding in accordance with the principle of rectification of holdings is entitled to that holding.
>
> (4) No one is entitled to a holding except by (repeated) applications of (1)-(3).

These four entitlement principles stem from the Lockean proviso. It is Locke's Theory of Labor Rights that links individual liberty and the legality of resource acquisition, forming the philosophical basis of the entitlement theory. We will first go through the Lockean proviso, then review Nozick's critique of Rawls's egalitarianism, and finally analyze others' critiques of Nozick's entitlement theory.

#### 2.2.2.1 Nozick and the Locke's theory of acquisition

No matter what type of entitlement is defined in Nozick's principles (acquisition, transfer, or rectification), the key question is why people are entitled. John Locke's Labor Theory provides the very basic ground: people's natural rights of property are based on their own labor. If you put labor into certain property, then you possess a natural legitimacy of its acquisition. For example, I planted a tomato seed and carefully

cultivated it for then weeks, then I naturally and rightly owned its fruits. The justification of property right is based on labor and must fulfill the Lockean proviso.

The Lockean proviso consists of two provisos: sufficiency proviso and spoilage proviso. The former refers that individual possession is legitimate in the case “at least where there is enough, and as good left in common for others”. The latter refers that individual possession is illegitimate if he/she is going to spoil it. The reason is that God has given resources to human beings for the purpose of enjoying instead of spoilage. The sufficiency proviso recognizes that private possession generates a negative influence on the non-asset-owned. To reduce the negative impacts, Locke puts up a further opportunity for the other left to possess good resources. However, neither of these provisos can hold.

Sufficiency proviso faces resource limitation, while spoilage proviso is confronted with the problematic definition of spoilage. Firstly, since the world resource is not infinite, there is an objective bottom-line for the enough and good left. If we assume everyone wants to acquire food/water/money, as long as the number of possessors keeps increasing, there is no doubt a limitation for all to possess enough good resources. The lack of qualified water resources in Africa is a simple and intuitive example. Secondly, the idea of “being” also works on physical resources. The occupation of certain land is unique and irreplaceable. If I own a high-quality apartment building in the city center, it is quite obvious that the other has fewer opportunities to earn as a good return on investment (ROI) than me. But even if I own a low-yielding agricultural land in the remote suburbs, it also prevents others from possessing this agricultural land. No matter the value of possessed resources, their being is unique and exclusive. For spoilage proviso, the idea of waste/spoilage cannot hold its ground. Old clothes can be sold to the second-hand market or made into new clothes. Wasted fruit could be a crew’s dinner. Rotten apples are the nutrients of Spring. If we abandon the idea that taking human beings as the dominant stakeholder, it is hard to find out true spoilage.

Nozick pointed out another limitation of the Labor theory: the boundaries of labor (Nozick, 1974, pp. 174-179). The famous example put up by Nozick is that if a private astronaut cleans a piece of land on Mars, can he claim his ownership of Mars as a whole planet or a particular land? Similarly, if I add a bowl of salted water into the Atlantic, then how much of the entire sea could I acquire? Despite the amount of labor, the effectiveness of labor might also be problematic as an indicator of entitlement. For example, it seems reasonable if I plant tomato and acquire its fruit. Because my labor makes the land and the plant more valuable than previous. But what if I plant normal weeds? Can my ownership of normal weeds lead to my entitled ownership of the land? If only valuable labor can contribute to entitled possession, then the definition of “valuable” contains unavoidable subjectivity. In the example, weeds seem valueless to human beings but might provide suitable habitats for rabbits. The subjectivity in value affects the entitlement of ownership, which is unacceptable for Nozick.

To solve the limitations of Locke’s theory of acquisition, Nozick revised its proviso. The basic idea is that if the acquisition does not obstruct others (worsen others’

condition), then the acquisition is legitimate. He defines the worsening of others' conditions from two sides: individual welfare and public resources. As long as individual welfare is not affected and good enough public resources are left, then the ownership led by labor is entitled.

#### 2.2.2.2 Nozick's critique of Rawls: The Patterned Principle

The two distinct philosophical approaches of Nozick and Rawls–substantive justice and procedure justice–lead to numerous academic critiques. Among them, two of the most powerful Nozick's critiques of Rawls are: the critique of the original position and the patterned principle. The original position, which lies behind "a veil of ignorance", establishes the primary logic why Rawls's two principles of Justice as Fairness have been chosen. Behind the veil of ignorance, people don't know their economic and social position, occupation, or their intelligence. They cannot choose the justice principle according to their own characteristics and make a profit for themselves. Rawls argues that in the original position, the two principles of Justice as Fairness will be chosen because of the possibility of each person and their descendant being disadvantaged. Nozick challenged the existence of the original position in order to undermine its philosophical basis. However, we will not focus on this logical reasoning of the philosophical basis here. Rather the critique of Rawlsian theory as the patterned principle is the core.

The patterned principle refers that the just distribution of goods "is to vary along with some natural dimension" (Kaufman, 2004; Nozick, 1974, p. 156). Natural dimensions include individual need, desert, merit, I.Q., and effort. Then why the patterned principle is problematic? It seems reasonable if the distribution of goods varies along with certain natural dimensions. For example, more intelligent people achieve more personal wealth. The richer gain more social resources. However, the legitimacy of the patterned principle is plausible.

Nozick argues that the patterned principle is problematic because of it determines a precise distribution of goods according to the patterned natural dimension. The precise just distribution of goods harms the entitlement of every individual regardless of his/her historical entitlement. The confirmed natural dimension is a forced power to affect how social goods to just distribute. The patterned principle distorts the entitled way of achieving social goods by defining an affirmatory just outcome. On one side, it is the gap between substantive justice and procedural justice that clarifies the problem of the patterned principle. How could a just procedure be affected by its outcome and be changed into an unjust distribution? On the other side, the patterned principle offers an asymmetrical justice standard while facing all the people. People with a certain natural dimension gain a preference for goods acquisition, which comes out from nowhere. If we question why should the wealthy naturally gain better education resourcse, then the question of why the poor should naturally gain better education resources should also stand up.

Nozick regards that in Rawls's Difference Principle, the natural dimension is the social position of disadvantage. Their historical disadvantages lead to their entitled priority of acquisition following goods. Nozick's critique is persuasive from the perspective of procedure justice. The Difference Principle does obtain lean to the disadvantaged since it requires the greatest benefits for the least disadvantaged. The unhistorical considerations in the Difference Principles fail to respect rights established through historical entitlement. Kaufman (2004) argues that Nozick's critique of Rawls's theory does not hold. Because the Difference Principle does not fit the definition of the patterned principle: it cannot provide a precise just distribution of social goods. Kaufman's argument can hold only when the disadvantaged is a dynamic concept. We will leave the dispute between Nozick and Rawls later since Nozick's entitlement theory faces multiple critiques itself.

#### 2.2.2.3 Others' critique of Nozick: The Border of Liberty

Although Nozick intensively critiques Rawlsian theory, his own theory–the entitlement theory–was confronted with a significant number of critiques at the same time. A brunch of scholars has made multiple dimensions critiques of Nozick's theory while promoting their own justice philosophies. They include Amartya Sen, G.A. Cohen, Michael Walzer, Richard Arneson, Ronald Arneson, and Martha Nussbaum. If we categorize those critiques according to their purposiveness, then there are two kinds of critiques: pure critiques of Nozick's entitlement and critiques leading to another justice philosophy. This section will focus on the former since the other justice philosophy will be discussed in their own sections. It does not mean that the latter kind of critique has little legitimacy. On the contrary, the latter critiques, i.e., the lack of feminism consideration in entitlement theory leading to the feminist conception of distributive justice, are strong enough to form their own advocates. It is a matter of paragraph organization that we have to focus on the pure critiques here.

Among numerous critiques of Nozick's theory, the critique from G.A. Cohen is one of the most persuasive which questions the border of individual liberty. He revealed the core philosophical basis of entitlement theory is the ***reflective significance*** of each individual: **each is the morally rightful owner of himself/herself** (Cohen, 2019). The reflective significance refers to the ownership of each individual. Since one person (despite those who lack full cognitive and functional capacity) owns sovereignty over his/her own being, it is morally right for everything that he/she is willing to do on his/herself. This sovereignty forms the basis of Nozick's entitlement theory. Only with the individual reflective significance, it is the right to maximum liberty according to Nozick's just acquisition principles.

However, Cohen questions whether this rightful sovereignty of each individual has the supreme which can exceed all kinds of ethical principles and owns the highest legitimacy. An extreme example will be that even if people own him/herself, it is still counter to intuitive that he/she has the rightful right to sell his/her organs in a completely free market. Carney (2012) recorded the underground organ market in

India and accordingly documentary events that led to moral controversies. This kind of individual behavior does not only impact the single individual but also builds a link between the individual and the external world. However, the impact and link cannot build up an absolute normative standard:

> The factual truth is a prima facie plausible basis for, not a logical entailer of, the sated normative claim. But there is no comparable presumptive normative tie between any person and any part or portion of the external world. (Cohen, 2019)

The above argument reveals that individual liberty and freedom, albeit factual and individually determinant, cannot be changed into a normative tie between the individual and the external world. In other words, the ownership of individual liberty is limited and this ownership has certain borders while faced with the external world. In this way, Cohen argues that this sovereignty over one person's own being does not exist.

The failure in building the rightful sovereignty of each individual liberty disintegrated the basis of Nozick's entitlement theory. If the full liberty of an individual does not exist, how could the maximum liberty exist and be regarded as the most just situation? Derived questions include the relationship between the affirmation of self-ownership and inegalitarian distribution (Cohen, 1985), the role of social choice and collective action in determining the distribution of resources (Sen, 1976), and the problem of past injustices and inequalities in present distributions of good (Dworkin, 1981b).

Above critiques focus on the relationship between procedural individual liberty and substantive distributive justice. In the following section, we will find out that these two distinct philosophical approaches to justice, along with their representative theories (Rawlsian egalitarianism and Nozick's entitlement), are the two sides of one coin. They together complete the liberty theory of justice.

### 2.2.3 Rawls and Nozick: Two Sides of One Coin

John Rawls and Robert Nozick developed two distinct and contrasting liberalism approaches to the justice philosophy. Not only the two key philosophers but also numerous scholars have participated in this long-lasting academic debate: should we take justice normative as substantive justice or procedural justice? Should the principle of justice be (un)patterned? Should we focus on overall distributive justice or individual liberty? Can we aggregate individual welfare into a collective one? If yes, then which one should be prioritized, individual liberty or collective liberty?

The above questions are of course hard to provide answers to satisfy everyone. Moreover, the competing philosophical insights between Rawls and Nozick actually inspired far more questions like those above. One might stand for Rawls in certain questions, while jump to the other's camp in another question. However, one thing is more important than choosing one side of each, which is to realize that their dueling academic perspectives of justice philosophies complete the liberalism approach to justice philosophies.

For example, for the first question about the choice between substantive justice and procedural justice: distributive justice cannot be achieved only through procedural justice or substantive justice. These two distinct approaches to justice must be combined. We cannot define certain resource distribution as just and fairness merely depends on its quo status. On the contrary, we can neither define just distribution merely depends on its acquisition process. There might be a priority between the two in specific cases. One may argue that we should fulfill both procedural and substantive justice to define an issue as justice or injustice. On the other hand, the other may also argue that as long as in a certain issue its announced justice approach (procedural or substantive) has been achieved, then the issue can be regarded as justice. But the point is that, within the sphere of substantive justice and procedural justice, we cannot abandon either of them in general. Similarly, individual liberty is important, while the interests of a group of people also matter. Inequalities are inevitable in society, as well as the conflicting interests of different social groups. The question then turns to how to compensate for the historic injustice instead of armchair theorizing. Having written this, I have no intention to avoid the contradictions between the two theories. Rather, I would like to address that the contradictions were raised because of their being on the same table. Rawlsian egalitarian liberalism and Nozickian entitlement liberalism are like the two sides of one coin; they take human liberty as the theoretical ground. They are attempting to seize each other's territory because they are playing the same game of international chess and are evenly matched.

Overall, Rawls and Nozick represent two opposite sides of the liberty theory of justice. While Rawls prioritizes social justice and equity, Nozick emphasizes the importance of individual liberty above all else. These contrasting views have contributed to ongoing debates in the field of political philosophy regarding the role of the state and the balance between individual liberty and social justice.

### 2.3 Marxism and (Neo) Socialism

Given the historical background of Shanghai experiencing the socialist, post-socialist, and market-oriented socialist housing systems, the research imports the justice concept in Marxism and (neo) socialism for a better understanding of the Shanghai case. Marxism and (Neo) Socialism in Marx's original works, there is no content directly related to fairness and justice. The focus of Marxism is on the critique of capitalism and the importance of class struggle. However, scholars later discover and develop the relationship between Marxist theory and justice morality (Smith, 1994). For example, Peffer (2014) argues that Marxists view morality as a social construct that is shaped by historical and cultural context and that the importance of class struggle derives from the pursuit of social justice. Here we focus on two influential (neo) socialist theories, which directly build up the justice conception following a (neo) socialist thought.

### 2.3.1 Walzer's Spheres of justice: Atypical Socialism

Michael Walzer developed a significantly different theory of justice– "spheres of justice: complex equality" –compared to liberalism. Nor is his philosophical thought of justice typical of socialism. His core proposition is the pluralistic feature of justice principles, that is, the normative principles of justice change with the subject. The principles of justice are themselves pluralistic in form (Walzer, 2008). He puts forward a series of subject spheres in his book, such as security and welfare, money and commodities, and office and work. Each of the subject spheres owns its systematic justice principle. And each sphere of justice should not interact with another:

> No social good *x* should be distributed to men and women who possess some other good *y* merely because they possess *y* without regard to the meaning of *x*. (Walzer, 2008, p. 20)

A typical case is that the wealthier should not possess more basic educational/medical resources, which is unfortunately a realistic fact in many countries. Various equality principles in a series of social goods form Walzer's complex equality. By doing so, he refuses the simple egalitarianism, that every kind of social good should distribute equally. The reason for his refusal is that: **egalitarianism distorts our actual reasons for judging distribution injustice** (Cohen, 1986). This refusal seems to mark his theory of justice as opposed to socialism/Marxism. However, the refusal actually derives from his Marxism and socialism advocates and is closely related to his two essential bases.

The two bases of his philosophical advocates are **communitarianism** and the **diversity of values.** Communitarianism argues that the distributive justice rule of social good is based on communities. In other words, how a social good x should distribute, is not owned by a single individual but is formed by the community/membership one person belongs to. Typical communities/memberships include neighborhoods, clubs, and families. Value diversity refers to two-level diversity: the different understandings owned by different communities and the different distributive norms of justice aimed at different objects. The first level is a subjective difference among social groups, while the second level is an objective difference among social goods distribution. For the first level difference, it means how educational/medical resources should be distributed may have divergent understandings according to the socio-economic status of the community. For the second level, it argues that the same community/social group has various distributive norms of social goods.

However, these two bases also constitute two key criticisms of Walzer's theory. Communitarianism faces the gap between individual value and group value. It is quite often that individual interests do not align with his/her community. Similarly, individual value cannot be transferred to the community level. It is contrary to common sense that people share the same opinion of how medical resources should distribute merely because of their same hobby or neighborhood. Value diversity comes up with the problem of unordered pluralism (Cohen, 1986). If we carefully examine Walzer's spheres of justice,

we will find that the diversity in group value and social groups are mixing with each other and forming a giant value matrix. The norm of distributive justice depends not only on the socio-economic status of the community but also on the objects. Egalitarianism distorts groups' understanding of distributive injustice in the way of mandatory unification. On the contrary, Walzer's spheres of justice distorts our understanding of distributive justice in the way of unordered pluralism. Peffer (2014, p. 100) evaluated Walzer's theory as an approach of "radically particularist", which is not very distanced from his daily life. To be more specific, the phrase "radically particularist" refers to the two features of Walzer's justice theory. The word "particularist" aims at his's opinion on human construction as a pluralistic form, which means each item/object owns its particular method of organization and distribution. The word "radically" mainly refers to Walzer's refusal of high philosophical abstraction and the classic Marxism approach to justice.

### 2.3.2 David Harvey: Justice in Spatial Consciousness

If we regard Walzer's spheres of justice as an independent theory distinct from classic Marxism, then David Harvey tried to extend the intrinsic core of Marxism (socialism) into a spatial consciousness. In Harvey's famous book "Social Justice and the City", he first analyzed the main content and limitation of the liberal formulations of social justice and city, then tried to build up the socialist formulations, and finally concluded the methods and theories of ontology and epistemology that revealing the nature of urbanism. At the very beginning of the book, he revealed one critical defect of the liberalist approach of Rawlsian theory:

> John Rawls whose voluminous work on "A Theory of Justice" (1971) contains explicit statements on the nature of distributive justice **without mentioning production**: … chapter 3…recognized that production and distribution are related to each other and efficiency in the one is related to equity in the other…But not until chapter 6 is it accepted that *production is distribution and efficiency is equity in distribution*…The collapse of the distinction between production and distribution, between efficiency and social justice, is part of that general collapse of all dualism of this sort accomplished through accepting Marx's approach and technique of analysis. The evolution that occurs in this essay is from a liberal to a socialist (Marxist) conception of the problem. I move from a predisposition to regard social justice as a matter of eternal justice and morality to regard it as something contingent upon the social processes operating in society as whole (Harvey, 2009, p. 15).

Harvey argues that the plausible relationship between production and distribution, efficiency, and equity within the liberal formulation calls for a socialist (Marxist) formulation.

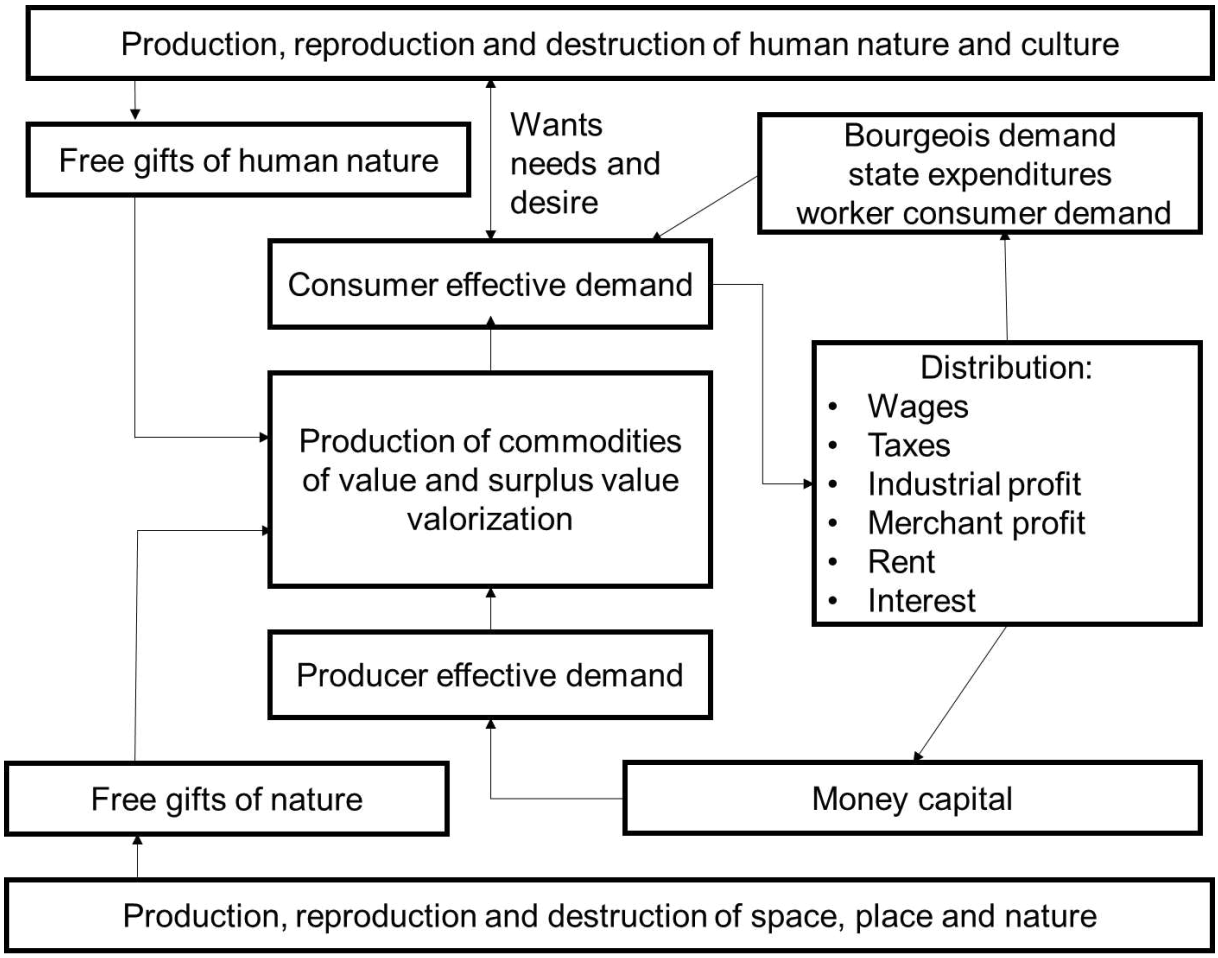



Figure 2.4 A simplified version of capital accumulation (modified from (Harvey, 2020))

In Harvey's socialist formulations, there are two notable features: spatial consciousness and the circulation of surplus and production. The spatial consciousness seems to be a result impacted by Lefebvre's "the Production of Space". The relationship between spatial form and political, social, and economic processes has been a critical discussion issue. The hypothesis seems to be: certain spatial structures will impact the hidden mechanism which controls the (re)distribution of public goods and other resources, and (the spatial structure) will further influence equity and efficiency in the urban system (Harvey, 2009, p. 86). Although this tendency to space determinism might be problematic, this research agrees on the certain relationship between spatial form and (re)distributive mechanism of resources.

The other feature–the circulation of surplus and production–can be regarded as a further development of Marxism theory. Harvey uses a circulation of surplus and production to explain the relationship between political and economic development and urbanism. As Figure 2.4 shows paths of capital accumulation, there are two small circulations with the production of commodities of value and surplus value valorization as the core, including use values, means of production, and labor power. Two kinds of demand–consumer and producer effective demand–support the two small circulations to generate the production, reproduction, and destruction of space nature and human nature. In Harvey's opinion, it is the pursuit of surplus value that creates capitalism,

while the spatial flow of surplus value produces urbanization. Under the market mechanism, the (re)distribution and (re)production of the surplus value cannot be based on the principle of justice (Harvey, 2012). It is vulnerable groups who lack power in the urban structure that are exploited in the circulation of surplus and production, such as females, ethnic minorities, and subcultures. That is why Harvey adopted Lefebvre's right to the city in order to summarize their political needs in urbanization:

> So where does this leave us with respect to Lefebvre's thesis?... The evidence suggests that the forces of urbanization are emerging strongly and moving to dominate the center stage of world history. Urbanization has become global in scope. Urbanization of the countryside is proceeding apace. Created space is replacing effective space (Harvey, 2009, p. 313).

Harvey tried to analyze the structural reason for social injustice and tried to build up socialist formulations to replace the liberal formulations to realize a just territorial distribution (Smith, 1994). Moreover, Harvey's ambitious aim is to transform Marx's ontology and epistemology into the internal dynamic of global urbanization. The (neo)socialist advocate tries to merge the totality of Marxism into the current geographic context. However, Harvey's theory of the socialist formulation of justice and the circulation of surplus and production are theories of the analytic form where between philosophy and spatial planning, which lack definite and practical normative standards for realization of justice in the spatial dimension.

### 2.4 Habermas's Discourse Ethics

Similar to Marx, Habermas has not formed a direct philosophical theory of justice. Different from Marx, Habermas is fully aware of the liberal approach to justice. He has written quite a lot about the gap between John Rawlsian theory and Kantian transcendental philosophy. As Thomas McCarthy wrote: "In his approach to moral theory Habermas is closest to the Kantian tradition (Habermas, 1990, p. vii)." We will find his discussion on many scholars' views who follow the Kantian tradition, such as Kurt Baier, Marcus Singer, John Rawls, Paul Lorenzen, Ernst Tugendhat, and Karl Otto. The closeness to the Kantian tradition is a strong feature of Habermas's moral theory. Furthermore, Habermas wrote the mutual critiques of Kant's and Hegel's thoughts.

Secondly, Habermas put forward a moral concept–discourse ethics–based on his communicative action theory. The famous communicative action theory argues that communicative rationality shapes communication processes, achieves shared understanding and consensus on various issues, and fundamentally forms social relationships (Habermas, 1985). Accordingly, moral consciousness is needed and established in the communicative process, which is called discourse ethics. Discourse ethics and communicative action are interdependent. Discourse ethics are notes on a program of philosophical justification within the communicative action theory (Habermas, 1990, p. 41). In discourse ethics, justice is one ethic among various ethics. It pursues the justice of communicative rationale. Specifically, justice in discourse ethics follows a

procedural approach and calls for equal access to communication in the decision-making process of social activities.

Thirdly, discourse ethics fit the normative rightness and the cognitive structure at the same time. Its Kantian tradition builds up discourse ethics a normative rightness in moral practices. In the meantime, Hegel's thought also played a great role in Habermas's discourse ethics. There is a concept called constructive learning (summarized by Kohlberg) during the communicative process that enables discourse ethics well suited to the description of cognitive structures (Habermas, 1990, p. 120). The constructive learning refers to the transition from a low level to a high level of moral stages, including pre-conventional level, conventional level, and postconventional and principled level. If we take justice as the moral subjective, then the principle of justice in discourse ethics will be a procedural and post-conventional concept. Giri (1998) also located Habermas's theory of discourse ethics in the contemporary movement to moralize institutions and to build a post-conventional moral theory.

Last but not least, Habermas's discourse ethics aim at a universal principle, refuse instrumental reasons, and suggest a hermeneutic dimension of research. The universality refers that in various social and cultural contexts, discourse ethics hold priority over the other moral theory, which is a universal moral principle at the geographical level. The refusal of instrumental reasons and promotion of the hermeneutic dimension are mutual connected:

> Max Horkheimer once pointed out with critical intent, the idea that an instrumental reason restricted to purposive rationality must let its ends be determined by blind emotional attitudes and arbitrary decisions: "Reason is calculative; it can assess truths of fact and mathematical relations but nothing more. In the realm of practice, it can speak only of means. About ends it must be silent." (Habermas, 1990, p. 41)

Therefore, justice in discourse ethics will focus on neither the instrumental reason nor the purposive rationality. Instead, it is a hermeneutic dimension of social research that analyze the ends of certain planning practice, especially contextual, cultural, and historical factors. This study follows the above description to a certain extent. In the beginning, it carries out a calculative analysis of how basic resources distribute and what are the different statuses of residents. Then, it is the hermeneutic analysis of the planning process that various justice philosophies have been reflected or partly implemented. One difference is that we do not focus on one universal principle of justice. Instead, the study tries to figure out which principles of justice, such as substantive or procedural principles, discourse ethics, or instrumental utilitarianism, have been implemented.

## 2.5 Recognition Justice

If we regard utilitarianism and liberalism as justice following Kantian philosophy, then the recognition justice is a typical cognitive approach to justice. Distinct from the

normative approach, the recognition justice focuses on the relation of balance between individuals and society, especially feminism, marginalized groups, and homosexuality. Due to its focus on multiple social groups, the recognition justice owns many subdivisions that vary by type of social group. However, it is hard to transfer one specific social group–either female or homosexual group– into the spatial dimension. Since this study takes the planning practice of the shared ownership housing in Shanghai as a case study, this section tends to focus on the role of general social groups in recognition justice instead of one specific social group, such as feminist thought, in recognition justice.

Although sharing the same theoretical basis, scholars in recognition justice offer diverse opinions on the conceptual framework for recognition justice. Three of the most influential theorists in the field of recognition justice, i.e., Iris Marion Young, Nancy Fraser, and Axel Honneth, hold different perspectives. Starting from the identity model which transposes the Hegelian recognition schema (Fraser, 2000), Iris Marion Young argues that recognition is a political matter which forms the social structures and institutions and identifies five types of oppression (Young, 2011). Nancy Fraser built up a three-dimension justice theory, which consists of redistribution (economic), recognition (cultural), and representation (political) (Fraser, 2005; Fraser & Honneth, 2003). Alex Honneth identifies three essential types of recognition for human flourishing: love, rights, and solidarity (Honneth, 2004a). Furthermore, Honneth puts forward a plural concept of social justice, including three principles of love, equality, and merit (Honneth, 2004b). While Nancy Fraser understands recognition with a focus on social participation, Honneth put more effort into mutual recognition. He argues that love, respect, and social esteem are three different kinds of recognition which are important components of personal autonomy (Van Leeuwen, 2007). In Honneth's view, social justice is not the distribution of human dignity or social participation, but a way to respect individual differences and personal identity. Regarding the research objective, this study put focuses on the theories of Iris Marion Young and Nancy Fraser. Because these two theories show a closer linkage to spatial planning and can be further transferred into the concept of spatial justice.

### 2.5.1 Iris Marion Young's Politics of Difference

In her famous book "The Politics of Difference", Iris Marion Young discussed the differences between social groups and how these differences affect power, justice, and social relation. If we regard Fraser's three-dimension justice theory as a complete justice theory that can replace the distributive paradigm, then Young's aim is not to build up a complete justice theory but to criticize some tenets of justice theory (Young, 2011, p. 15). instead of replacing distributive justice, Iris Marion Young aims at displacing the idea of the "politics of difference" in the discussion of justice theory. Compared to the other scholars, there are three features of her critical theory: a paradigm shifts from distributive justice, the importance of difference in the public realm, and the continuation of Marxist thoughts.

Firstly, Young promotes a paradigm shift from distributive justice to recognition justice. She pointed out several problems of the distributive paradigm. She argues that the transformation of distributive justice from material to non-material level cannot stand for justice legitimation, such as the distribution of rights, opportunities, and dignity. The distributive paradigm cannot reveal the hiding social structure and institutions that cause the distributive patterns. The social capital, institution, and power within the decision-making process and culture of certain collective activities are invisible in distributive justice. In the meantime, these social issues could be the key factors that cause social injustice. On one hand, the distributive paradigm hides these key issues, which makes it difficult to identify how and why injustice is produced. On the other hand, the power in decision-making and its hindered social relationships cannot be distributed. For example, the distributive paradigm cannot distinguish the labor relation in which someone occupied the fruits of the others' labor.

Secondly, Young criticizes that a common underlying hypothesis in many philosophies is a homogeneous public realm. A homogeneous public assumes that the entire society has a universal interest, such as demand for economic development. This universality hides the heterogeneous groups and suppresses their interests and needs. In Young's view, the homogeneous public is a shared limit in philosophies and modernization:

> While I follow Habermas's account of advanced capitalism and his general notion of communicative ethics, for example, I nevertheless criticize his implicit commitment to a homogeneous public (Young, 2011, p. 15).
>
> Rousseau conceived this public realm as unified and homogeneous, and indeed suggested (Young, 2011, p. 109).
>
> Hegel's political philosophy provides the most thorough and explicit account of the state as expressing impartiality and universality as against the particularity of desire and interest (Young, 2011, p. 113).
>
> 'The gaze of modern scientific reason, moreover, is a normalizing gaze (Foucault, 1977; West, 1982).' (Young, 2011, p. 125)

Young emphasizes that the public is heterogeneous. The illusion of a homogeneous public is at the cost of the oppression of various social groups. More specifically, Young does not only refers to female, but all the social groups under oppression, including "Blacks, Chicanos, Puerto Ricans and other Spanish-speaking Americans, American Indians, Jews, lesbians, gay men, Arabs, Asians, old people, working-class people, and the physically and mentally disabled (Young, 2011, p. 40)". Although Young's examples of oppressed social groups are in the typical American context, the particularity of marginalized groups' various interests and needs is ignored globally. As long as moral reason seeks a universal judgement of justice, it is evitable to reduce differences in social groups and conduct a normalization process. The pursuit of a generalized interest is incompatible with the distinct interests and needs of different social groups. Moreover, these differences in social groups are not an objective concept. They

change their identities and features from country to country, from time to time. It is the social relations and interactions that build up the identification of social groups, even if the oppressed group member cannot realize this fact.

Table 2.9 Five types of oppression and according affirmative action in planning (adapted from Harvey (1992), Young (2011), and Zhou et al. (2019))

| Five types of oppression | Explanation | Affirmative action in planning |
|---|---|---|
| Exploitation | Encroachment on the fruits of labor | Labor exploitation must be minimized in the workplace and in the place of life by structuring social and political organization or production/distribution systems |
| Marginalization | Marginal people abandoned by the production system | Marginalization must be confronted in a non-paternalistic stance and ways to influence it within the existing politics of marginalization must be found to ultimately liberate those trapped within this type of oppression |
| Powerlessness | Without political discourse, rights cannot be expressed | The oppressed must be empowered and empowered to express themselves |
| Culture imperialism | Minority groups ignored by the mainstream values of society are labelled by stereotypes and marked as heterogeneous | Must be extremely sensitive to cultural hegemony and dismantle hegemonic attitudes in urban program design and public consultation through various methods |
| Violence | Social violence, organized crime, evictions, forced demolition, etc. | Non-exclusive, demilitarized forms of social control must be sought to limit rising individual and institutional violence without destroying empowerment and self-expression |

Thirdly, Young recognizes “oppression” as a structured concept, which is a powerful continuation of Marxist thoughts. The Marxist idea of class reveals the exploitation in social institutions. Young further concretizes the exploitation into different types of oppression. The Marxist criticism has been visualized and able to be analyzed and Table 2.9 shows the five types of oppression and their corresponding affirmative action in planning: exploitation, marginalization, powerlessness, culture imperialism, and violence. The oppressions are not designed for purpose but exist in daily life in a subtle way, which helps build up a cultural background that identifies different social groups. Social groups recognize their self not only through self-awareness but also their role in collective actions, in which oppression has amorphous forms. Different social groups

are faced with different types of oppression. Therefore, oppression has been part of social relations and institutions, named as part of social structure.

The structural disadvantages caused by oppression must involve collective action to transform social systems and create more just social arrangements (Young, 2010). Young argues that oppression in social structure reflects historical patterns of discrimination and exploitation. Young offers a critique of conventional liberal ideas about the responsibility that concentrates exclusively on individual actions and decisions, contending that they overlook the influence of social structures on individual possibilities and results. The responsibility for structural oppression should extend beyond individual actions and takes the form of collective actions.

### 2.5.2 Nancy Fraser's Recognition Justice

Nancy Fraser's recognition justice seems more ambitious than Young's and seeks to achieve a paradigm shift from redistribution to recognition (Fraser & Honneth, 2003). She first promoted the recognition paradigm in order to reveal the importance of social groups' identification in social justice. The identification of social groups includes not only the class in Marxism but also marginalized social groups, such as racial-ethnic and gender injustice (Fraser, 2013). She argues that "redistribution" and "recognition" refer to *a folk paradigm of justice* that lies in everyday life. The folk paradigm involves historical and persistent discrimination against marginalized groups, in the sense of cultural and economic background. The folk paradigm hides the injures of marginalized groups for being unidentified in society. Therefore, the participation of different social groups in collective actions has been an important affirmative action to the historical injustice.

Fraser's theory of recognition justice in continuous improvement. After the folk paradigm of justice, Fraser (2009) further builds up a three-scales theory of justice: redistribution, recognition, and representation. Smaal et al. (2021) summarize three dimensions in her theory (Figure 2.5): economic redistribution (equal share), cultural recognition (equal respect), and political representation (equal say). While the following three dimensions seem to build a systematic recognition theory of justice, it is important to realize a redistribution-recognition dilemma.

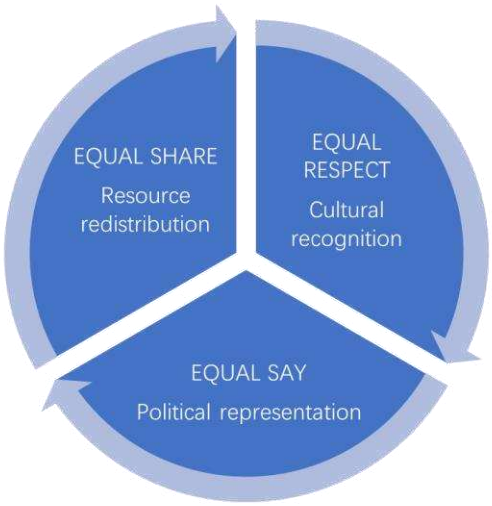



Figure 2.5 Visual representation of Fraser's three justice dimensions (modified from (Smaal et al., 2021))

The redistribution-recognition dilemma (Fraser, 2014, p. 23) refers to the conflicting goals led by the redistribution and recognition paradigms. Since the redistribution paradigm focuses on how resources distribute, then it encourages equality of resource occupation in a hidden way. The hidden premise of the redistribution paradigm is that one can acquire enough good life quality when she/he has enough good resources. Then there is a tendency to ignore the individual difference in the redistribution paradigm. On the contrary, the recognition paradigm emphasizes the identical characteristics of certain individuals and social groups. Only when one owns her/his specific identity, her/his human dignity could be recognized in social activity. Therefore, the hidden premise of the recognition paradigm is to visualize the individual difference.

To solve the redistribution-recognition dilemma, Fraser put forward the concepts of affirmation and transformation as two different solutions to correct injustice. The affirmation refers to keeping the difference in social groups and evaluating their historical marginalization. The transformation refers to decreasing the difference in social groups in order to correct unfair outcomes. For example, the affirmation of discrimination against homosexuals is to affirm their identity by granting homosexuals the same rights as heterosexuals. The method of transformation is to shake the fixed gender identity and create more possibilities by breaking the binary opposition between homosexuality and heterosexuality. Fraser further mixes these two solutions in redistribution and recognition paradigms (see Table 2.10). In Fraser's view, the affirmation of redistribution occurs in the liberal welfare state and transformation in redistribution is a typical case of socialism. The affirmation in recognition leads to multiculturalism, while the transformation in recognition leads to deconstruction.

Table 2.10 A four-celled matrix to distinguish affirmation and transformation in redistribution and recognition paradigms (Fraser, 2014, p. 27)

| | Affirmation | Transformation |
|---|---|---|
| Redistribution | *The liberal welfare states*<br>Surface reallocations of existing goods to existing groups; supports group differentiation; can generate misrecognition | *Socialism*<br>Deep restricting of relations of production; blurs group differentiation; can help remedy some forms of misrecognition |
| Recognition | *Mainstream multiculturalism*<br>Surface reallocations of respect to existing identifies of existing groups; supports group differentiations | *Deconstruction*<br>Deep restructuring of relations of recognition; destabilizes group differentiation |

Like John Rawls, Nancy Fraser has faced critiques mostly not from external theories and theorists inside the recognition justice. For example, Young (2011) criticized that Fraser's view tends to simplify the feminist struggles as a prevailing issue in economic development. Honneth criticizes the unbalanced relationship between recognition and redistribution and the lack of a broader structural relationship in her theoretical framework (Baptista, 2020; Honneth, 2004a). Other critiques of her theory include the overemphasis on cultural recognition, the potential for fragmentation, and a multiculturalist tendency toward deconstruction by recognition shifts. However, these criticisms discuss the detailed issues within recognition justice instead of the legitimacy of recognition justice.

## 2.6 Conclusion

Table 2.11 summarizes the comparison between the above key justice theories in this study, including the definition of justice, strength, critical reflection, and the relevance to spatial justice. We could see a great variety of these theories, especially the definitions of justice and their relevance to spatial justice. Classic utilitarianism, classic intuitionism, and Rawls's egalitarian liberalism tend to focus on substantive justice, including utility and social goods. They are relatively close related to spatial justice, in the form of spatial equity, as in the spatial distribution of utility and goods. They have different standards of spatial equity as justice, such as the maximum of the average or overall spatial equity of social goods in classic utilitarianism. And Rawls's egalitarian liberalism takes the greatest benefits of the least advantaged as the benchmark. On the contrary, Nozick's entitlement theory and Habermas's discourse ethics tend to procedural justice, which further leads to the justice issue in the planning process. In addition to substantive-procedural justice dualism, there are justice theories with their own claims and characteristics. Sen's capability approach takes the maximum individual capability as the standard of justice, which is then difficult to transfer the individual

attribution into a spatial reflection. Similarly, the circulation of surplus (re)production in David Harvey and five types of oppression seem also hard to find their corresponding spatial reflection.

Table 2.11 The comparison between the key justice theories in this study

| Philosophy of justice | Definition of justice | Theoretical advantage | Critical reflection | Relevance to spatial justice |
|---|---|---|---|---|
| Classic utilitarianism | The maximum of average/overall utility | Theoretical rigor, support for liberty | Subjectivity of utility; "Man as an end, not a means."<br>Lack value diversity | Spatial equity: the maximum of average/overall utility |
| Classic intuitionism | The most goods for the greatest satisfaction/distribute satisfactions equally/… | Value diversity | Lack theoretical rigor | Spatial equity: the most goods for the greatest satisfactions/ equally distribute... |
| Sen's Capability Approach | Maximum individual capability | Bridge institutionalism and actual societies instead of a perfect state of justice | an incomplete ethical theory for its limited focus on individual capability | Gap between spatial reflection and individual capability |
| Rawls's egalitarian liberalism | Equality of liberty; the greatest benefit of the least advantaged | Theoretical rigor<br>value variety in liberalism | The uncertain, dynamic, and unpredictable close-knitness (welfare distribution)<br>The patterned principle<br>The just saving principle | Substantive justice: spatial equity of resources and goods aiming at the greatest benefits of the least advantaged as the benchmark |
| Nozick's entitlement theory | Four entitlement principles based on Labor Theory | Unpatterned principle | The gap between the borders of labor and acquisition entitlement<br>the rightful sovereignty of each individual liberty has been doubted | Procedural justice<br>Planning process of justice in acquisition, transfer, and rectification |
| Walzer's spheres of justice | Each social good owns its distributive norms of justice | Communitarianism and the diversity of values | The gap between individual value and group value<br>unordered pluralism | Each social good has its own spatial reflection of its distributive norms of justice |
| David Harvey | socialist formulations to realize a just territorial distribution | Spatial consciousness; The circulation of surplus (re)production, and destruction of space nature, and human nature | Lack definite and practical normative standards | The relationship between spatial form and political, social, and economic processes |
| Habermas's Discourse Ethics | equal access to communication in the decision-making process of social activities | based on the communicative action theory<br>hermeneutic dimension of the social research | No focus on instrumental reason or purposive rationality | Hermeneutic analysis of communication in planning, especially contextual, cultural, and historical factors. |
| Iris Marion Young's recognition justice | Politics of difference in justice | The public is heterogeneous | Not a holistic justice theory | Five types of oppression and according to affirmative action in planning |
| Nancy Fraser's recognition justice | Equal share of economic redistribution, equal respect of cultural recognition, and equal say of political representation | Affirmation and transformation as two solutions to the redistribution-recognition dilemma | Simplify the feminist struggles<br>unbalanced relationship between | Affirmation and transformation in redistribution and recognition paradigms |

recognition and redistribution

However, the spatial equity of resource distribution occurs frequently in the relevance to spatial justice of different justice theories. More than half of the key justice theories mentioned the issue of resource distribution. Classic utilitarianism, classic intuitionism, and Rawls's theory are three theories that prioritize the issue of resource distribution with different normative standards. Walzer's theory tries to discover each social good its own spatial reflection of its distributive norms of justice. Fraser's three-scales theory of justice includes the equal share of economic distribution as one essential pillar. Although there are various concepts important, spatial equity is an indispensable concept in the relevance to spatial justice of the justice theories. Therefore, spatial equity of social goods in certain spatial areas is an essential content in the analysis of spatial justice.

Furthermore, there tends to be a dialectical relation between the theoretical advantage and critical reflection of these key justice theories. Classic utilitarianism holds the subjectivity of utility, which forms its theoretical rigor as well as the lack of value diversity. Classic intuitionism holds value diversity and inevitably lacks theoretical rigor. As Walzer emphasizes the different distributive norms of justice of each social good, his theory has to be confronted with the difficulty in ordering those plural distributive norms, which is also its critical reflection. Sen's theory focuses on the development of individual capabilities which is confronted with the collective problem of individual capabilities. Habermas's discourse ethics refuse instrumental rations and relate spatial justice in the form of hermeneutic analysis of communication in planning, which emphasizes especially contextual, cultural, and historical factors. This tendency to cultural impacts cannot avoid the refusal of the instrumental reason or the purposive rationality.

# 3 The Theoretical Framework for Spatial Justice

## 3.1 The Research Question of Spatial Justice

This section tries to build up a theoretical framework for spatial justice based on justice philosophies in the planning discipline. Current studies focus more on the distribution of tangible factors, such as public goods and demographical factors (Barbieri et al., 2019; Maroko et al., 2009), while the spirit of justice philosophy and spatial features has been neglected (Israel & Frenkel, 2018; Williams, 2018). The main aim here is to construct the bridge between justice philosophies and spatial planning. Three critical questions were raised:

- Why should we consider justice in a spatial dimension? In other word, why is spatial justice important?
- What is spatial justice? What is the difference between the definition of spatial justice and the other related concepts, such as distributive justice or spatial equity?
- How to transfer the justice philosophy to planning?

The following sections try to answer above questions accordingly.

## 3.2 Spatial Dimension in Justice Theories

### 3.2.1 Spatiality as an Inherent Element of Justice Theories

Looking at the theories of justice, we will find that spatial dimension is inherent and essential in the philosophy of justice. The necessity of spatial justice stems from that spatiality is the inherent element of justice theories. First of all, the spatiality in justice theories originates from the primordiality of space itself. The primordiality of space is structured by a set of spatial systems: physical space as a foundation, social space as a mixture of reflection, and mental space as a tool of consciousness. Physical space acts as a container for natural and socio-economic activities. Cartesian's absolute space, which makes mathematics calculation of reality possible, could be seen as an abstraction of physical space. Lefebvre's social space reflects social relations and social practices. In this way, the past and ongoing social formations are fixed and consolidated in typical and various spaces. In Hegelian's words, the rationality immanent to space solidifies time. Furthermore, Kantian space is among an *a priori* realm of epistemology, which is a relative tool to gain knowledge and recognize the world. Space and time, which are two forms of intuition and independent of experience, constitute *a priori* knowledge. Nietzsche maintained the primordiality of space, in which absolute space as the substratum of force and limits and forms come latter (Kaufmann & Hollingdale, 1968, p. 293). To be more specific, spatiality exists in the philosophy of Kant, Hegel, and Nietzsche. This primordiality of space, along with time, exists not only in the most superficial daily life but also in the basis of human consciousness.

The primordiality of space leads to the primary spatial dimension of justice philosophies. There are numerous philosophical schools and debates about the conception

of justice. Smith (1994) provides a list of mainstream justice philosophical schools, including egalitarianism, utilitarianism, libertarianism, contractarianism, Marxism, communitarianism, and feminism. Although each of them has distinct advocates and focuses, they all share a spatial dimension as an inherent characteristic, which is a precious feature in the few commonalities of justice philosophy schools. On one hand, it is the mental space, as well as its position in a priori, that constructs its priority in justice philosophy. One example is Rawls's Original Position, which is a spatial representation that grounds his theory of justice (Williams, 2018, p. 13). Similarly, Chomsky suggests that orientation and symmetry are the characteristics of mental space (Lefebvre, 1992, p. 5). Concepts with spatial representations, like horizontal and vertical comparison in the capability approach, frequently show up in the justice philosophies. On the other hand, it is the intrinsic nature of justice supports its spatiality.

### 3.2.2 Space as an External Representation of Justice

David Harvey's social space argues that space reflects the social relation and production process behind it. Going a step forward, the justice philosophy embedded in various social relations is also recorded in the spatial dimension. In this study, social spaces reflect not only social relations but also the justice theory implemented. Due to the mapping relationship, the social space embodies what kind of justice philosophy is being pursued. Theories of justice implemented in social space can be deeply hidden. Social relations and production in social space may have a relatively clear form, such as social intuitions and policies, while a justice theory in social space is embodies in the way social intuitions and policies are organized and implemented.

There is a massive diversity in principles, approaches, and conceptualizations in justice theories, and their unique characteristics may lead to further different space forms. The justice theories listed in this study are only some of the mainstreams and related to the subject of this study, and they have been quite different. Each justice theory holds its own propositions and characteristics. The definitions and realization of justice have greater diversity, whereas its spatial dimension could provide certainty and form to a certain extent. The objectivity of space, albeit cruel and indifferent, reflects social production and relations. What kind of justice principles are incorporated into social practices; these principles often have a distinct spatial form in reality. For example, communities built in the 1950s in China have similarities in architectural form throughout the country, because justice was considered as the absolute equality of residential conditions and also impacted by the limited production of material. Once social practices form a certain range of space, their spatial uniqueness has been determined. The uniqueness includes the location, the ecology and biology, the form of construction, and the hidden social production. The tangible space, unless changed by another force, owns its characteristic and cannot be overlaid or mixed. Compared to the 'many faces' of justices, the certainty and form of space do not only play a role as practical evaluation dimensions of justice but also as a reliable way to explore the conception of justice. For example, the apartheid struggle and the institutionalized racial segregation in South Africa have their external spatial representation.

Space can reveal the limit, certainty, and form of justice philosophy. The demand for spatial justice unfolds a monadology of the particular body, an irreplaceability of position, and an impossibility of sharing the same space at the same time (Philippopoulos-Mihalopoulos, 2011). Despite the university and generality of justice, the conception of justice is based on limits. A typical example is the second principle of John Rawls's theory (1971): " Social and economic inequalities are to be arranged so that they are both to the greatest benefit of the least advantaged, and..." When we think of the least advantaged, it is unavoidable that there must be a certain group of people and a certain limit of conditions in the discussion. Feminism is about justice within the limited focus of masculinity and femininity, in other words, the realm of sexuality. Entitlement theory, although with a bottom-up approach, defines the legal way of people's entitlement; it implies a certain spatial limitation of the human being's entitlement. Since physical space is irreplaceable, its specific spatial justice is also irreplaceable. The physical space effectively limits the scope of justice discussion, which is a prerequisite for productive discussion.

## 3.3 Social Justice in Urban Planning

### 3.3.1 Justice-Related Concepts in Planning

The spatial dimension of social justice has gained proliferated attention in planning, philosophy, and geography (Harvey, 2009; Schlosberg, 2009; Smith, 1994). Scholars have endeavored to explore the spatial dimension of justice and developed a series of concepts such as environmental justice, spatial justice, spatial equity, and distributive justice (Dobson, 1998; Kunzmann, 1998; Soja, 2013; Wenz, 1988). Figure 3.1 shows the two-level differences in these justice-related concepts.

The first level is the difference between subjects, that is, the spatial entities. For example, environmental justice focuses on the ecological environment with a tendency to nature (Agyeman, 2014), while spatial justice takes the spatial relations of things as a subject (Soja, 2013) and distributive justice emphasizes the abstract distribution of things under the framework of justice philosophies (Pereira et al., 2016). This subject difference deals with the matter of what kind of content is just and fair. The difference in content lead to divergent focuses on justice principles, which is the second level of difference. To be specific, social justice may focus on substantive justice and procedural justice in social institutions and groups (Rawls, 1971). Distributive justice may argue the ideal just distribution form of social goods (Varian, 1975). Spatial equity mainly refers to the just equal access to basic public facilities, which is measured in distances, accessibility, or proximity (Kunzmann, 1998; Talen & Anselin, 1998). Environmental justice has a focus on equal protection and ecological benefits and burdens (Mohai et al., 2009; Schlosberg, 2009). Spatial justice is rather vague, which could refer to the physical moving of human bodies (Philippopoulos-Mihalopoulos, 2014) and also the geographical reflection of social justice (Soja, 2013). We could also find that social justice and distributive justice are abstract philosophical theories, while spatial justice and environmental justice are relatively concrete with a focus on spatiality.

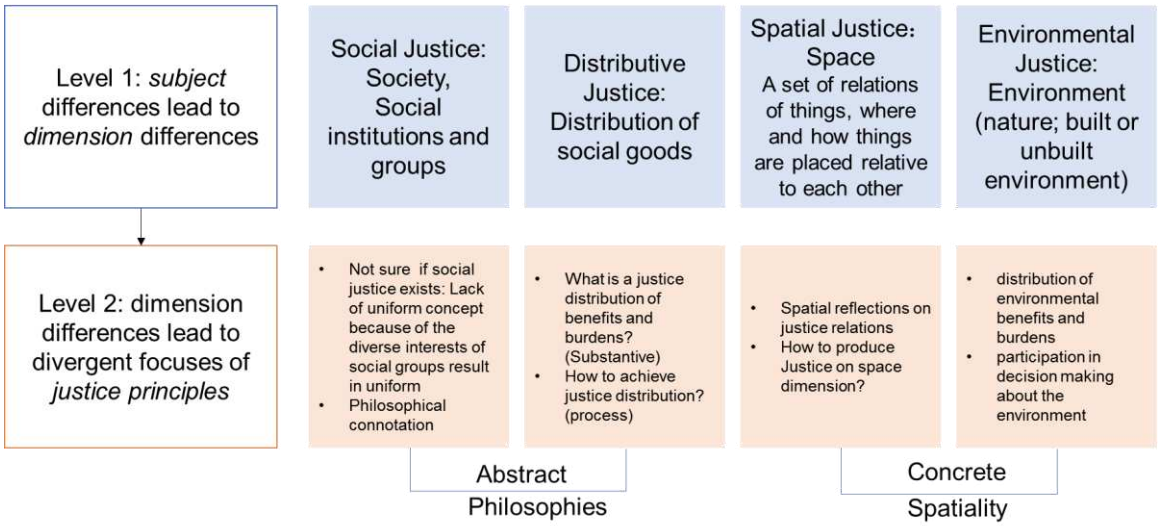



Figure 3.1 The two-level differences in the justice related concepts

These notions have blurry research boundaries, as a result of an interfolding etymology. The normative peculiarity of each above notion is hard to distinguish, which is affected by the complexities of justice philosophies. If we look into the normative standards of these notions, we will find a surprising missing of spatiality. As the sentence, spatial justice is afraid of space (Williams, 2018). This fear of space does not exist only in spatial justice but is shared by notions about the spatial dimension of justice. The critical questions, of why space should be considered and what is within the spatiality of justice, lack certain theoretical analysis and remain unsolved in the level of justice philosophy. In the series of related notions, there is conceptual vagueness and analytical poverty in the arguments for the necessity of spatiality in justice (Williams, 2018). This typical construction, in which the type of spatial entity is followed by the related concept of justice, leads to two-level differences among their conceptions (Figure 3.1).

### 3.3.2 Empirical Studies: From Territorial Justice to Spatial Justice

If we take a look at empirical studies of social justice in urban planning, we will find there has been an evolving conceptual development since the 1980s. Despite the comprehensive theoretical research of equity, justice, and fairness, the concept in the practice of assessing the spatial dimension of social justice seems to be far more straightforward. There are four stages in concept development, territorial justice, location equity, spatial equity, and spatial justice (Smith, 1994), as Figure 3.2 shows.

From the 1980s to the 1990s, with the rise of geographic analysis technology, related research focus on how to describe the locational distribution of certain public facilities, that is, locational equity. During this period, there is a simplification of geographic calculation in presenting equity. In the early 1980s, equity assessment included the use of the facility (the frequency and duration of the facility use), users' willingness to pay (Lucy, 1981), market, demand, and need (Wicks & Crompton, 1986). Afterward, place-based analysis, how the public facility (e.g., park, primary school, and hospital) distributes and how to measure and present the geographical distribution, along with detailed

calculation methods of accessibility (Talen & Anselin, 1998) has become a research hotspot. Small-scale analyses (a neighborhood or community as a spatial analysis unit), precise digital calculations, and visualization results could be regarded as an improvement over the previous period.

In the late 1990s, place-based locational equity was criticized for neglecting how people use the facility, and spatial equity taking human factors into account has become the research focus. Accessibility is no longer the geographical distance of users to facilities, but it is added various attributes, such as how much money and how long time it takes for people to use the facility, what kind of transportation people use, and the opportunity for different social groups to get the access of the facility (Cho et al., 2003), using geographically weighted regression (GWR) approach to describe the inequity of objectives. Moreover, affected by communicative planning theory, the planning process, in other words, procedural justice has also been discussed (Pastor Jr et al., 2006). Spatial equity here connects social equality with space entity and reflects social fairness and justice in the space arrangement. It put emphasis on the social attributes of space, that is, the attribution of people and how people act in the space. The trend of underlining human factors has also led to attention on social groups, especially vulnerable groups (Miranda & Tunyavong, 1994). The principle of equity is no longer the equal amount of everyone or every unit, but taking the differences in use requirements, accessibility, and constraints of different groups into account. The equity analysis is based on different social groups, as well as different locations. Therefore, spatial equity is more targeted to people.

The concept of spatial justice was raised around 2010. Marcuse (2009) identified two forms of space injustice the unfreedom argument and the unfair resources argument. The former refers to segregation and ghettoization, while the latter refers to unjust resource allocation. Soja (2013) contends that justice possesses a spatial dimension and that the fair distribution of resources, goods, and opportunities is a fundamental human right. Madanipour et al. (2021) implemented the concept of spatial justice to examine the European Union policy. Spatial justice represents a closer relationship to the philosophy of justice than previous concepts. Its theoretical content is more concerned with the definition and role of justice theories, the planning process, and the institutional and cultural background.

When it comes to the analysis method reflecting injustice, it seems to be a simplification of the conceptual level. In the 1970s and 1980s, influenced by the idea of equal distribution, the per capita amount of public service or resources is used as the core indicator to reflect regional inequality, including low-income population and the amount of playground per neighborhood (McLafferty, 1982; Rich, 1979; Stilwell, 1989) Later, accessibility replaced it, which means not only the different calculation of geographical distance (Talen & Anselin, 1998), but also social attributions, for example, mismatch of population demand (need) and population (Dadashpoor et al., 2016). The analysis of spatial justice involves not only accessibility but also the planning process as an important aspect.

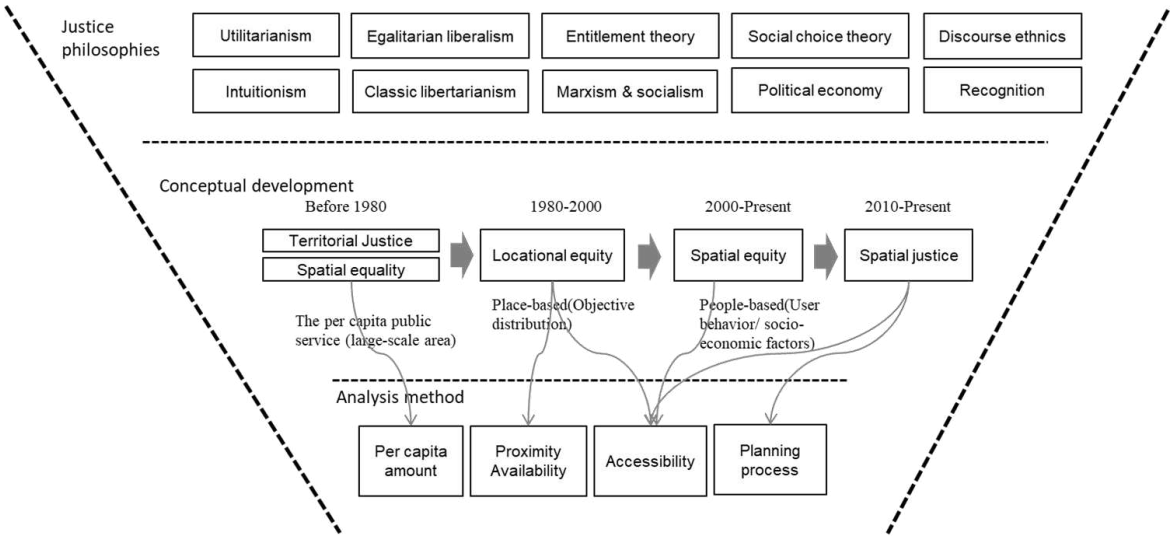



Figure 3.2 Theoretical, conceptual and data development of fairness and justice studies

As shown in Figure 3.2, there are simplifications and abstractions from the justice theory level to the analysis method level. Although terms such as equality, equity, justice, and fairness are meaningful in political and philosophical theory, it is difficult to transfer the meanings into analysis methods. It cannot be denied that in early studies, accessibility is not the only indicator to reflect spatial equity, other indicators such as the frequency, duration, and the social impacts of the facility utility (Lucy, 1981; Massey & Denton, 1988) have been considered. However, those metrics with various social attributions seem to be hard to be transferred into visualization. Chapter 4 discusses proper measurement of indicators in more detail.

### 3.3.3 Assessing Spatial Equity

In various empirical studies of assessing the fair distribution of resources, spatial equity has been a critical concept with various subjects and methods. Table 3.1 summarizes subject and assessment measures of spatial equity. Based on different subjects, spatial equity assessment measures are various. The Subjects of spatial equity can be divided into three categories: region/city/district, urban service delivery, and common resources. The first type “region/city/district” means to take a comprehensive spatial entity as subject and does not focus on equity issue of certain aspect but aims to access the overall spatial structure of inequity. From the overall structure perspective, the visualization of inequity in a region/ city/ district is presented generally (Kunzmann, 1998), using socio-economic statistics as indicators to present inequity (Massey & Denton, 1988; Stilwell, 1989).

The second type “urban service delivery” focuses on various public services and how they distribute in a certain research area, using geographical analysis. According to divergent subjects, it could be divided into two groups: public facility distribution and public transportation. The assessment of the spatial equity of various urban service deliveries can be divided into two general analysis approaches: 1) the assessment of

accessibility (Talen, 2001; Talen & Anselin, 1998) including the facility supply and population demand (Dadashpoor et al., 2016; Omer, 2006; Smoyer-Tomic et al., 2004); 2) the specific social issues regarding accessibility. The social issues show a great extent of diversity, such as community opportunity (Wang & Chen, 2015), integrated spatial equity of community (Tsou et al., 2005), the social impacts and efficiency (Di Ciommo & Lucas, 2014; Manaugh et al., 2015; Monzón et al., 2013; Welch & Mishra, 2013). Related to this study, Xiao et al. (2017) also took Shanghai as a case study and compare the park access of the welfare housing residents.

The third type "natural resource" refers to the management of environmental sources distribution, which is mainly discussed in the theme of environmental justice (Karkazis & Boffey, 1997; Shah et al., 2016). Its research approaches include not only quantitative analyses but also qualitative analyses. For example, the institutional approach is used to study the self-governance of "common-pool resource (CPR)" (Gardner et al., 1990); Karkazis and Boffey (1997) find out that the distribution of urban population makes little influence on the environmental cost; Bowen et al. (1995) analyzes the association between race, income and toxic emissions.

Table 3.1 Classification of subject and assessment measures of spatial equity

| Subject | | Assessment measures | |
|---|---|---|---|
| | | Main Indicators | Approaches |
| Region / City /District | | Socio-economic statistics (population/employment/ finance/housing/…) | Spatial distribution/ list of related data |
| Urban service delivery | Public service facility (Playground/ School/ park/ health care facility/…) | Accessibility | Supply and demand analysis |
| | Public Transportation (Road network/ BRT system/High-speed rail /…) | Accessibility | Spatial distribution of accessibility values / "Do-nothing" comparative study |
| Natural resource | | TRI （Toxics Release Inventory facility） and emissions/… | Geographically weighted regression / Case study/ Institutional analysis |

### 3.3.4 Social Justice and Social Sustainability

Social justice and social sustainability are two fundamental concepts that shared a temporal dimension and a broad universality (Arrow, 1973a). As social sustainability focuses on the equitable development interest of future generations (Hiedanpää et al., 2012), social justice includes inter- and intragenerational equity as core components (Golub et al.). However, whether these shared similarities can lead to a conceptual causality remains uncertain. To explore their relationship, it is integral to understand the conception of social sustainability.

Despite various frameworks, there are two ways of interpreting the term 'social' in social sustainability. One way is to take it as a noun, which defines the subject within the society. For example, Dempsey et al. (2011) argue that social sustainability should be considered a dynamic concept and should include social equity, sustainability of the community, and participation in collective groups and networks in the community. Dempsey et al. (2012) evaluate the influence of density on social sustainability through access to amenities and residents' perceptions of the community. Woodcraft (2012) develops four dimensions of social sustainability regarding neighborhood development, which include amenities and infrastructure, social and cultural life, voice and influence, and change in the neighborhood. Similarly, Pitarch-Garrido (2018) proposes an indicator to assess accessibility and equity as the basis of social sustainability.

The other way is to take “social” as an adjective, which describes the social attribute, dimension, and reflections in sustainable development. There is a focus on the linkage between society and the eco-physical system. Vallance et al. (2011) define a threefold concept consisting of development (equity and justice), bridge (between people and eco-physical environment), and maintenance (preservation practices) of social sustainability. Eizenberg and Jabareen (2017) involve urban forms, equity, safety, and eco-presumption in their conceptual framework for social sustainability. Although the connection between the ecological system and society remains significant, this study follows the former way and focuses on the sustainability of society. How to manage a sustainable society seems intricate enough, and the links between the three pillars (economic, ecological, and social sustainability) may be a higher level of analysis to achieve overall sustainable development.

Similar to “social”, the meaning of “sustainability”, which is the other keyword in social sustainability, contains analogous conceptual complexity. Briassoulis (2001) lists indicators in planning for sustainable development with an emphasis on population growth and living conditions. This implies that in a sense, sustainability is equivalent to development and growth. Another discourse takes risk into count (Eizenberg & Jabareen, 2017), such as the aging society, which is similar to the 'survival' meaning in the term 'resilience' (Davoudi et al., 2012). Vallance et al. (2011) criticize that Weingaertner and Moberg (2014) take sustainability simply as to “generate desirable outcomes for all, all of the time”. This complexity of social sustainability limits its application in practical management (Omann & Spangenberg, 2002) and leaves it fragmented (Weingaertner & Moberg, 2014).

Nevertheless, equity and justice are common concepts in various interpretations of social sustainability. This may derive from the essence position of justice in sustainable development. Campbell (1996) has social justice among the three key goals in the "'planners' triangle" to achieve sustainable development. The problem is whether justice is an objective to define the kind of society we want to sustain (Boström, 2012) or is an approach to promoting social sustainability.

As stated in Chapter 2, there are multiple philosophical theories of justice, i.e., Utilitarianism, intuitionism, liberalism, Marxism, (neo)socialism, and recognition justice. Despite the many schools of thought and debates, the intertemporally of justice has been a consensual feature and core constitution in diverse theoretical systems. Rawls (1971) developed a just savings principle to maintain justice across generations regarding material capital, which later was questioned by Arrow (1973a); (Arrow, 1973b) from the perspective of welfare economics. The entitlement theory sets up the principle of rectification to deal with historical injustice (Nozick, 1974). Historical factors can also pose a threat to the capability approach. In Sen's example, what if Anne, the only person who has learned how to play the flute, already owns more than ten flutes? This temporal dimension of justice, considering both history and the future, has led to genuine academic discussions (Davis, 1976; Goldman, 1976; Lund, 1996).

However, there is a subliminal equivalence of justice and social sustainability. The shared temporality between social sustainability and justice has led to a "mutual component" of each other. The concept of social sustainability forms a framework consisting of diverse, complex, and integrated concepts, with justice as a common and core element (Boström, 2012; Campbell, 1996; Murphy, 2012; Pitarch-Garrido, 2018; Vallance et al., 2011; Zuindeau, 2006). Meanwhile, sustainability is also an essential concept of inter- and intragenerational justice (Barry, 1997; Grunwald, 2001; Omann & Spangenberg, 2002). Sustainability implies an equal development opportunity for each generation, which is somehow related to the concept of justice. Langhelle (2000) argues that intragenerational justice is the first priority of sustainable development and sustainable development is broadly compatible with liberal theories of justice. The interpenetration of two complex concepts allows each to simplify the other in their respective conceptions. In particular, there is a tendency that takes either inter- or intragenerational justice as an essential component of social sustainability (Barry, 1997; Weingaertner & Moberg, 2014). Vasconcellos Oliveira (2018) analyses the distributive justice principles in the 2015 UN Sustainable Development Goals (SDGs) and advocates for the application of the intergenerational sufficientarian principle aiming at the distant generation. Even in this systematic analysis of justice in sustainability, there is an inherent assumption that promoting intergenerational justice is equivalent to promoting sustainability. On the other side, Marcuse (1998) pointed out that the promotion of 'sustainability' might also encourage the sustaining of unjust situations. This plausible causality of justice in sustainability, especially in social sustainability, may obfuscate the practical approach to both social sustainability and justice.

We will continue the discussion of the causality between justice and social sustainability on the basis of empirical experiences in Chapter 6, which analyzed the spatial justice of Shanghai shared ownership housing. In Sen's story, if justice philosophies discuss who should take the only flute, then this study tries to find out whether the justice allocation will sustain the social relationship between the three children. In other words, the aim is to examine whether justice and social sustainability are compatible objectives empirically (Dobson, 1998). In a theoretical analysis, a just or unjust society can either be sustainable or unsustainable. Natural aristocracy can still be sustained based on the social consistency of justice. Democratic equality in a small village has little chance to survive in nearby armed riots. It remains uncertain whether inter-temporal justice can guarantee social sustainability.

## 3.4 The Theoretical Model of Spatial Justice

The above argument solves the two questions: why should we consider the justice philosophy in a spatial way? how can we build the theoretical link between justice philosophies and the spatial planning discipline? This section tries to solve these two problems from the analysis of the gaps from justice philosophy to spatial planning.

### 3.4.1 The Development of Justice Philosophy and Planning Theory

Figure 3.3 shows the development of justice philosophy and relevant planning theory according to the above context. We will find an intertwined spectrum of justice schools, including utilitarianism, intuitionism, liberalism, Marxism, socialism, and recognition. Each school has its own representative scholars and works. The ideas of earlier philosophers have evolved over time in justice and planning theory. The background of the times also has an impact on the formation of the theory. These justice schools critique each other’s theories and also help others to refine them. Contradictions, continuations, paradoxes, and mutual influences are quite common among the various theoretical schools of justice.

Planning theory has been influenced by certain justice philosophies. Collaborative planning (Healey, 2020) has been impacted by Habermas’s communicative action theory. Feinstein’s “the just city” involves the liberal, recognition, and the capability approach to justice and forms the concept of just city with democracy, diversity, and equity, as the core spirits (Fainstein, 2010). Some scholars focus on the spatiality of justice and develop the concept of spatial justice (Philippopoulos-Mihalopoulos, 2014; Soja, 2013). Vale (2022) analyzes the concept of justice in the planning practices of urban design. Since this study takes Shanghai shared ownership housing as a case, we focus on the concept of spatial justice as it is the most relevant and feasible planning practice concept.

There are at least two gaps from justice philosophy to spatial planning in building the concept of spatial justice: the variety of justice philosophies and their abstract levels. There is a great variety of justice philosophies. Chapter 2 lists five mainstreams of justice philosophies, while there are many more academic schools, such as culture

justice (Ross, 2013) and indigenous justice (Amara et al., 2012). In the meantime, each justice theory obtains distinct and even contractionary opinions. In the scope of spatial planning, it is quite difficult to handle the multiple justice philosophies. The relationship between them, especially those justice theories against each other, was left to solve and even harder to handle in the spatial planning discipline. The different philosophical schools of justice and their ethical principles cannot be combined without conflict (Hartmann, 2018). Among various justice theories, it seems impossible to propose a comprehensive theory that incorporates a variety of theoretical claims. This study does not aim to choose only one right justice philosophy but to analyze, compare, and integrate these distinct justice connotations in planning theory.

Secondly, justice philosophy and spatial planning have different abstract levels. Many justice philosophies are highly abstract and summarize various social lows. On the contrary, spatial planning is respectively concrete. The spatial structure, the geographical location, and even the spatial organization of planning design and practice are concrete, figurative, and definite. Compared with justice philosophies, spatial planning is more substantive, including planning theory and planning practice. Spatial entities host the reproduction of space, the reproduction of institutions, and even the reproduction of humans. The problem is how spatial entities can host multiple justice philosophies.

This study tries to build up a feasible approach toward spatial justice in planning. Justice has many faces (Mascareño, 2012), while modern social structures are also highly fragmented (Teubner, 2008). Conflicts and paradoxes are inevitable in merging a universal justice theory, which is not the objective of this study. When it comes to planning, it is possible to decompose the planning process and analyze corresponding justice philosophies behind the planning practices, especially in a heterogeneous public realm.

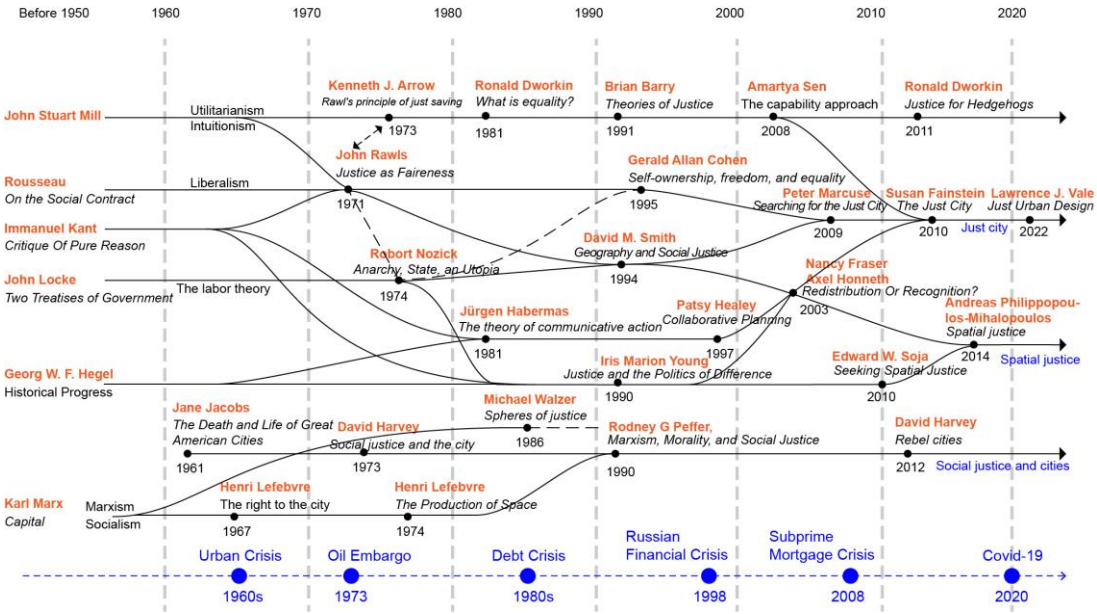



Figure 3.3 The development of justice ideology and planning theory (modified from Zhou et al. (2019))

### 3.4.2 The Ideal Model of Spatial Justice: Space as Mirror

#### 3.4.2.1 The Theoretical Framework for Spatial Justice

Figure 3.4 shows a possible answer for how to link justice philosophy with spatial planning. This study builds up the ideal model of spatial justice by taking space as a mirror. The concept of spatial justice is not to take space as a carrier of justice but as a reflection of justice philosophies. In other words, spatial justice does not form another justice philosophical theory but reflects the implemented justice theories.

As shown in Figure 3.4, the spatiality of justice builds the precondition of spatial justice. Various and conflicting justice theory exist not only at the philosophical level but also in spatial planning. Space cannot be a filter for contradictions in justice theories. In other words, the spatial dimension of justice philosophies cannot solve the problem at the philosophical level. It can only reflect what kind of justice theory has been implemented. For example, Hartmann (2018) argues that libertarian-oriented spatial planning must focus on avoiding market failures, aiming for resource efficiency, and allowing as many freedoms as possible. Although Hartmann's argument might not be fully correct, since there are numerous advocates of libertarian justice besides Nozick's approach, the consistency between spatial planning and justice theories is the bridge over the gaps. Despite their different variety levels and different abstract levels, taking space as a mirror can build up the consistency between justice philosophies and spatial planning.

Therefore, spatial justice plays a role in understanding and interpreting justice philosophies in the planning discipline in this study. Rather than the question of what the only right and good theory of justice is, the study focuses on what kinds of justice philosophies are implemented in the planning practice. More specifically, this study analyzes the different manifestations of justice theories in planning practice and their consistency by the conception of spatial justice.

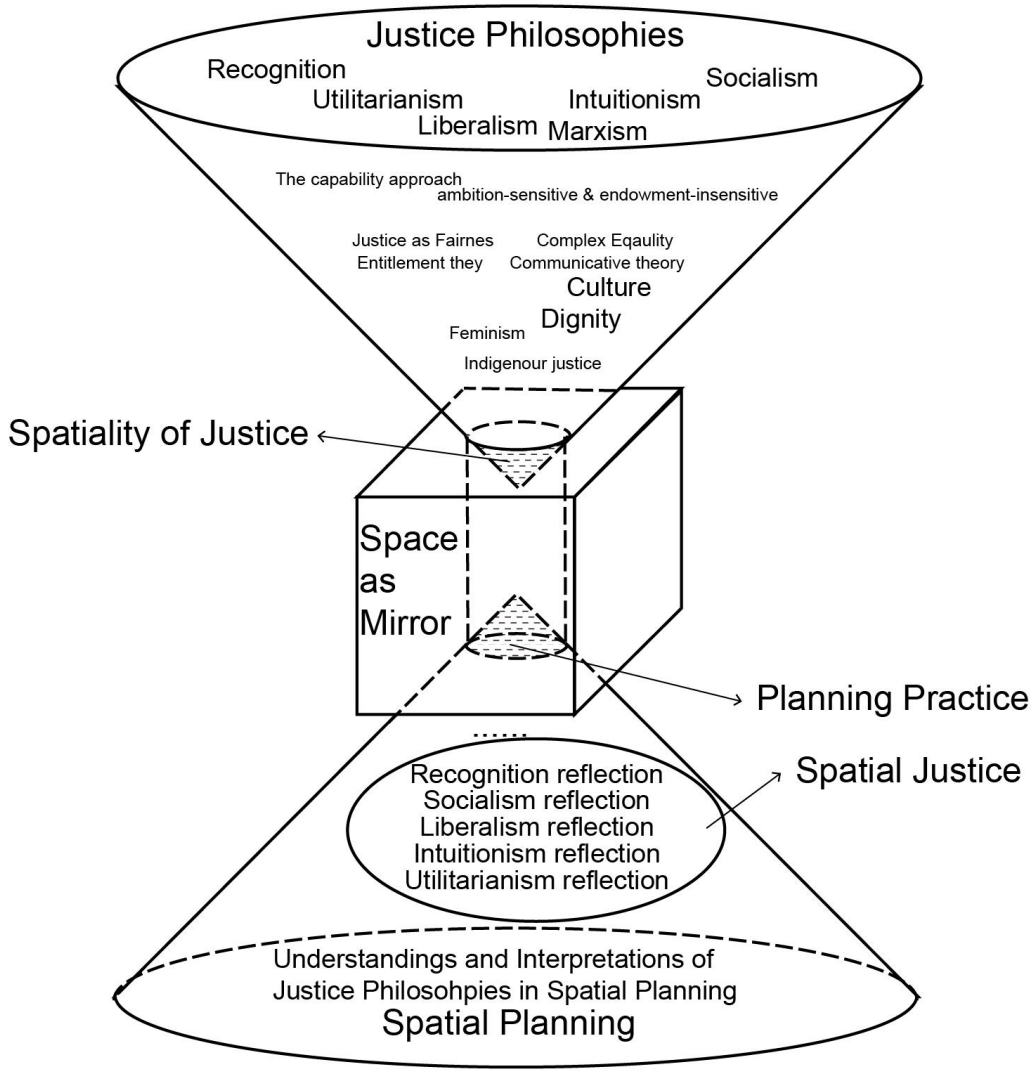



Figure 3.4 The ideal model of spatial justice

### 3.4.2.2 The Reflections of Justice Theories in Planning

The above framework for spatial justice provides a possible analytic method for spatial justice in planning practice. This section provides detailed possible reflections from various justice theories in spatial planning. When analyzing spatial justice, it is first necessary to figure out which theories of justice are employed in planning. In the analysis of spatial justice, the first step is to figure out which justice theories have been adopted in the planning. The second step is to determine whether the adopted justice theories have been adequately implemented. For different justice theories, their reflection in spatial planning differs according to their theoretical advocates.

Table 3.2 The reflections of justice theories in planning

| Philosophy of justice | Relevance to spatial justice | The corresponding reflection in planning |
|---|---|---|
| Classic utilitarianism | Spatial equity: the maximum of average/overall utility | The maximum of average/overall utility as planning objectives; planning principles; resource allocation |
| Classic intuitionism | Spatial equity: the most goods for the greatest satisfactions/ equally distribute... | Equal distribution of resources as planning objectives; planning principles; resource allocation |
| Sen's Capability Approach | Gap between spatial reflection and individual capability | Maximum of Individual capability as planning objective |
| Rawls's egalitarian liberalism | Substantive justice: spatial equity of resources and goods aiming at the greatest benefits of the least advantaged as the benchmark | Enlarging the benefits of the least advantages as planning objectives; planning principles; resource allocation |
| Nozick's entitlement theory | Procedural justice<br>Planning process of justice in acquisition, transfer, and rectification | The entitlement judgment in planning process |
| Walzer's spheres of justice | Each social good has its own spatial reflection of its distributive norms of justice | Each social good applies its distribution norms of justice; planning principles; resource allocation |
| David Harvey | The relationship between spatial form and political, social, and economic processes | The circulation of surplus (re)production in planning outcome and process |
| Habermas's Discourse Ethics | Hermeneutic analysis of communication in planning, especially contextual, cultural, and historical factors. | Equal access to communication in the planning process |
| Iris Marion Young's recognition justice | Five types of oppression and according to affirmative action in planning | Whether the five types of oppression (exploitation, marginalization, powerlessness, culture imperialism, and violence) exist in planning process |
| Nancy Fraser's recognition justice | Affirmation and transformation in redistribution and recognition paradigms | Equal share of economic redistribution, equal respect of cultural recognition, and equal say of political representation |

Table 3.2 shows the possible reflections of justice theories in planning. For the theories focusing on substantive justice, it is planning objectives, planning principles, and the allocation of resources as its corresponding reflection in planning. Their different theoretical advocates then led to different planning objectives. For example, classic utilitarianism takes the average/overall utility as planning objectives of justice, which could be further transferred into a pursuit of the average/overall GDP of certain areas. Classic intuitionism might have more variations, and one possible aim is to pursue the equal distribution of resources. Sen's capability approach in planning should take the maximum of individual capability as a planning objective. The planning adopting Rawls's egalitarian liberalism would try to enlarge the benefits of the least advantages in terms of planning principles. Walzer's spheres of justice embodied in planning might require different distribution norms of different social goods in planning.

For the theories focusing on procedural justice, it is the factors in the planning process needed to be analyzed. For example, the planning adopting Nozick's entitlement theory should examine the planning process of justice in the entitlement of acquisition, transfer, and rectification. Habermas's discourse ethics then turns to the pursuit of

equal access to communication in the planning process. Young's recognition justice might require whether the five types of oppression, i.e., exploitation, marginalization, powerlessness, culture imperialism, and violence, exist in the planning process. There are also justice theories a mixture of substantive justice and procedural justice, such as David Harvey's circulation of surplus (re)production in planning outcomes and processes. Nancy Fraser's recognition justice has been to a combination of equal share of economic redistribution, equal respect of cultural recognition, and equal say of political representation in the planning.

### 3.4.3 The Three Judgment Conditions of Justice in Planning

The previous section addressed the question of how to transfer the complex relations of justice theories into spatial planning. However, it does not solve the question of how to judge specific planning as justice or injustice in planning theory and practice. Here, three kinds of judgment conditions are introduced to identify the justice level of planning: the strict condition, the tolerant condition, and the custom condition. If the previous ideal model of spatial justice aims at analyzing which justice theories are embedded in planning, then these three judgment conditions aim at the evaluation of multiple justice theories in spatial planning.

#### 3.4.3.1 The strict condition

In the strict condition, a planning practice can be regarded as just only when it met all the requirements of justice principles. If we focus on procedural justice and substantive justice at the same time in one planning practice, then the planning practice has to fulfill the requirements of both procedural justice and substantive justice. However, the strict condition seems to be impossible universally. Since there are conflicting justice philosophies, neither planning theory nor planning practice can meet the requirements of all the justice philosophies.

#### 3.4.3.2 The tolerant condition

In the tolerant condition, one planning practice can be regarded as just as long as it met one requirement of justice principles. If a planning practice follows the instructions of procedural justice, then it can be regarded as just even if its results enlarge the inequalities of certain aspects. The tolerant condition fits the complicated and conflicting systems of justice philosophy well. While it may lead to a biased evaluation in assessing the justice of certain planning practices. It may overlook recognition justice with an emphasis on distributive justice.

#### 3.4.3.3 The custom condition

In the custom condition, a planning practice first should be analyzed its intended justice principles, and then it can be regarded as just as long as it met its intended justice principles. If a planning practice is designed to fulfill Rawlsian egalitarian liberalism of justice, then it can be regarded as justice as long as it increases the benefits of the least advantaged. In this example, even if the planning practice ignores the

collaborative process, it can be defined as just since procedural justice is not its intended justice principle. The difficulty in the custom condition is to figure out which justice philosophies have been its core spirit.

#### 3.4.3.4 An analysis sample of the three judgement conditions

To clarify the application of the three judgment conditions, this section provides its implementation for a virtual planning practice (see Table 3.3). Assuming that the planning practice takes Sen's capability approach and Fraser's recognition justice as the embodied justice theory, the practice is judged differently under the three conditions. As stated, Sen's capability approach takes the maximum of individual capability as justice, while Fraser's recognition justice consists of equal share of economic redistribution, equal respect of cultural recognition, and equal say of political representations, which form the four requirements of the planning practice for spatial justice. Under the strict condition, the planning practice must satisfy these four requirements to achieve spatial justice. Under the tolerant condition, if any one of the four requirements is met, the planning practice can be considered to have achieved spatial justice. Under the custom condition, it is the planning design determines which requirements are essential and which are auxiliary. For example, the planning design might define that only the A and B.1 requirements need to be fulfilled in purpose of the spatial justice of planning practice.

The analysis example in Table 3.3 shows an ideal theoretical situation. Few of planning practices in reality clarify the justice theories they implement, let alone the necessity for each different justice theory. However, the three judgment conditions provide a possible analytical method for spatial justice of certain planning practices. For specific planning practice, a possible analysis method of its spatial justice is to analyze what kind of justice theory it applied and what kind of the judgment conditions are implied in planning practice, so as to achieve a comprehensive analysis.

Table 3.3 An analysis example of the three judgment conditions

| Justice theories in planning | The strict condition | The tolerant condition | The custom condition |
|---|---|---|---|
| A. Sen's capability approach: the maximum of individual capability<br>B. Fraser's recognition justice:<br>B.1 Equal share of economic redistribution<br>B.2 Equal respect of cultural recognition<br>B.3 Equal say of political representation | The planning practice must meet all the requirements (A, B.1, B.2, and B.3) to achieve spatial justice | As long as one of the requirements (A, B.1, B.2, or B.3) is met, the planning practice can be considered to achieve spatial justice. | Depends on the planning design:<br>For example, the planning designs that only the A and B.1 requirements need to be realized to be regarded as spatial justice. The other requirements (B.2 and B.3) play a supporting role. |

# Part II Empirical Study: Shanghai Shared Ownership Housing

The empirical study part takes the planning practice of Shanghai shared ownership housing as a case study. Chapter 4 introduces its contextual background, development, and evaluation of framework, including the measurement of indicators. Chapter 5 assesses spatial equity based on a horizontal comparison of five social goods distribution, namely health resources, educational resources, job opportunities, green space (parks), and public transportation. For each social good, there are four analysis indicators, i.e., accessibility, availability, proximity, and affordability. Chapter 6 analyzes spatial justice based on a vertical comparison across the five social goods, along with the comparison of the shared ownership housing residents' status. Moreover, Chapter 6 analyzes the reflection of different justice theories in the planning practice of Shanghai shared ownership housing.

# 4 Overview: Research Objects and Basic Data

## 4.1 Overview of Shanghai and Affordable Housing System

### 4.1.1 Shanghai Overview

Shanghai is located in the southeast of the People's Republic of China, at the mouth of the Yangtze River (Figure 4.1). As a global center for finance, innovation, and transportation, Shanghai is the heart of a world-class urban agglomeration in the Yangtze River Delta, surrounded by many cities in Jiangsu, Zhejiang, and Anhui provinces. In 2021, the gross domestic product (GDP) of Shanghai municipality amounted to approximately 4.32 trillion yuan[1]. Due to its leading position in economics, Shanghai is one of the most populated metropolises in the People's Republic of China, with a population growing from 23.02 million in 2010 to 24.20 million in 2017. During its expand urbanization, social inequality has been a particularly severe problem (Li & Wu, 2008), as well as the gap in the distributing of various resources between urban and rural areas (Xiao et al., 2017).

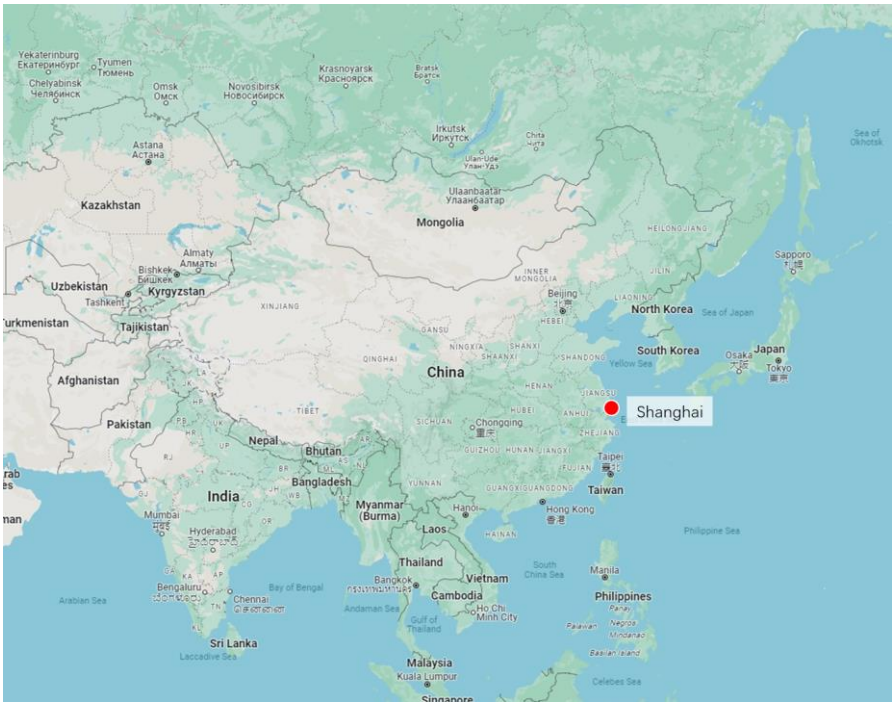



Figure 4.1 Shanghai's location in the People's Republic of China

(Map data ©2023 Google, TMAP Mobility)

[1] One yuan equals approximately 0.16 U.S. dollars and 0.14 euros (as of March 2022). Source: https://www.statista.com/statistics/802355/china-gdp-of-shanghai/

### 4.1.2 Development History

Shanghai has a long history. As early as 6,000 years ago, the western part of Shanghai became land, and the eastern part also formed land for 2,000 years. In 751 A.D. (Tang Dynasty), there was an official county established in nowadays Songjiang District in Shanghai. In 991 A.D. (Song Dynasty), Shanghai was named “Shanghai Pu” as an important commercial port for foreign ships to berth. In 1292 A.D. (Yuan Dynasty), the central government at that time approved the establishment of Shanghai County, marking the beginning of the city of Shanghai[2].

This study focuses on Shanghai’s modern development, which is after China’s “reform and opening up” in 1978. In 1987, the policy called “reform and opening up” was a nationwide economic and political policy, which aimed to reform the country from a socialist institution to a market-oriented socialism. Instead of resources planned and distributed by the government, the policy promoted a market-oriented economy and a liberal ideology. These reforms had a major impact on Shanghai, which made Shanghai one of the four “Special Economic Zones” in China, along with great autonomy in economic development.

The reform policy stimulated the rapid economic and population growth, urbanization, and modernization of the city. Throughout the 1980s and 1990s, millions of households migrated to Shanghai. Table 4.1 shows the number of resident populations, the density of the registered population, and figures for households from 1978 to 2017. During almost three decades, the year-end resident population has more than doubled, along with the density of the population. It was a period of rapid urbanization. From 2013 to 2017, there is an obvious slowing population growth trend since the amount of Shanghai resident population maintained at about 24 million.

However, rapid urbanization and economic growth led to an increasing gap between urban and rural households in Shanghai. Table 4.2 shows the disposable in-come per capita, the per capita consumption expenditure, and the per capita living space (year-end) of urban and rural households from 1990 to 2014. We can find that the disposable income of rural housed holds was about three-quarters of the urban in 1990, while it was less than half in 2014.

While the urban incomes continued increasing, its per capita living space continued decreasing as a result of rapid population concentration. Since in the late 1990s, rapid increased demand for housing and economic growth led to a significant rise in Shanghai housing prices. In response to rising housing prices, the municipal government has implemented a series of housing policies, including strict restrictions on home purchase qualifications and the provision of affordable housing for low- and middle-income residents.

[2] Source: https://web.archive.org/web/20111109114612/http://www.inc.sh.cn/touzishangahi/showinfo.asp?id=79

Table 4.1 Total households, population, and density of registered population (1978～2017) (Statistics, 2018)

| Year | Year-end Resident Population (10 000Person) | Density of Population (person/sq.km) | Total Households (10 000households) | Average Persons Per Household (person) | Year-end Registered Population (10 000Person) |
|---|---|---|---|---|---|
| 1978 | 1 104.00 | 1 785 | 291.69 | 3.77 | 1 098.28 |
| 1979 | 1 137.00 | 1 838 | 296.71 | 3.82 | 1 132.14 |
| 1980 | 1 152.00 | 1 862 | 303.87 | 3.77 | 1 146.52 |
| 1981 | 1 168.00 | 1 888 | 314.56 | 3.70 | 1 162.84 |
| 1982 | 1 186.00 | 1 917 | 321.71 | 3.67 | 1 180.51 |
| 1983 | 1 201.00 | 1 942 | 330.60 | 3.61 | 1 194.01 |
| 1984 | 1 217.00 | 1 968 | 340.78 | 3.54 | 1 204.78 |
| 1985 | 1 233.00 | 1 993 | 351.72 | 3.46 | 1 216.69 |
| 1986 | 1 249.00 | 1 970 | 364.92 | 3.38 | 1 232.33 |
| 1987 | 1 265.00 | 1 995 | 380.19 | 3.29 | 1 249.51 |
| 1988 | 1 288.00 | 2 031 | 394.95 | 3.20 | 1 262.42 |
| 1989 | 1 311.00 | 2 067 | 406.82 | 3.14 | 1 276.45 |
| 1990 | 1 334.00 | 2 104 | 415.28 | 3.09 | 1 283.35 |
| 1991 | 1 350.00 | 2 128 | 425.84 | 3.02 | 1 287.20 |
| 1992 | 1 365.00 | 2 154 | 431.67 | 2.99 | 1 289.37 |
| 1993 | 1 381.00 | 2 179 | 438.69 | 2.95 | 1 294.74 |
| 1994 | 1 398.00 | 2 204 | 444.38 | 2.92 | 1 298.81 |
| 1995 | 1 414.00 | 2 230 | 450.76 | 2.89 | 1 301.37 |
| 1996 | 1 451.00 | 2 288 | 457.49 | 2.85 | 1 304.43 |
| 1997 | 1 489.00 | 2 348 | 461.40 | 2.83 | 1 305.46 |
| 1998 | 1 527.00 | 2 409 | 465.72 | 2.81 | 1 306.58 |
| 1999 | 1 567.00 | 2 472 | 470.11 | 2.79 | 1 313.12 |
| 2000 | 1 608.60 | 2 537 | 475.73 | 2.78 | 1 321.63 |
| 2001 | 1 668.33 | 2 631 | 478.92 | 2.77 | 1 327.14 |
| 2002 | 1 712.97 | 2 702 | 481.77 | 2.77 | 1 334.23 |
| 2003 | 1 765.84 | 2 785 | 486.06 | 2.76 | 1 341.77 |
| 2004 | 1 834.98 | 2 894 | 490.58 | 2.76 | 1 352.39 |
| 2005 | 1 890.26 | 2 981 | 496.69 | 2.74 | 1 360.26 |
| 2006 | 1 964.11 | 3 098 | 499.54 | 2.74 | 1 368.08 |
| 2007 | 2 063.58 | 3 255 | 503.29 | 2.74 | 1 378.86 |
| 2008 | 2 140.65 | 3 376 | 506.64 | 2.75 | 1 391.04 |
| 2009 | 2 210.28 | 3 486 | 509.79 | 2.75 | 1 400.70 |
| 2010 | 2 302.66 | 3 632 | 519.27 | 2.72 | 1 412.32 |
| 2011 | 2 347.46 | 3 702 | 522.01 | 2.72 | 1 419.36 |
| 2012 | 2 380.43 | 3 754 | 524.31 | 2.72 | 1 426.93 |
| 2013 | 2 415.15 | 3 809 | 527.52 | 2.72 | 1 432.34 |
| 2014 | 2 425.68 | 3 826 | 532.55 | 2.70 | 1 438.69 |
| 2015 | 2 415.27 | 3 809 | 536.76 | 2.69 | 1 442.97 |
| 2016 | 2 419.70 | 3 816 | 541.62 | 2.68 | 1 450.00 |
| 2017 | 2 418.33 | 3 814 | 546.13 | 2.66 | 1 455.13 |

* the figures of household and year-end registered population are provided by Shanghai Municipal Public Security Bureau. From 2016, the figures of year-end registered population refer to the data of the end of November published

by Shanghai Municipal Public Security Bureau (same as follows). The figures of life expediency are provided by Shanghai Municipal Health and Family Planning Commission.

**Shanghai has cancelled the distinction between agricultural and non-agricultural household accounts in 2018.

Table 4.2 Basic statistics of rural households (1990-2014) (Statistics, 2018)

| Year | Urban Households | | | | Rural Households | | | |
|---|---|---|---|---|---|---|---|---|
| | Number Of house-holds Sur-veyed (house-hold) | Dispos-able In-come Per Capita (yuan) | Per Capita Con-sump-tion Ex-pendi-ture (yuan) | Per Capita Living Space Year-end （sq.） | Number Of households Surveyed (household) | Disposable Income Per Capita (yuan) | Per Capita Consumption Expenditure (yuan) | Per Capita Living Space Year-end （sq.） |
| 1990 | 500 | 2 183 | 1 937 | 56.5 | 1 000 | 1 665 | 1 262 | 37.08 |
| 1991 | 500 | 2 486 | 2 167 | 56.9 | 600 | 2 003 | 1 540 | 39.60 |
| 1992 | 500 | 3 009 | 2 509 | 55.9 | 600 | 2 226 | 1 967 | 42.07 |
| 1993 | 500 | 4 277 | 3 530 | 53.1 | 600 | 2 727 | 2 200 | 44.22 |
| 1994 | 500 | 5 868 | 4 669 | 53.5 | 600 | 3 437 | 2 715 | 44.15 |
| 1995 | 500 | 7 172 | 5 868 | 53.4 | 600 | 4 246 | 3 368 | 43.08 |
| 1996 | 500 | 8 159 | 6 763 | 50.7 | 600 | 4 846 | 3 868 | 45.47 |
| 1997 | 500 | 8 439 | 6 820 | 51.7 | 600 | 5 277 | 4 228 | 46.44 |
| 1998 | 500 | 8 773 | 6 866 | 50.6 | 600 | 5 407 | 4 207 | 47.24 |
| 1999 | 500 | 10 932 | 8 248 | 45.2 | 600 | 5 481 | 3 867 | 49.00 |
| 2000 | 500 | 11 718 | 8 868 | 44.5 | 600 | 5 565 | 4 138 | 53.58 |
| 2001 | 500 | 12 883 | 9 336 | 43.4 | 600 | 5 850 | 4 753 | 54.70 |
| 2002 | 500 | 13 250 | 10 464 | 39.4 | 600 | 6 212 | 5 311 | 57.08 |
| 2003 | 500 | 14 867 | 11 040 | 37.2 | 600 | 6 658 | 5 670 | 59.03 |
| 2004 | 1 000 | 16 683 | 12 631 | 36.4 | 600 | 7 337 | 6 329 | 59.84 |
| 2005 | 1 000 | 18 645 | 13 773 | 35.9 | 600 | 8 342 | 7 265 | 56.56 |
| 2006 | 1 000 | 20 668 | 14 762 | 35.6 | 600 | 9 213 | 8 006 | 59.99 |
| 2007 | 1 000 | 23 623 | 17 255 | 35.5 | 600 | 10 222 | 8 845 | 61.22 |
| 2008 | 1 000 | 26 675 | 19 398 | 36.6 | 600 | 11 385 | 9 115 | 62.30 |
| 2009 | 1 000 | 28 838 | 20 992 | 35.0 | 600 | 12 324 | 9 804 | 60.18 |
| 2010 | 1 000 | 31 838 | 23 200 | 33.5 | 600 | 13 746 | 10 225 | 59.68 |
| 2011 | 1 000 | 36 230 | 25 102 | 35.5 | 1 200 | 15 644 | 11 272 | 58.90 |
| 2012 | 1 000 | 40 188 | 26 253 | 36.8 | 1 200 | 17 401 | 12 096 | 60.42 |
| 2013 | 1 000 | 43 851 | 28 155 | 34.9 | 1 200 | 19 208 | 13 425 | 58.48 |
| 2014 | 1 000 | 47 710 | 30 520 | 35.0 | 1 200 | 21 192 | 15 291 | 58.92 |

* Data in this table are obtained from the sample survey of urban households and provided by Survey Office of the National Bureau of Statistics in Shanghai.

** Incomes from selling properties and social security expenditure are excluded from disposable income since 2002.Other years follow the original caliber.

***Growth of per Capita Disposable Income and growth of per Capita Consumption Expenditures are calculated by the same caliber.

### 4.1.3 Shanghai Affordable Housing System

Affordable housing is a special type of housing in the construction of urban housing in China. It usually refers to the housing that is planned and coordinated by the government in accordance with national policies and laws and regulations, provided for use by specific groups of people, and the construction standards and sales prices or rent standards of this type of housing are limited, and it plays a role in social security. Affordable housing and commercial housing have different attributes: one is a public good, and the other is a commodity. Affordable housing embodies the service function of the government.

Before the 1978 overall reform policy, Shanghai housing construction followed a typical socialist approach including social institution and housing construction. In the aspect of housing construction, before 1986, the government was responsible for providing public housing, and state-owned enterprises built the typical residential community called “Workers’ Quarter”. Employees employed in a formal “danwei” (work unit, including state-owned enterprises, public institutions, and government agencies) has the right to rent an apartment/housing close to their “danwei” according to their family status. In the early 1960s, the Workers’ Quarters were designed with shared amenities such as kitchens and bathrooms. In the late 1980s, the living condition of the Workers Quarter was improved to reach 30 sq. per capita with a separate kitchen and bathroom.

In 1986, the Chinese government allowed private investment in real estate development. Shanghai’s municipal government then began to encourage private investment in housing construction. which led to a significant increase in the number of high-rise buildings and commercial properties in Shanghai.

In 1991, the Shanghai Municipal People's Government formulated the "Shanghai Housing System Reform Implementation Plan”, marking the beginning of Shanghai's housing commercialization reform. The plan adopted comprehensive and diversified reform measures to promote housing commercialization, including the promotion of the Housing Provident Fund (HPF), the raise of rental subsidies, the allocation of housing, the discounts of purchasing housing, and the establishment of housing committees. In the aspect of social institutions, the national Housing Provident Fund (HPF) is a mandatory savings program for employees and their employers to purchase or rent housing. Under the HPF, both employees and employers must contribute a certain percentage of the employee’s salary to a dedicated HPF account. The funds in the HPF account can be used for a variety of purposes, including housing purchases, repayment of housing loans, and rental payments. There is a possibility for employees to withdraw HPF for other purposes, such as education or medical expense. The HPF program is managed by the Shanghai Housing Provident Fund Management Center, which is responsible for collecting contributions, managing accounts, and providing services. Another important measure is the sale of previous socialist public housing. In May 1995, Shanghai promulgated the “Interim Measures on the Sale of Public Housing”. Public housing tenants can buy the property rights at a preferential price, and the length of the employee year can be deducted from the purchase price.

There are two rounds of affordable housing policy in Shanghai, with its mode shift from “For Sale Only” to “For Rent Only”. The first round was launched in the early 1990s and lasted for about two decades. The targeted audience of the first-round affordable housing was the residents with extremely limited living conditions. In 1995, the applicants should have a living area of less than 4 m² per capital, which was later enlarged to 5 m² per capital in 2000. The first-round affordable housing policy launched a "neighborhood renovation" program aimed at improving the quality of the older Workers’ Quarters. The housing communities were demolished and rebuilt, and the original residents were also relocated to new residential areas. The program involved the renovation and redevelopment of existing housing units, as well as the construction of new affordable housing for low-income residents. At this stage, Shanghai’s affordable housing system is based on housing ownership, which means the residents owned the full property rights.

However, it was not until 1998 that Shanghai’s real estate industry became actual marketization. In 1998, the China State Council issued the "Notice on Further Deepening the Reform of the Urban Housing System and Accelerating Housing Construction" (No. 23), which stopped the socialist distribution of public housing and gradually implement monetary distribution. As a result, the first-round affordable housing policy was stopped in order to encourage the marketization of Shanghai housing construction. The termination of the first round of affordable housing policy was affected by the collapse of Hong Kong’s stock and real estate market in 1997 when the governmental provision of affordable housing exacerbated the housing market crash (Wilson & Zurbruegg, 2004). In the following years, the real estate industry in Shanghai experienced a construction boom, with numerous private developers and rising housing prices.


Figure 4.2 The “four in one” affordable housing system in Shanghai

In response to rapidly rising housing prices and the growing wealth gap, the Shanghai government launched second-round affordable housing projects in 2007. In 2007,

Shanghai promulgated the "Shanghai Development Plan for Solving the Housing Difficulties of Urban Low-income Families (2008-2012)". The plan clarified that by the end of 2012, the number of new low-rent housing-income family workers should not be less than 100,000, and the proportion of benefited residents would be expanded to 20-30% of the total, and a total of 300,000 units of low-rent housing and shared ownership housing would have been built.

The second-round affordable housing policy established the construction of a “four in one” affordable housing system (Figure 4.2) in Shanghai, including low-rent housing, shared ownership housing, public rental housing, and resettlement housing. There are two features of the second-round affordable housing policy. The first feature is the increased proportion of low-rent housing in the affordable housing system. After 2018, the provision of affordable housing tended to increase the low-rent housing and aimed at *“For Rent Only”* affordable housing provision. The second feature is the enlarged targeted audience. The applicant changed from those with extreme living conditions to the “Sandwich Class”, who cannot afford commercial housing on their own income but owns a middle-low living condition. The shared ownership housing was named as economical housing at the early stage of the second-round affordable housing policy. In actual operation, the applicant and the government can sign a housing contract according to three property ratios of 8:2, 7:3, or 5:5, which will be clarified in the housing ownership certificates. The shared ownership housing program is a special public product proposed by the government to solve the housing difficulties of low- and middle-income groups.

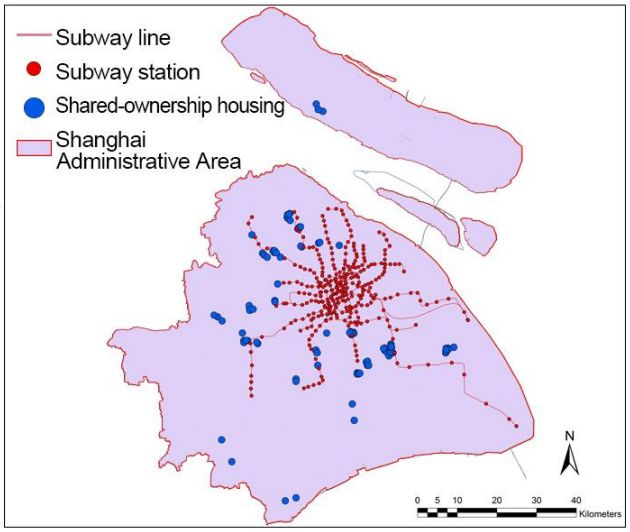



Figure 4.3 Shanghai Shared Ownership Housing Distribution in 2017

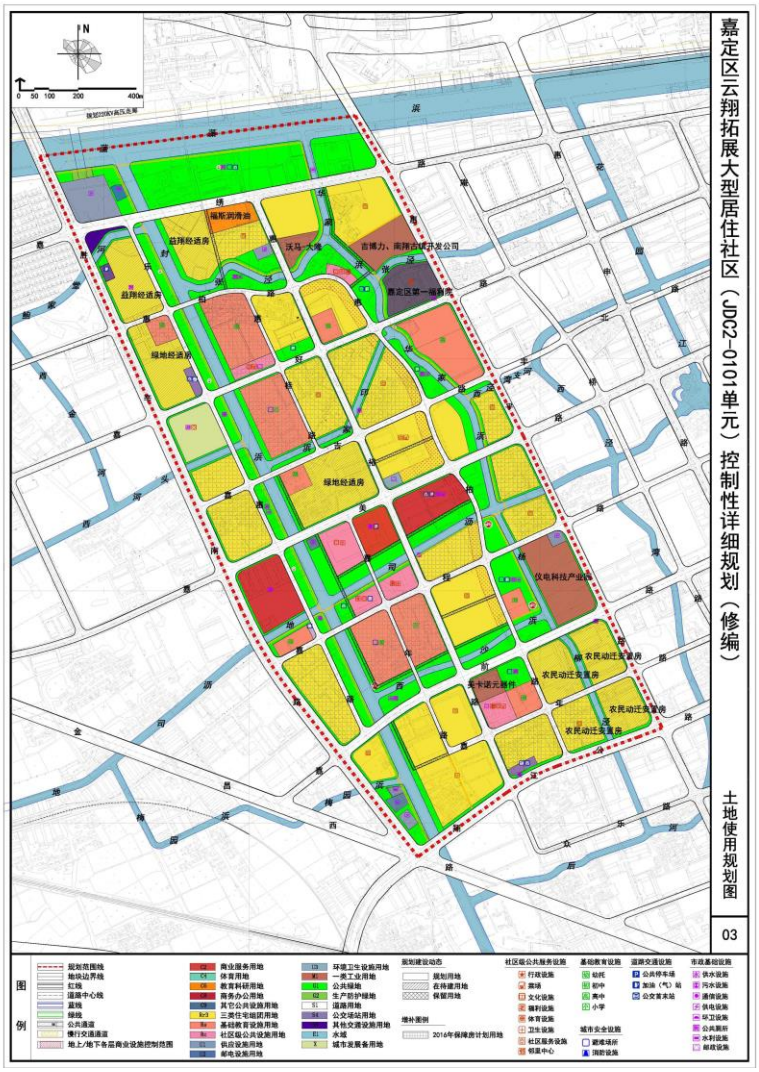



Figure 4.4 A publicly available land use planning of a large residential area in Shanghai (Source: http://www.jiading.gov.cn/guitu/ghzyyw/ghsp/content_446257)

The program included subsidies for low- and middle-income residents and restrictions on the resale of shared ownership housing units. In 2013, there were 104,000 units of shared ownership housing, and the renovation of old housing units completed construction, along with a construction focus from the city center to the suburbs[3]. From 2013 to 2018, there were 493,000 units of shared ownership housing constructed[4]. Figure 4.3 shows the distribution of the shared ownership housing completed construction in 2017. The total number of blue points, which represents an affordable housing community, is 97. Figure 4.4 shows a typical example of shared ownership housing planning, which was included in a suburban large-scale residential area planning. The

[3] Source: Shanghai Mayor Yang Xiong's Government Work Report (January 2014). https://www.shanghai.gov.cn/nw14332/20200906/0001-14332_1996.html

[4] Source: Shanghai Mayor Ying Yong's Government Work Report at the First Session of the 15th Shanghai People's Congress (2018). https://www.suibe.edu.cn/xb/2021/0315/c17076a135672/page.htm

light-pink land-use patches in the middle of Figure 4.4 was planned as shared ownership housing and have been already constructed.

## 4.2 Shanghai Shared Ownership Housing

### 4.2.1 Historical Development

Before the Shanghai Municipal Government announced the shared ownership housing policy in 2007, a series of ancillary commercial housing was planned to support low- and middle-income residents since 2003. Ancillary commercial housing refers to commercial housing with prices at a medium to low level of the housing market. Between 2003 and 2005, the total area of completed, under-construction, and planned ancillary commercial housing in Shanghai is about 30 million square meters. However, the ancillary commercial housings were located outside the main city (see Figure 4.5) and lacked public transportation. Since the residents are low- and middle-income groups, who largely relied on public transportation and were engaged in low-skilled retail and service industries. The location of ancillary commercial housing increased their travel cost and time, reduced their employment opportunity, and caused a spatial mismatch between their residence and employment (Lin, 2011).

In 2010, the first batch of Shanghai shared ownership housing became its public application, which was named as economical housing. Shanghai's shared ownership housing policy mainly aims at local *Hukou* holders as limited social welfare. The *Hukou* system is a socialist household registration system in Shanghai, China. It allows the government to regulate the number of people who can legally reside in Shanghai, plan urban development, allocate public resources, and maintain social stability by ensuring that individuals without legal residency cannot access certain public services. It divides residents into two categories: local *Hukou* and non-*Hukou*. Local *Hukou* holders are Shanghai natives, highly educated people, or individuals who have lived in Shanghai for a long period. Non-local *Hukou* holders are individuals who come from other regions, with the other regions' *Hukou* accordingly. The *Hukou* system provides a wide range of social welfare for local *Hukou* holders, including access to shared ownership housing and educational resources. In recent years, the Shanghai government has taken steps to reform the *Hukou* system to make it more inclusive, particularly for migrant workers who have lived and worked in the city for many years. These reforms aim to grant more rights and benefits to non-local *Hukou* holders while also maintaining the stability of the system. After 2018, the Shanghai shared ownership housing policy started to include non-local *Hukou* holders with limited provision of shared ownership housing in the outskirts.


Figure 4.5 The location of ancillary commercial housing in 2003-2005 (modified from (Lin, 2011), Map data ©2023 Google, TMAP Mobility)

During 2006 and 2007, the construction of shared ownership housing in Shanghai is in a period of adjustment. Shanghai Municipal Government studied the problem of previous ancillary commercial housing, including the limited provision of ancillary commercial housing, the lack of public transportation, and the spatial mismatch of job opportunities and residential location. In 2007, the China State Council promulgated "Several Opinions of the State Council on Solving Housing Difficulties of Urban Low-income Families"[5]. This document motivated governments at all levels to develop shared ownership housing policies for low- and middle-income families. In 2008, Shanghai started the construction of affordable housing, which was the first batch of shared ownership housing provided in two years later (2010). By the end of 2009, Shanghai's shared ownership housing had accumulated a construction area of about 6.05 million square meters.

The construction of Shanghai shared ownership housing was guided by the large residential community planning since 2008. To avoid the problems of previous ancillary

[5] http://www.gov.cn/zhengce/content/2008-03/28/content_4673.htm

commercial housing, there were five principles of the site selection in Shanghai 2010 large residential community planning (Lin, 2011):

**Focusing on the new towns—**according to Shanghai Master Plan, the planning aims to promote population concentration and functional improvement in the new towns around Shanghai's downtown area, with large residential communities, the urban renews in the old towns, and the replacement of farmers' housing sites.

**Prioritizing public transportation—**the planning should prioritize the arrangement of various public transportation facilities, including rail transit, high-speed rail, and intercity railways, according to the commuting needs of the middle-low-income residents for living and employment.

**Highlighting functions**—the planning should adhere to the functional positioning and orientation of "residence, citizen consumption, and ordinary commodity housing," and consider the scale, structure, and functional layout of ordinary commodity housing and shared ownership housing comprehensively.

**Integrating industry and city**—according to the requirements of coordinated development of living and employment, the planning should combine the structural layout of housing, industry, and various public facilities, with the regional industrial layout to promote the balance of work and living.

**Easy to initiate**— the planning should prioritize the selection of land with better initiation conditions based on the current land use and land ownership status. The planning should determine the phased implementation plan according to the demand for affordable housing.

Since 2010, the Shanghai Municipal Government has continued to promote the implementation of large-scale residential community planning in the suburbs, and the supply of shared ownership housing has continued to grow steadily from 2011 to 2018. Figure 4.6 shows the amount of shared ownership housing provision compared with the overall residential housing construction and transactions. Despite the peak of a shared ownership housing provision and residential housing transaction in 2013, there is a stable growth of shared ownership housing from 2011 to 2018.

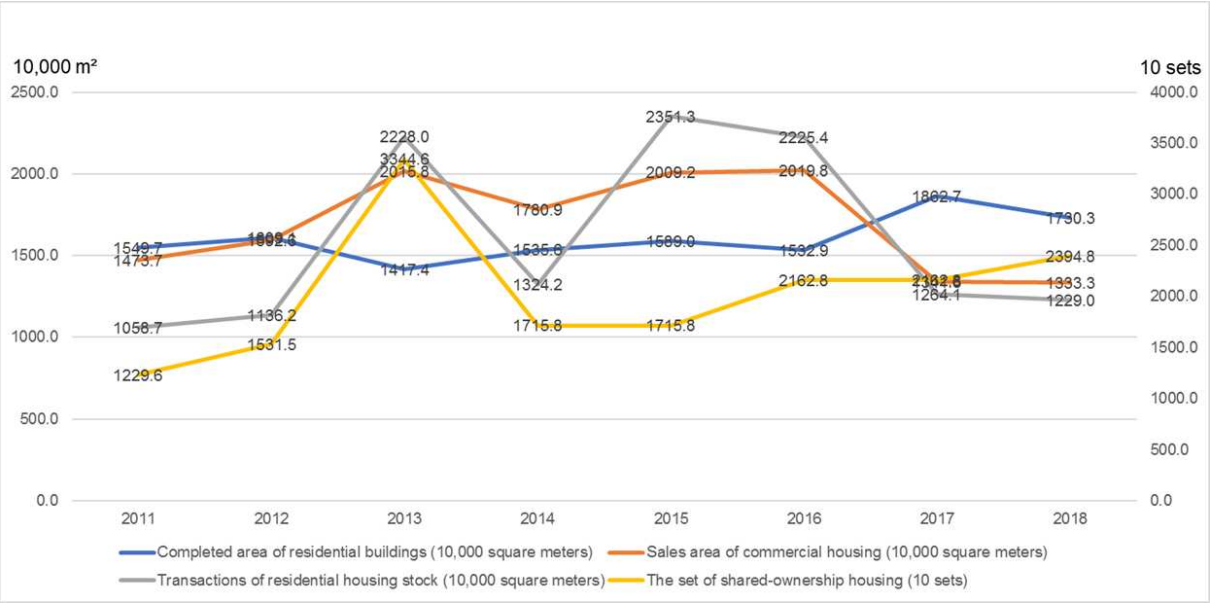



Figure 4.6 Shanghai residential housing construction and transactions compared with shared ownership housing provision 2011-2018 (based on (Statistics, 2018))

The applicant for shared ownership housing must go through strict screening and meet conditions such as low income and housing difficulties, such as the per capita property below 180,000 yuan and the per capita housing construction area of the family being less than 15 square meters (including 15 square meters). After 2018, non-*Hukou* residents can also apply for co-ownership housing, as long as they have urban permanent residence in Shanghai for 3 consecutive years and have permanent residence in the city where the application is made for 2 consecutive years. To prevent the economic realization of housing benefits, shared ownership housing cannot be sublet or gifted. However, common property rights can be converted into general private property rights after five years by purchasing government property rights, so as to be traded in the real estate market.

### 4.2.2 Production Mode

The housing production mode refers to the entire operation mechanism of developing housing. The production mode includes the process of planning, allocation of different resources, housing construction, and the interesting relationship of each subject involved in the development process. In Shanghai, the production mode varies according to the housing type and can be analyzed from five aspects, i.e., development reason, development body, source of funds, the way of land acquisition, and planning institution. Table 4.3 shows the production modes of five different housing types in Shanghai.

Table 4.3 Production mode of five housing types in Shanghai (Yu, 2011)

| Housing Type | A. Socialist welfare housing | B. Affordable housing | C. Model housing | D. Commercial housing | E. High-end international housing |
|---|---|---|---|---|---|
| Development reason | Solve the living needs of "*danwei*" employees | Provide housing for low- and moderate-income families (limited profit for developer) | Pioneering and exemplary housing (limited profit for developer) | Pursue economic benefits | Pursue economic benefits |
| Development body | *Danwei*, government, enterprise | Various domestic enterprises | State-owned background enterprise | Various domestic enterprises | Foreign-funded enterprises |
| Fund Source | Government funds, *Danwei* revenue | Government funds, enterprise, and financial credit | Enterprises and financial credit | Enterprises and financial credit | Enterprises and financial credit |
| land acquisition | Allocation | Agreement transfer | Agreement transfer, auction | Agreement transfer, auction | Agreement transfer, auction |
| Planning institution | Local | Local | External | Local/external | External |

As Table 4.3 shows, the production mode of shared ownership housing has both the characteristics of a socialist planned economy and a certain degree of marketization. Compared to socialist welfare housing, shared ownership housing has the same characteristic "planned by the government": their development reasons are based on the government's political needs and public interest; and their development body, as well as the planning institutions, are those domestic enterprises and organizations influenced by the government. Different from socialist welfare housing, shared ownership housing acquires the land use right via the method of agreement transfer instead of allocation. The "allocation" refers to the development body does not need to pay the fee of land use right, while the "agreement transfer" refers to a limited land use fee negotiated or auctioned with a limited scope.

The limited marketization of shared ownership housing in reflected in the limited audience, limited selling price, and limited living conditions. Regardless of whether the development body is a state-owned (with a government background) or a private real estate enterprise, the land use fee is at a certain low price, and the built flats are allocated or sold to certain residents with difficulties in living conditions. In 2016, the

applicants for shared ownership housing in a family of three should have a less than (equal) 15 m² per capita, less than 72,000 yuan (about 10,843 dollars) of per capita annual disposable income, and the per capita property is less than 180,000 yuan (about 27,108 dollars). The planning and architecture design are also constricted and will be discussed in the following section.

Furthermore, the fund source reflects the marketization of affordable housing. There is a variety of fund sources including government funds, enterprise revenue, and financial credit. For the aspect of financial credit, a common form is the Asset Backed Securities (ABS). Figure 4.7 shows its transaction structure diagram. To reduce investment risk, the shared ownership housing ABS projects usually adopt double Special Purpose Vehicles (SPVs) with fund trusts. A special program is designed for shared ownership housing construction. The original rights holders will issue trust loans to the construction agency (development body) of the affordable housing, which takes the shared ownership housing as a backed asset pool. After the construction and sale of affordable housing, the construction agency uses the sales income as the source of repayment, including differential payment. At the same time, the credit support provider provides financial/liquidity guarantee support for the trust fund and special program. The original rights holders provide the trust fund and transfer the trust beneficiary rights to ABS holders. ABS holders provide the subscription funds to receive the trust beneficiary rights and its according principal and interest. All in all, the developed aim of shared ownership housing is a typical socialist approach, while its construction and sale reflect a certain degree of marketization.

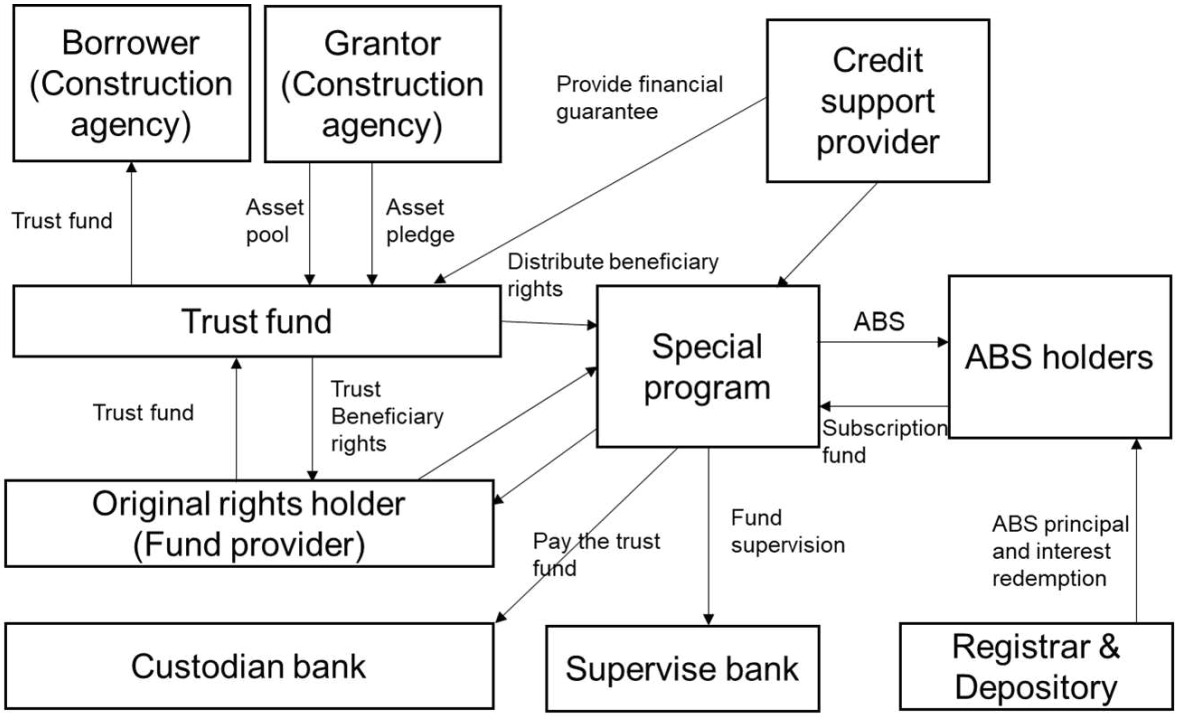



Figure 4.7 The structure diagram of Asset Backed Securities (ABS)

### 4.2.3 Planning Process

In 2009 and 2016, the Shanghai Municipal Government issued the “Guidelines for the Construction of Affordable Housing in Shanghai” and the “Administrative Measures for Shared Ownership Housing Rights in Shanghai”. These two documents define the planning process and planning content for shared ownership housing.

The planning process of shared ownership housing can be divided into two categories: one is the construction of separate sites, and the other is part of commercial residences. The two categories’ difference lies in whether the shared ownership housing is a separate land or a part of the commercial housing land.

Figure 4.8 shows the planning process of the first category. There are three stages: project bidding, land preparation, and management approval. The first project bidding determines the development body of the shared ownership housing, which is organized by the local government. It is the local government, including the housing administration and planning bureau, that prepares the project bidding, including the residential siting, the size of the shared ownership housing, and the qualification of companies participating in the bidding. The second stage is the preparation of land before construction, which is carried out by the Shanghai Housing and Urban-Rural Construction Management Committee after the payment of the land fee from the development body. It deals with the relationship between the separate land and the other city area, including infrastructure and pipelines. The third stage, management approval, examines the planning and construction permits, which involves a publication of the planning project for 30 days.

For the second type of shared ownership housing, its planning process is the same as that of commercial housing. Its ratio and construction requirements shall be specified in the state-owned land use right transfer documents, which shall be carried out simultaneously. After completion, the shared ownership housing shall be handed over to the local housing administration in accordance with the land transfer contract.


Figure 4.8 The planning process of the separate-site shared ownership housing

### 4.2.4 Planning Standard and Design

The “Guidelines for the Construction of Affordable Housing in Shanghai (2009)” strictly stipulated the planning standard of shared ownership housing, including the housing type, number of rooms, and housing area. Table 4.4 shows the detailed housing type according to family structure. There are three types of shared ownership housing. The building area of Type I should not be more than 50 m²; Type II should be around 65 m²; Type III should not be more than 80 m². Therefore, the living area per capita is no more than 25 m² in general. This design guideline ensures that the shared ownership housing is set up to meet the basic living conditions and avoids possible market profit margins.

Similarly, shared ownership housing also has the characteristics of being economical and applicable in terms of community planning. The size of the shared ownership housing tends to be large and concentrated, as a result of the special program’s construction, which leads to the general size of the residential community being about 1 km². In order to save construction costs, the planning of shared ownership housing tends to dominate multi-story residences (4-6 floors). A majority of the residential building is in the form of multi-story residences (Guo, 2015). Because multi-story buildings have relatively low construction costs and less public space (elevator and stairwell) compared to high-rise buildings. Moreover, compared with commercial residences, residential construction is relatively standardized and simplified.

The shared ownership housing is a typical housing type in the large-scale residential area planning. As Figure 4.4 shows, the large-scale community planning involves a large number of communities and a variety of public facilities, including public transport and commercial facilities, which follow the “Standards for public facilities of urban residential areas and district in Shanghai”. The land use of the large-scale residential area planning includes comprehensive land use types and tries to build up a mature urban residential area. However, the construction of the public facilities in reality could be different from the planning design. This study focuses on the practical effects of the shared ownership housing which leads to the overall structure of the social goods distribution.

Table 4.4 The design guidelines of shared ownership housing (Commission et al., 2010)

| Type | Separate room | Flat set mode | Number of people | Family structure |
|---|---|---|---|---|
| Type I | 1 | Single bedroom combined living and dining room | 1 | Single Family |
| | 2 | Double bedroom + living, dining room | 2 | Husband and wife |
| | | Double bedroom combined living room + dining room | | Husband and wife |

| | | | | |
|---|---|---|---|---|
| | | Single bedroom +single bedroom combined living and dining room | | Core family |
| **Type II** | 3 | double bedroom + single bedroom + living-dining room | 3 | Core family; Stem family |
| | | double bedroom + single bedroom combined living room + dining room | | Core family; Stem family |
| | | double bedroom combined living room + single bedroom + dining room | | Core family; Stem family |
| **Type III** | 4 | double bedroom + single bedroom * 2 + living and dining room | 4 | Stem family |
| | | Double bedroom + Single bedroom + single bedroom combined living and dining room | | Stem family |
| | | Double bedroom * 2 + single bedroom + living and dining room | 5 | Stem family |
| | | Double bedroom + Single bedroom + double bedroom combined living and dining room | | Stem family |

## 4.3 The Rectification to the Evaluation Framework for Spatial Justice in the Shanghai Case

### 4.3.1 Rectification Principles

This section tries to rectify the ideal model of spatial justice in Chapter 3 into a practical evaluation framework for spatial justice in the Shanghai shared ownership housing case. There are four key principles in rectification.

First is the feasibility of the empirical study. The theoretical model of spatial justice focuses on the bridge between justice philosophy and planning discipline, while the empirical case of Shanghai shared ownership housing emphasizes practical evaluation. The evaluation index system requires basic data which can be obtained in the research. The feasibility of the research is a priority in the empirical part. Therefore, those indicators that lack realistic feasibility are excluded.

Secondly is a simplification. There are multiple evaluation dimensions in the empirical part, including temporal dimension (before and after the shared ownership housing planning), spatial dimension (different locations in Shanghai), resource dimension (different basic resources and their distinct levels, i.e., medical resources, primary, and junior schools), and philosophical approaches to justice. It is important to simplify the

empirical framework to arrange the above analysis dimensions and conduct a clear, efficient, and effective case study.

Thirdly is the representation and comparativeness. Although the Shanghai shared ownership housing case owns a certain socio-spatial character, this research tries to build up a representative and comparative case study of a modern Chinese city during its rapid growth. The case of Shanghai shared ownership housing tries to analyze the realization of spatial justice in the typical context, which can be compared with other cases in the other region and areas.

Last but not least, it is the comprehensive logic of the evaluation framework. The evaluation of spatial justice in the Shanghai shared ownership housing planning aims at a comprehensive assessment via the above multiple analysis dimensions.

### 4.3.2 The Rectification of Evaluation Framework and Indicator System

Table 4.5 shows the evaluation framework for spatial justice in the case of analyzing Shanghai shared ownership housing planning. There are two dimensions: horizontal and vertical comparison. The horizontal comparison refers to the spatial distribution of five basic social goods, including public transportation, basic medical and education resources, job opportunities, and green space. Each resource has four indicators to describe its distributive justice. The first indicator, accessibility, describes the resource acquisition per capita regarding facility utilization and spatial distance. Its proper calculation method is a major difficulty in the measurement process, which will be discussed in the following sections. Availability refers to the number of social goods located in certain living scopes, which will be determined by the Shanghai Planning Standard and spatial utilization of the specific resource. Proximity refers to the distance from the residential community to the nearest resources. The above three indicators are all based on quantitative analysis via GIS/QGIS software. The last indicator, affordability, is based on qualitative analysis and focuses on the facility-using thresholds in socioeconomic policy.

If we define the horizontal comparison as a resource dimension in spatial justice, then the vertical comparison puts emphasis on residents' interests and institutional impact in spatial justice. The vertical comparison firstly analyses the spatial-temporal statuses of shared ownership housing residents according to their decisions regarding the five-resource distribution. Each resource should conduct its temporal comparison (in 2010 and 2017) to compare its distributive justice before and after the construction of shared ownership housing planning. However, due to the limited data resources, the basic data part of the five social goods is available. Secondly, a compressive qualitative analysis will reveal what kind of justice and philosophy and how space reflected during the Shanghai shared ownership housing planning process. This section tries to build a version that how distinct philosophy approached to justices interwoven and pulled by each other in the case study, as well as provides certain suggestions and lessons to be learned in the realization and analysis of spatial justice.

Table 4.5 The evaluation framework and indicator system of spatial justice in the case of Shanghai shared ownership housing planning

| Category | Indicator | Content | Evaluation method |
|---|---|---|---|
| Horizontal comparison (the indicator of five basic resources, including public transportation, basic medical and educational resources, job opportunity, and green space) | Accessibility | Resource acquisition per capita regarding facility utilization and spatial distance | Quantitative |
| | Availability | In a daily living scope, how many resources are available? | Quantitative |
| | Proximity | What is the distance to the nearest facility? | Quantitative |
| | Affordability | Can people afford the cost of certain facility utilization? | Qualitative |
| Vertical comparison (different statuses of shared ownership housing residents) | Status comparison | Resource acquisition between different spatial-temporal statuses according to shared ownership housing residents' decisions | Quantitative |
| | Philosophical school analysis | What kind of philosophical claims are reflected behind the different phenomena? | Qualitative |

## 4.4 The Study Objects

### 4.4.1 The Spatial-temporal Scope

This study, due to the data availability, chose two points in time as comparative temporal scopes: 2010 and 2017. Since the Shanghai shared ownership housing policy began in 2010, its realistic construction and major impacts had not begun then, which was regarded as a status before policy implementation. In 2017, the policy had been implemented for 7 years, which was regarded as a status after the planning realization.

This study chose the administrative land region of Shanghai (6340.5 $km^2$) as the research area (Figure 4.9) for three reasons. First, the gap in spatial injustice between rural and urban areas is significantly larger than the gap between districts in the urban area of Shanghai (Xiao et al., 2017). Due to the ambiguous boundary between the rural and urban areas, the administrative region is necessary to delineate a full scope of spatial justice of health facilities. Secondly, the giant difference between the size of census blocks in the rural area and urban area is idealistic for observing the MAUP. The greater the difference between cell sizes, the more obvious the MAUP effect (Dark & Bram, 2016). Also, an extensive study area is desirable for the observation of the urban expansion and the corresponding medical resources development and the reliability of the multivariate analysis.

When it comes to the analysis of objects, this study has a focus on social goods. Social goods are the goods or services that are beneficial to society as a whole. Within the social goods, public goods have a natural attribution of fairness, which is mainly reflected in three aspects. First of all, the consumption of public goods is non-excludable and non-competitive. Once public goods are provided, they are open for everyone to use. The utilization of anyone should not affect others' utilization of public goods. Secondly, the provision of public goods should follow a fair and just mechanism. Private goods are produced for profit-seeking motives. On the contrary, public goods should be provided to all members of society without further limitation to guarantee individual liberty. Thirdly, the provision of public goods can make up for market failure and safeguard the needs of social public interests. The fair and just spatial distribution of public goods are crucial for the development balance. Therefore, this study focuses on the four public goods, including medical resources, educational resources, public transportation, job opportunities, and green spaces (parks). In addition, considering the well-being of residents, job opportunities are also included in this study. This research focuses on five basic social goods, i.e., medical resources, education resources, public transportation, job opportunity, and green space (parks).

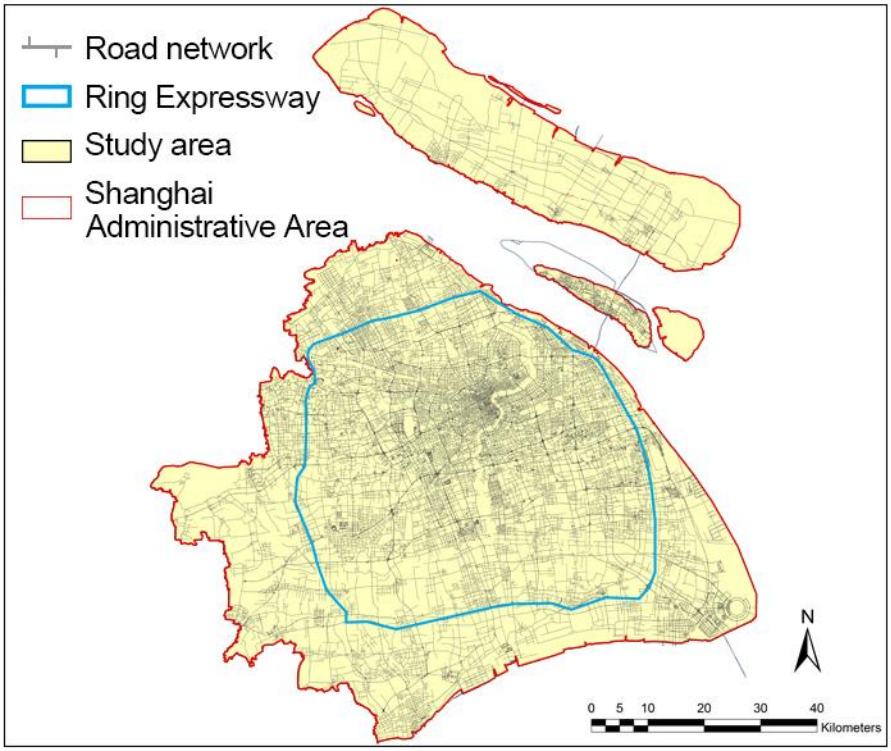



Figure 4.9 Study area

As stated above, the study focuses on five basic social goods: medical resources, educational resources, public transportation, job opportunity, and green space. The locations and service capacities vary according to different resources because of data availability. For medical resources, the Chinese official three-tier level is set as a benchmark of the service capacities of different medical institutions. For education resources, primary schools and junior middle schools are the main study objects. Public transportation includes road networks, underground stations, and buses. Job opportunity is an estimated value based on company type and size. Green space refers to the public park providing entertainment space for the public, which excludes protective green belts and private green space.

### 4.4.2 Data Sources

There are three data sources: the 2010 sixth national population census of the People's Republic of China, Urban Data Party, and EXPO Shanghai Atlas (Atlas, 2010). These three sources provide three kinds of basic data: population, transport, and Points of Interest (POI) data. All data require its distribution both in 2010 and 2017. The 2010 population data comes from the sixth federal population census, while the 2017 population generated from cell phone signaling data, purchased from Urban Data Party. The transport data include road networks, subway lines and stations, and bus lines and stations. The facility's data include the distribution of five basic social goods: job, transport, green space, medical, and education resources.

The original Points of Interest (POI) data was purchased from Urban Data Party (UDP) via its data service. The datasets provided by UDP are accessed from AMAP through web crawler technology. The Urban Data Party membership provides cell phone signaling data, road network data, and the points of primary schools, companies, bus stations, parks, and hospitals in Shanghai in 2017. This study used cell phone signaling data to generate the Shanghai population grid. UDP has subsequently deleted the 2017 cell phone signaling data and instead cooperated with WorldPop et al. (2000-2018) to provide a broader map of population density that is publicly available.

As an alternative to the restricted UDP datasets, OpenStreetMap provides publicly available POIs and road network data of Shanghai, while WorldPop provides the population density of Shanghai.

The underlying data consists of the cell phone signaling data, road networks, point of interest (POI) data (hospitals, schools, companies, green parks, and bus stations) in Shanghai in 2017, which was purchased from Urban Data Party (UDP) via its data service. These datasets cannot be made publicly available because they are under copyright to Urban Data Party. The following URLs are only available with Urban Data Party member registration:

•Points of schools

https://www.udparty.com/index.php/detail/articledetails/?id=4502…title=19\%E5\%B9\%B4\%E4\%B8\%8A\%E6\%B5\%B7\%E5\%B8\%82\%E6\%95\%99\%E8\%82\%B2\%E5\%A4\%A7\%E7\%B1\%BBPOI\%E6\%95\%B0\%E6\%8D\%AE

•Points of hospitals, companies, green parks, and bus stations

https://www.udparty.com/index.php/detail/articledetails/?id=1585…title=\%E4\%B8\%8A\%E6\%B5\%B7\%E5\%90\%84\%E7\%B1\%BBPOI\%E6\%95\%B0\%E6\%8D\%AE\%E6\%B1\%87\%E6\%80\%BB

•Shanghai road network

https://www.udparty.com/index.php/detail/articledetails/?id=3820…title=\%E4\%B8\%8A\%E6\%B5\%B7\%E5\%B8\%82\%E9\%81\%93\%E8\%B7\%AF\%E6\%95\%B0\%E6\%8D\%AE\%EF\%BC\%882018\%E5\%B9\%B411\%E6\%9C\%88\%EF\%BC\%89

•Population density: Urban Data Party has since deleted the cell phone signaling data and updated the population density from WorldPop:

https://dx.doi.org/10.5258/SOTON/WP00675.

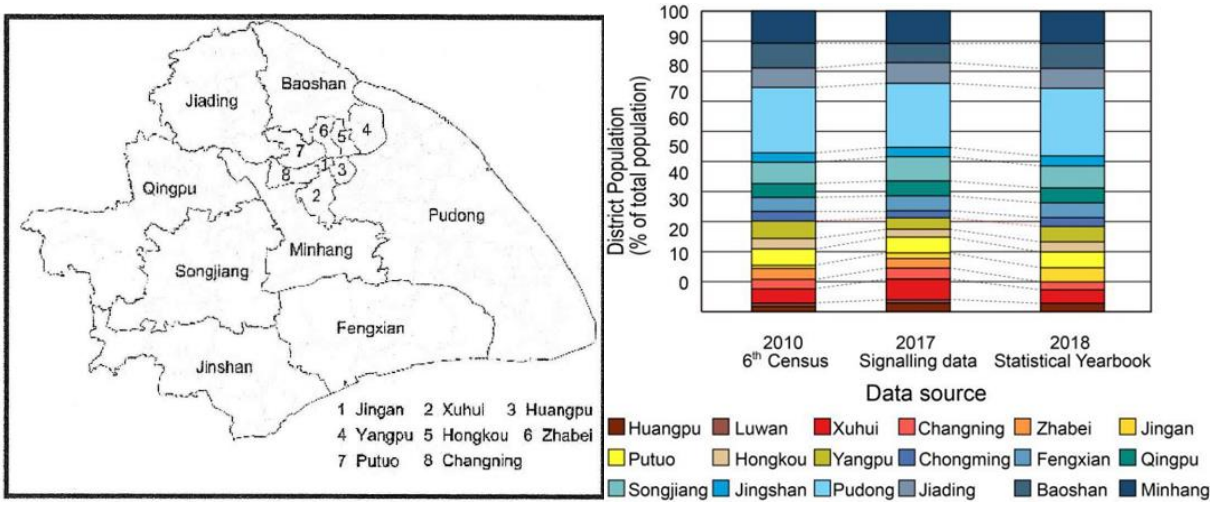
As an alternative to the restricted UDP datasets (points 1-3), OpenStreetMap provides publicly available POI and road network data for Shanghai which is representative of the analyzed datasets: https://www.openstreetmap.org/relation/913067. This data can be downloaded directly on the website via the Overpass API. The QGIS plug-in

QuickOSM can also download the OpenStreetMap data and convert it to shapefiles, see tutorials here.

### 4.4.3 Data Processing

By integrated application of the software, ArcGIS, QGIS, and Navicat for MySQL, this study compares the four indicators of five basic social goods in Shanghai, along with various indicators. ArcGIS forms basic data maps, i.e., population, transportation, and POI distribution. Due to the huge amount of calculation, QGIS generates the distance matrices between the geometric center points of the population unit and the health facility points, and then Navicat combines all the data to calculate the corresponding four basic indicators of each population unit. Since the measurements of the four basic indicators vary and the population in 2010 is reliable, in this section we focus on the estimation of population distribution in 2017.

Figure 4.10 examines the reliability of the population distribution formed from the phone signaling by comparing the results with the population of the sixth national population census and the 2018 statistical yearbook (Statistics, 2018). The warm colors indicate inner-city districts, and the cool colors represent suburb districts In. The similarity of population distribution by administration districts from three data sources ensures that the population created by the signaling data is robust. However, due to the total population growth, Shanghai's population density gradually expanded from urban areas to suburbs from 2010 to 2017 (Figure 4.11 and Figure 4.12), reflecting the rapid urban development and urban sprawl on geospatial.




A. District distribution in Shanghai B. District population

Figure 4.10 District population (% of total population) from different data sources

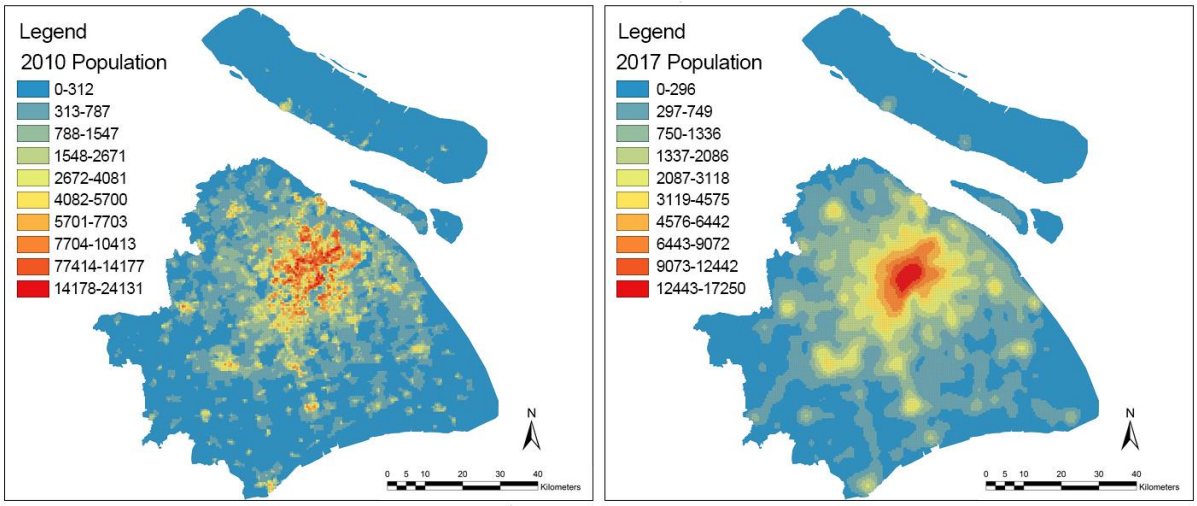
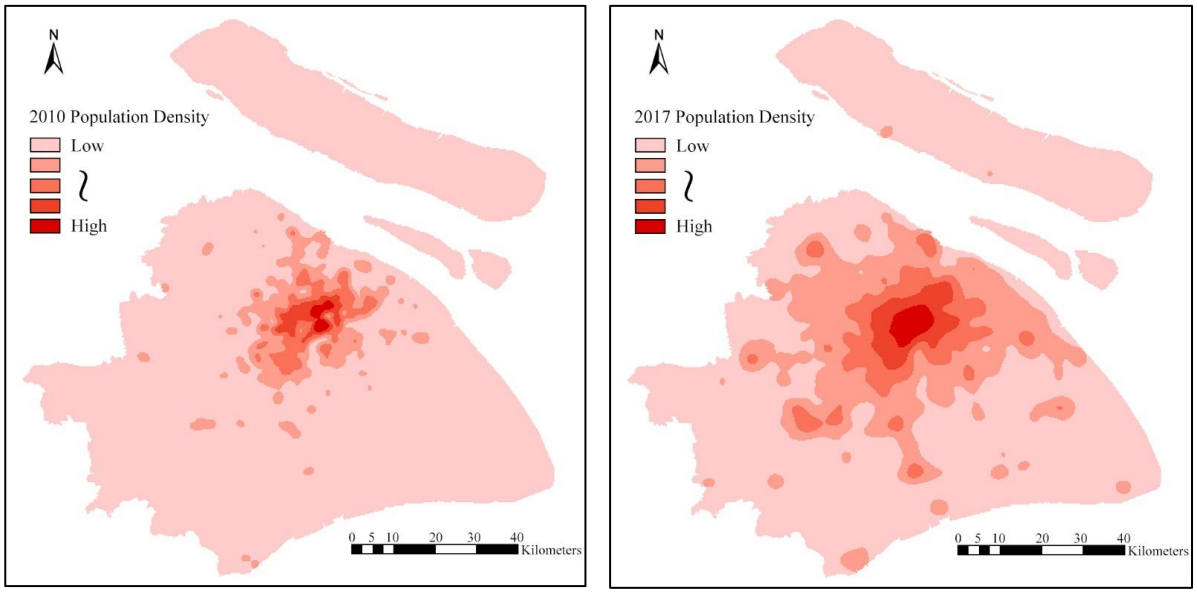



Figure 4.11 Shanghai 2010 and 2017 population distribution maps (generated from the 2010 PRC sixth national population census and Urban Data Party)




A.2010 Shanghai population density B. 2017 Shanghai population density

Figure 4.12 Shanghai 2010 and 2017 population density maps (same sources as above)

## 4.5 Major Indicator Measurements: Accessibility

Spatial accessibility to various facilities has been a key concept in assessing the distributive justice of social goods (Yang et al., 2006), revealing social inequality in physical space (Guagliardo et al., 2004) and providing suggestions on social goods for policy makers (Neutens, 2015). Manifold critical factors related to geographical context convey the complexity of health accessibility assessment, involving the scale of spatial analysis (Higgs, 2004) (region, city, or community level), different types, levels, and

capacities of health facilities (Spencer & Angeles, 2007; Taleai et al., 2014), individual socioeconomic statuses and preferences (Dadashpoor et al., 2016; Giles-Cortia & Donovan, 2002; Paez et al., 2010), neighborhood characteristics and boundaries (Vallée et al., 2014; Wan, Zou, et al., 2012), and social exclusion (Preston & Rajé, 2007). Among those critical factors, the importance of methodology and its correlation with spatial equity annotation have been widely recognized since Talent and Anselin's evaluation of different accessibility measures (1998). Scholars have endeavored to build various accessibility models to reflect proper distributive justice, including but not limited to the buffer model, isochronous model, and cumulative-opportunity model, which further intensifies the diversity of spatial accessibility.

Despite the diversity and complexity of accessibility (Wang, 2012), univariate analysis in the measurement of accessibility has been a popular discourse to improve accessibility models. Controlling other constituents as the same, scholars evaluate the efficacy of certain variables in the gravity model, such as unit aggregation (Bell et al., 2013), distance type (Apparicio et al., 2008), and distance decay coefficient (Giles-Cortia & Donovan, 2002). The univariate analysis with the control variable method reveals the impact of crucial aspects and promotes specific calculation methods of critical parameters in the assessment. As a decomposition of the complexity of accessibility models, the univariate analysis separates the function and influence of determinants from multiple variables in accessibility models to conduct definite improvements.

However, due to the flexibility of the accessibility model (Neutens, 2015), the univariate analysis focusing on one determinant also raises apprehensions about other variable settings. The improvement in certain determinants is accompanied by the neglect of the other variables. Mao and Nekorchuk (2013) propose a multi transportation method for health accessibility with concerns about the disregard of hospitals' service capacity and population datasets. Hewko et al. (2002) examine aggregation-error effects in neighborhood spatial accessibility with worries about the limited distance type. This kind of bewildering distress derives from the confines of the control variable method, which omits the relative importance and interrelations of determinants in the accessibility model.

These apprehensions focus on a central question: given the specific geographic context, what are the proper settings of various determinants in the measurement to approximate the exact accessibility distribution? Past research frequently approaches this problem by adjusting accessibility models based on theoretical simulations of realistic healthcare services utilization. Notwithstanding the diversity and flexibility of methodologies, there is a considerable gap between theoretical simulations and accessibility results. Studies that implement determinant measurements in accessibility models based on theoretical simulations to solve related issues, such as the border-crossing problem and distance impedance, lack evidence of the effectiveness of measurements and simulations in the results (Higgs, 2004). On the other hand, counterintuitive patterns in accessibility maps may not attribute to the determinant

measurements, but to the setting of covariates regarding geographical contexts (Kwan, 2012; Luo & Qi, 2009).

This section focuses on the methodologies of accessibility measurements by three levels: the key factors in accessibility measurements, the role of weights in the accessibility's Floating Catchment Method (FCA), and the evaluation standards of accessibility measurements. For the first subsection, this study took health facilities as the research objectives and determined which factor matters in accessibility measurements. The first subsection established the FCA methods, which are the variant gravity model, as the basic models of accessibility measures. Secondly, the proper way of using weights in the FCA method has been explored in measuring the accessibilities to three facilities, including primary schools, job opportunities, and major hospitals. Finally, the third subsection explores the question of how to evaluate an accessibility measurement by taking the primary schools in Shanghai as the research object. The triple empirical performances, then, have been determined as the basic evaluation methods.

### 4.5.1 Key Factors in Assessing Accessibility

This subsection presents a multivariate analysis of accessibility measurements towards a rational combination of determinants by providing supportive evidence of the respective impact and interrelations of determinants. The multivariate analysis devises a three-level framework of the determinants, including three methods (the general gravity model, the two-step floating catchment area (2SFCA) method, and Kernel density estimation (KDE)), four parameters (distance, distance decay coefficient, catchment area, and supply capacity) and two surface types (polygon and raster). To ensure the reliability of the analysis, the accessibilities to three kinds of health facilities, that is, Shanghai's main hospitals in 2010 and 2017 and all health facilities in 2017, are compared within the seven typical model configurations. By the comprehensive multivariate analysis, this study differentiates the influence spectrum of determinants and possible fallacies caused by the superimposing of specific determinants. It provides practical recommendations for the organization of determinants and objective evaluation of health accessibility methods.

#### 4.5.1.1 Gaps in Accessibility Measurements

As a reflection of the composite connotation, accessibility measurements translate research foci into parameter settings in GIS models to produce consistent accessibility results. Various model parameters and impact factors, along with those above complicated geographic issues, necessitate univariate analysis for the influence of specific parameters and factors. The univariate analysis targets a particular element, explores reasonable values of the component, and examines its impact on accessibility distribution, as well as omits relative impact and interaction of determinants. The process of parameter examination also produced a differentiation between theoretical simulation and empirical results. Research gaps in accessibility measurements, regarding limitations of univariate analysis and the distinction between theoretical simulation and

practical effect, require multivariate analysis and focus on empirical results in accessibility assessment.

#### 4.5.1.1.1 Limitations of Univariate Analysis

This part focuses on univariate analysis of the three widely applied methods in the accessibility to health facilities: the gravity model, the 2SFCA method, and the KDE method. The univariate analysis derives from diverse value settings of numerous influence factors in accessibility models and helps examine the influence of varying factors on accessibility distribution. Dissecting the limitations of univariate analysis requires interpreting which variables currently signify, the determination approaches, and the interaction between them.

In particular, there are three critical factors in the gravity-based models of health accessibility: healthcare capacity, population demand, and geographic impedance (Luo, 2004; Wan, Zou, et al., 2012). First, fundamental indicators of healthcare capacity include staffing capacity, medical equipment, and the number of beds and physicians. At the same time, varying types and grades of health facilities increase the adversity of assessing the service capacity and offer great flexibility in the weighting of the indicators in addition to the official hospital grade. The catchment area in the 2SFCA method defines the service area of a health facility diverging in distance type and numerical value according to facility types. The radius of the catchment area can be 3 km distance (Tang et al., 2017), 20 km network distance (Yang et al., 2006), or 30-min driving distance (Luo & Wang, 2003). Lucas et al. (2015) attribute varied catchment sizes to differentiated accessibility results. Secondly, population demand generally equals the number of residents in a geographic unit, while specific research focus can extract specific social groups from the general population, such as the senior, the impoverished, or the ethnicity-specific groups. And the geographical units can be in the form of census tracts, census blocks, neighborhood tracts, dissemination tracts, and grids, even refined to specific households depending on the spatial scale of research (Taleai et al., 2014).

Thirdly, geographic impedance can be divided into direct distance measure and distance decay. Direct distance measures include Euclidean distance, Manhattan distance, network distance, transit time, transit cost, shortest network distance, and shortest network time. Bunel and Tovar (2013) argue that time-based measures generate more consistent results than distance-based models. Mao and Nekorchuk (2013) prove that multi-transportation and single-transportation models produce distinct accessibility estimations in urbanized areas, with similar outcomes in rural areas. Distance decay has sophisticated assignment approaches. One is to apply various distance decay functions, including the exponential function, the gravity function, the binary discrete, the multiple discrete, the Kernel density, the inverse-power function, the Gaussian function, and piecewise decay functions, etc. (Neutens, 2015; Wan, Zhan, et al., 2012). An alternative approach is to base on the survey to simulate the distance decay in realistic facilities utilization. Giles-Cortia and Donovan (2002) examined the

value of the distance decay coefficient (β) in a simple exponential function through investigations (see Eq. (A.1)). They evaluate that β equals 1.91 in the utilization of public open space and equals 1.03 for the golf course, which is consistent with people's endurance of long travel to use golf courses and preference to near green space.

The mentioned multiple determinants in accessibility models raise the problem of their own importance and sensitivity. Whether to emphasize one or another determinant is a controversial issue within accessibility models. The univariate analysis can ascend to the influence and evaluation of one parameter, but it fails to figure out which determinant is more critical. Therefore, researchers use multivariate analysis to generate accessibility distribution under different model configurations. Yang et al. (2006) contrasted the accessibility patterns made from the 2SFCA and the KDE and found that the 2SFCA is less problematic with a smoothing pattern. Apparicio et al. (2008) compared three kinds of census units with two distance methods. Dewulf et al. (2013) applied four accessibility methods within three types of spatial census. Notwithstanding the application of multivariate analysis, those studies accentuate specific assessment methods and particular model configurations instead of the relative importance and interaction of determinants.

Although the influence mechanism of each determinant remains ambiguous, there are covered hierarchical interactions between the determinants. In the 2SFCA models, the population distribution not only affects the demand simulation but also has impacts on the catchment area of health facilities. Different unit aggregations, as well as the distance calculation and the facility type and level, might change the community involvement of certain health facilities. Additionally, the distance decay can adjust its value and function according to catchment subdivisions (Luo & Qi, 2009). Similar to the catchment, bandwidth in the KDE representing the potential service area of health facilities are confronted with those plentiful influence factors and the difficulties in value selection. The influence factors include specific kernel functions, distance calculations (Okabe et al., 2009), and service capacities of health facilities (Spencer & Angeles, 2007). The bandwidth has a substantial impact on the distribution of accessibility calculated by KDE because of its boundary limitation of facility catchments and its significant effects on density estimation (Maroko et al., 2009). The limitations of univariate analysis led up to the application of multivariate analysis in this study, aiming at the respective sensitivity and interrelationships of determinants.

#### 4.5.1.1.2 Differentiation between Theoretical Simulations and Empirical Results

Studies that measure spatial accessibility to health facilities often conduct specific theoretical models that establish a logical and causal simulation of real facility utilization (Tang et al., 2017). Using the data of factual cases, the theoretical models generate the geographic distribution of accessibility as the empirical results. In this process, internal differentiation between the theoretical simulations and empirical results identifies the drawback of the accessibility measurements. One is the accessibility

distribution running counter to practical experience and cognition and the other is the methodological problems that account for inconsistencies in simulations.

Researchers frequently find counterintuitive patterns in accessibility results (Luo & Qi, 2009), acting as high accessibility in remote areas and low accessibility in populated districts. It reveals that potential erroneous settings may generate unpredictable results. On the contrary, there is also a possibility that incorrect settings exist in plausible outcomes without distinct features. The failure to recognize whether the erroneous model configurations produce the accessibility results, such as inappropriate unit aggregations (Kwan, 2012) or surface types, is attributed to the unreliability of the outcome and analysis based on personal experience judgment. The subjectivity in accessibility map analyses may, on the one hand, provide planning practitioners and decision-makers with misjudgments about the distribution of medical resources and on the other hand undermine the reliability and rationality of accessibility models.

And this subjectivity in result analysis extends to the methodological approach, which is disguised by accurate quantitative calculations. The application of the KDE is a typical example. While researchers theoretically demonstrate the priority of the KDE to the gravity model because of its simulation of distance decay and bordercrossing healthcare-seeking behaviors (Guagliardo et al., 2004; Maroko et al., 2009), it is unconvincing that the solution of complicated distance impedance and service area issues in facility utilization is the simply ration of the density of facilities capacity and population demand. The subjectivity further appears in the value determination and calculation method of parameters in the model. For instance, whether the stimulation of distance decay should apply the exponential function, the gravity function, or other functions lacks empirical evidence of the health facility utilization. The size of the catchment area is similarly arbitrary in the absence of the actual service area of a certain health facility. Furthermore, it is also problematic to emphasize one parameter or its calculation method among multiple determinants. It could be persuasive that network distance is superior to Euclidean distance with a better simulation of geography and transportation. Still, it is hard to distinguish whether the accessibility applied with network distance and exponential function is better than the one applied in Euclidean distance and precise function.

The gaps between theoretical simulations and empirical results emanate from the unrecognized model fallacy and the subjectivity in the research design. The complexity of accessibility issues not only brings about multiple parameters in the measurements but also adds complication to simulate the value and calculation of the factors in the model compared to reality utilization. It is essential to recognize that the theoretical approach does not confirm the accuracy and validity of the accessibility results. This study, therefore, tries to identify the model fallacy and provide research objectivity by comparing the empirical results from various model configurations.

#### 4.5.1.2 Study Design

To organize the various determinants in accessibility models, this study establishes a three-level research framework, including surface type, parameter value, and model formula (Figure 4.13). The third and core level is the specific model formulas, the general gravity model, the 2SFCA, and the KDE method. The model formulas are the endogenous force of accessibility calculation and determine the types of the second parameter level and the first surface level. The second level, the parameter value, is the core element in accessibility calculation with four main parameters: distance, distance decay coefficient, service capacity, and service area. The general gravity model takes the distance decay into account, ignoring the service area of the health facility, while the 2SFCA model values the service area and ignores distance decay. The first level, the surface type, refers to the two data forms in ArcGIS, polygon, and data, which is the concrete manifestation of accessibility maps. The gravity models generate results in polygons while the KDE method conducts in raster.

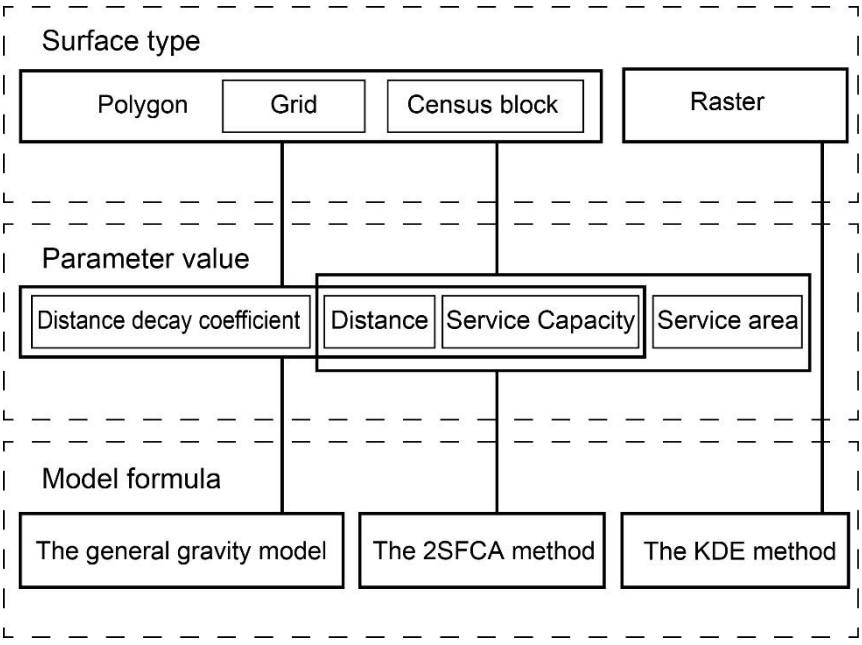



Figure 4.13 A three-level research framework of determinant factors

Table 4.6 The typical parameter combinations in the multivariate analysis

| Nr. | Model formula | Distance type | Supply Capacity | Catchment/ Service area | Unit aggregation | Distance decay coefficient |
|---|---|---|---|---|---|---|
| A1 | the general gravity model | Euclidean | S1 | - | census block | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| A2 | the general gravity model | network | S2 | - | census block | 1 |
| A3 | the 2SFCA method | network | S3 | 20 km | census block | 1 |
| A4 | the general gravity model | network | S2 | - | grid | 1 |
| A5 | the general gravity model | network | S3 | - | grid | 2 |
| A6 | the 2SFCA method | network | S2 | 20 km | grid | 1 |
| A7 | the KDE method | - | - | - | - | - |

For the sake of brevity, this study chooses limited values for each parameter. Distance between communities and health facilities includes the Euclidean distance and network distance. The service area of health facilities is 20km network distance. The distance decay coefficient is simplified to 1 and 2, based on the value of the distance-sensitive facility (β=1.91) and distance-insensitive facility (β= 1.06) (Giles-Cortia & Donovan, 2002). The service level owns three weight sets of four parameters, the official hospital level, the number of beds, the number of physicians, and the number of staff (set 1: 1,0,0,0; set 2: 0.6, 0.2, 0.1, 0.1; set 3: 0, 0.5, 0.25, 0.25). The unit aggregations involve the census blocks (5,432 units) and the 500m * 500m grid (28,250 units). According to the relationship between the model formula and parameter value, there should be 48 parameter combinations for the six main indicators, except for the KDE method. In the early stage, this study tested not only the proper bandwidth of KDE but also eighteen stepwise parameter combinations (see Table 8.1) for the accessibility to all hospitals in 2017. Among them, seven typical parameter combinations, which are the most streamlined and the ablest to reflect the relative impact and interaction between determinants, are shown in Table 4.6.

#### 4.5.1.3 Result Maps and Findings

##### 4.5.1.3.1 The Relative Influences of the Determinants

Figure 4.14 presents the geographic patterns of the accessibility to Shanghai health facilities by applying the seven typical parameter combinations shown in Table 4.6. The accessibilities to three kinds of health facilities, the main hospital in 2010 (α1-α7),

the main hospital in 2017 (b1-b7), and all health facilities in 2017 (c1-c7) are compared horizontally.

Comparing the amorphous geographic patterns with combination features, the results derive the relative impact sphere and sensitivity of the various determinants. Figure 4.15 shows the derivation of the influence hierarchy of the determinants. The determinants with high sensitivity and wide impact sphere refer to the indicators which change the results greatly with their small value change, and vice versa. In comparison with A4, A5 illustrate that the slight value change of the distance decay coefficient can turn the accessibility map from a mono-centric mode to a dispersed pattern. Simultaneously, the accessibility maps of A1 and A2 might be seen as similar at the city level. Yet, the enlarged views of the inner city in both maps reveal the difference made by Euclidean distance and network distance function at the meso level (Figure 4.14).

The multivariate analysis reinforces the gap between empirical results and theoretical assumptions. The KDE method, as researchers contended, is theoretically unlimited by unit boundaries and provides continuously changing accessibility maps, making up for the bordercrossing problem of the gravity model (Apparicio et al., 2008; Guagliardo et al., 2004; Spencer & Angeles, 2007). Notwithstanding, accessibility maps of the KDE vary according to different bandwidths and the A7 maps show the most reasonable pattern in this study. However, it remains counterintuitive compared to the gravity model results (A7), as dispersed and composite structures, with high accessibility values in remote areas, coincide with the results of Yang et al. (2006). And the significant disparities between the results of the KDE and the other methods suggest that the KDE might over-emphasize local accessibility because of the bandwidth which leads to high accessibility values not in more medical resources areas but in less populated areas. Also, network distance theoretically priors to Euclidean distance as the former contains geographical topography and road traffic details. However, the discrepancy between the two probably will not change the spatial structure of the accessibility distribution and may be discernible in certain areas. Another example is the impact of the MAUP. Researchers criticized the ignorance of the MAUP in spatial analysis, which affects the final results of accessibility in the way of unit aggregations and statistical bias (Apparicio et al., 2008; Dark & Bram, 2016). Comparing the A1 and A4 maps, the MAUP could remain the mono-centric structure of the accessibility results and reduce the range of regions with medium accessibility in the condition of few health facilities.

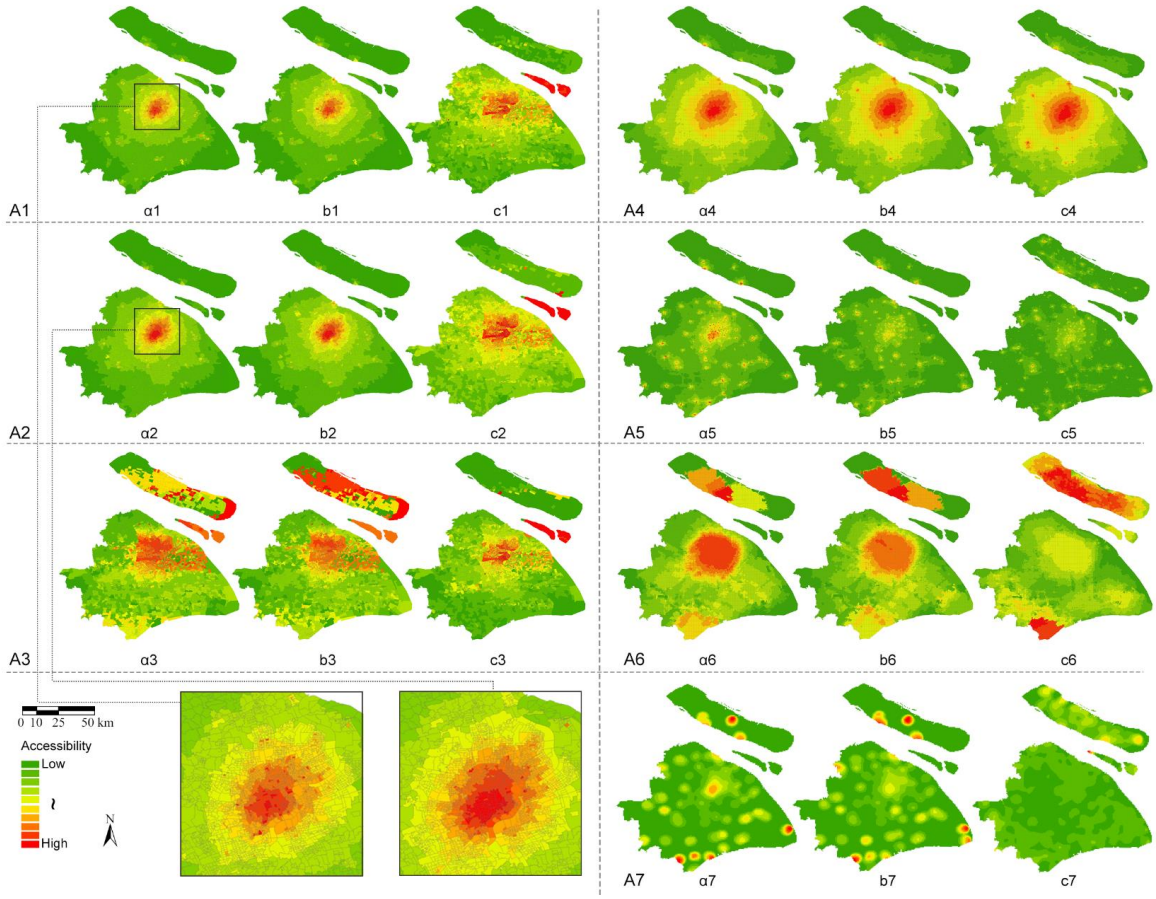



Figure 4.14 Comprehensive comparisons of the accessibility to Shanghai health facilities applying typical parameter combinations

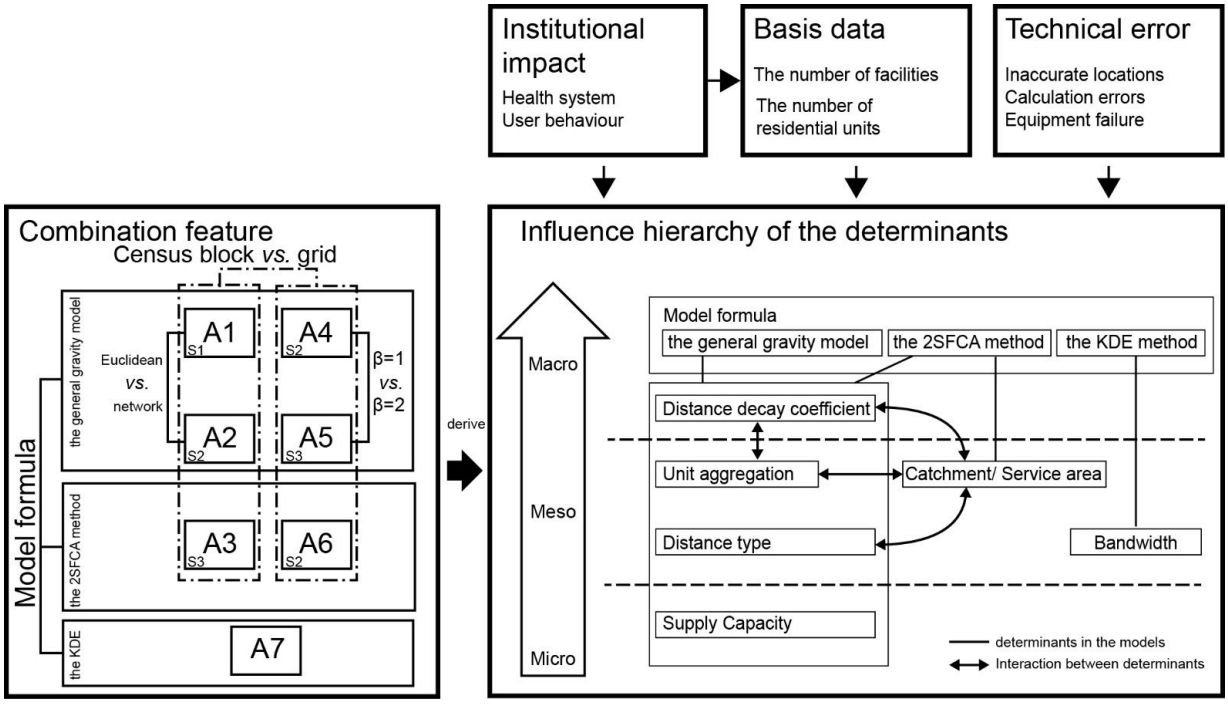



Figure 4.15 The derivation of influence hierarchy of the determinants

However, the influence hierarchy of the determinants is not fixed. Whether a factor has a high level of impact depends not only on its own attribute but also on the institutional impact, basis data, value of other determinants, and potential technical error. Potential technical errors are hard to detect. A minor mistake in early data collection, incorrect parameter settings, or deviation of geoprocessing environments could lead to intangible accessibility measurement inaccuracy, emphasizing or weakening the influence of certain parameters. Another issue is the value of the parameter. Because of the limited calculation methods of each determinant in this study, the influence hierarchy in Figure 4.15 may only be applicable in similar conditions. In the meantime, the interaction between determinant values could change the influence hierarchy. For example, applying census block as unit aggregation may cause not only MAUP but also changes in the catchment area and distance decay. Such synergistic effects among various determinants increase the complexity of their respective impact. Other Influence factors including basis data and institutional impact will be discussed below.

#### 4.5.1.3.2 The Superimposition of the Determinants

There are two striking features in Figure 4.14: discontinuous patterns and the “island effect”. The discontinuous patterns consist of the jumping accessibility values in a continuous space range, as the alternating red and green motifs in the c2 map. The “island effect” means the highest accessibility locate not in populated areas with abundant medical resources but in the middle area, “island”, of those populated areas (McGrail & Humphreys, 2009). This effect extends to the phenomenon of high accessibility values in remote areas, such as the red patches in the northeast islands in the b3 map. The possible reasons for the two features are complicated.

Table 4.7 Summary of the pattern features in the accessibility maps

| Basis data | Unit aggregation | Model | Map number | Pattern features |
|---|---|---|---|---|
| The main hospital | Census blocks | the general gravity model | α1, α2, b1, b2 | normal |
| | | the 2SFCA method | α3, b3 | discontinuous & “island effect” |
| | 1km *1km Grid | the general gravity model | α4, α5, b4, b5 | normal |
| | | the 2SFCA method | α6, b6 | “Island effect” |
| All health facilities | Census blocks | the general gravity model | c1, c2 | discontinuous & “island effect” |
| | | the 2SFCA method | c3 | discontinuous & “island effect” |

| | | | |
|---|---|---|---|
| 1km *1km Grid | the general gravity model | c4, c5 | normal |
| | the 2SFCA method | c6 | The “island effect” |

Table 4.7 summarizes the related factors of the two pattern features in this study, including basis data, unit aggregation, and applied model. The basis data focuses on the total of health facility points, that is, less than 300 main hospitals and more than 4,000 all health facilities. The unit aggregation aims to analyze the role of the MAUP: the census blocks causing the MAUP and the grid addressing the problem. The difference between the general gravity model and the 2SFCA method lies in the continuous (the distance decay coefficient) and the dichotomous measure (the catchment area) of distance decay.

Although researchers blame the catchment size of the 2SFCA method for the “island effect” (Wan, Zhan, et al., 2012), this study suggests that there is no single element that causes problematic patterns, but the superimposition of the determinants. The discontinuous patterns and “island effect” show up in both types of basis data, unit aggregation, and models with different attribute combinations. The “island effect” appears in all cases of the 2SFCA method and only in the general gravity model within census blocks aimed at all health facilities. It indicates that: (1) the 20 km catchment may be too small for the entire study area. Therefore, the “island effect” might be an inevitable phenomenon with small catchments in the 2SFCA method. (2) In the general gravity model, the “island effect” can still exist in the interaction of the MAUP and massive facility points. (3) The deficiency in ArcGIS that fails to identify water bodies and continents may lead to outliners on islands according to specific terrain. On the other hand, the discontinuous patterns accompany the “island effect” and emerge only within census blocks. To be exact, it comes out either in the 2SFCA method aimed at the main hospital or in both models aimed at all health facilities. Since its appearance only in the census blocks, uneven unit distribution, causing the MAUP, could be one of the main reasons for exacerbating the gap between adjacent units. Besides, the interaction of the means that might overemphasize local accessibility, such as massive object points and the catchment area, might also draw in discontinuous patterns.

The irregular patterns identify the cumulative effect of basis data, unit aggregation, and model formula in accessibility measurement. The combination of specific means may exaggerate the difference in accessibility between adjacent units and may overestimate accessibility in remote areas. The comprehensive comparison further exposes the limitation and applicability of the 2SFCA method. Among them, the great magnitude of the catchment size calls for value setting with caution. Inappropriate catchment sizes could result in completely different geographic patterns from the general gravity model, which may also be contrary to the actual utilization of the facility. This study proposes that in the condition of few facilities, applying the 2SFCA method in grids or the general gravity model in census blocks can produce reasonable

accessibility maps. In contrast, in the situation of plentiful facilities, the general gravity model in grids is recommended to deflect us from the counterintuitive results.

#### 4.5.1.3.3 Institutional Influence and Model Characteristics

Besides all mentioned methodological problems, the contextual factors, including the health system and user behaviors, are indiscernible but important elements in the accessibility measurement. Shanghai's health system remains the characteristics of the national health system and further develops its local specialties. The national three-tier healthcare delivery system consists of community-based primary hospitals (first tier), secondary hospitals (second) aiming at multiple communities, and tertiary hospitals (third) serving various districts. Although the healthcare system has undergone market-oriented reforms, it has continued the main body of public health (Meng et al., 2015). As a regional and national medical Centre, Shanghai exacerbates the gap between urban and rural areas and determines an inverted pyramid-shaped allocation of health resources (Liu & Chen, 2016). Among the 44 indicators of the health system evaluated in 2012 by the National Health Reform Office and the National Ministry of Health, Shanghai has 34 indicators ranked first nationwide (Shen et al., 2013). The inverted pyramid-shaped allocation refers to the concentration of high-quality health resources in tertiary hospitals. In the meantime, the service capacity of primary health facilities in Shanghai is relatively weak, especially the conditions in village clinics. Community health service centers in remote suburbs are even worse, resulting in the imbalance of primary health care.

These institutional characteristics lead to residents' preference for tertiary hospitals, bordercrossing healthcare seeking, and geographical inequality of health resources. Because of the absence of two-way referral and graded diagnosis, patients with severe or minor illnesses would prefer tertiary hospitals for treatment (Xu et al., 2011). Dealing with a large number of common diseases impedes the research and teaching of critical and complicated diseases in tertiary hospitals. Even if patients choose the primary health facilities, a delay in treatment may occur due to a lack of fast and unobstructed referrals.

With the convergence of the preferred tertiary hospitals located in the central city, the distance impedance seems to be a minor factor compared to the service capacity in patients' utilization of health facilities. Setting a high value of the distance decay coefficient, which means people taking distance as an essential indicator while using facilities, may be unrealistic to the Shanghai condition. As a result, the A5 maps in Figure 3, applied the high distance decay coefficient ($\beta=2$), generating the dispersed spatial structure, which could be an inappropriate accessibility distribution. Accordingly, the A4 maps could be the most realistic and least problematic results among the seven configurations. By contrast with the c4, the a4, and b4 plans assess the accessibility to the main hospital, reflect the different accessibility distribution of varying levels of health facilities, and validate the concentration of Shanghai's high-quality health resources in the central city.

Furthermore, linking the accessibility change with the new-built hospitals distinguishes the model characteristics. From 2010 to 2017, the expansion of hospitals is accompanied by population growth and urban expansion. Besides the eight new tertiary hospitals in the “5+3+1“project (one construction stagnated because of hospital management problems), 17 above-secondary-tier hospitals have been built outside the city. Despite the population growth, health accessibility will possibly increase at the new hospitals because the increase in demand probably will not exceed the increase in supply. Figure 4.16 shows the locations of new-built hospitals and the change in accessibility to main hospitals from 2010 to 2017. The A6 map, with the 2SFCA method in the grid, shows the scope of the 20km catchment area and highlights the method characteristic. The 2SFCA method tends to strengthen the accessibility around the boundary of the catchment and weaken the ones at the center. The A5 map, with the 2SFCA method in census blocks, reinforces that an interplay of MAUP and 2SFCA causes the discontinuity pattern. The maps applied to the general gravity model (A1, A2, A4, and A5) coincide with the new hospital locations and form patterns that continuously change globally. Relatively, the A7 map manifests that the KDE forms partially continuous patterns which are more sensitive to hospital changes.

#### 4.5.1.4 Conclusion and Discussion

Precise measurements of spatial accessibility to health facilities are prominent for urban planners and policymakers to recognize the supply-demand equilibrium of health resources. However, variations in the determinants of accessibility measurement may provide distorted accessibility distribution for their deviations. This section examined the relative influence of the multivariable and the model characteristics to produce an efficacious description of accessibility to health facilities.

This section applies the three-level research framework to analyze the influence of determinants in the measurement of the accessibility to health facilities in Shanghai. The determinants include three prevalent models (the general gravity model, the 2SFCA, and the KDE method), four corresponding parameters (distance type, supply capacity, catchment/ service area, distance decay coefficient), and two surface types (polygon and raster). By the observation of the accessibility results of seven typical determinant configurations from three basis data, this section identifies that: (1) different determinants engender divergent spheres of influence and sensitivities, which could modify with institutional factors, basis data, and potential technical errors. (2) The cumulative effect of specific determinants could exaggerate the accessibility between adjacent units, overestimate its value in remote areas and cause discontinuous patterns and the "island effect". These specific determinants involve census blocks (the MAUP), small catchment size, massive facility points, and the failure to identify water and continents in ArcGIS. (3) By comparing accessibility changes and new-built hospitals, this research differentiates the institutional influence and the model characteristics. The 2SFCA method tends to strengthen accessibility at the boundary of the catchment area and weaken the center. The general gravity model can form overall

smooth accessibility results consistent with facility changes, while the KDE method can result in partial and sensitive patterns.

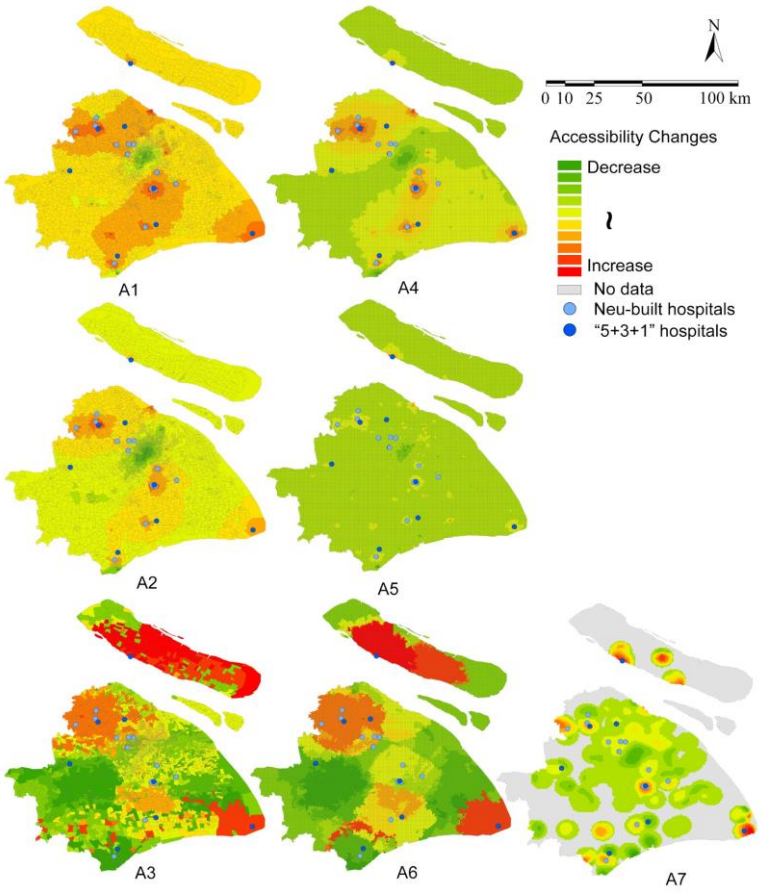



Figure 4.16 The change of accessibility to main hospitals between 2010 and 2017

According to the multivariable analysis, this section recommends applying the 2SFCA method in grids or the general gravity model in census blocks in the condition of few facilities and implementing the general gravity model in grids in the situation of plentiful facilities while assessing the accessibility to health facilities. Besides, the value selection of the distance decay coefficient and the catchment size should be done with caution because of the sensitivity and significant impact of the two factors.

However, there remain critical issues in the overall results. First, the limited value and calculation of parameters restrict the applications of the influence hierarchy. How the determinants influence changes with different calculation methods need further exploration. Secondly, the simulation of user behaviors should be refined. In the case of Shanghai, non-resident patients are a common phenomenon but seldom simulated, who cross the province borders for medical treatment. It leads to the problems of patients' preference for hospitals and the simulation of user behaviors.

Last but not least, the model characteristics raise questions about applicable conditions of model types and rational criteria for accessibility results. The model should be associated with the research theme, institutional system, and user behaviors in consideration of its characteristics. The unidentical accessibility results generated from

model characteristics need rational criteria in addition to empirical experiences. In this study, accessibilities at the new-built hospitals' locations are the standard points to evaluate the model efficacy. Although the accessibility measurement could be a simulation of unrecognized resource distribution, there ought to be underlying judgment and rational criteria for accessibility results. The definition and normative standards of effective accessibility results are crucial in assessing distributive justice and social inequality.

### 4.5.2 Trap of Weights[6]: The Geographical Weights in FCA methods

#### 4.5.2.1 Reusing weights in accessibility measurements

##### 4.5.2.1.1 Evaluation of weights under the complexity of accessibility measurements

The complexity in modeling spatial accessibility is derived from its abundant definitions and methodological flexibility, which vary across different fields and build distinct taxonomies. For example, in transportation, accessibility is defined as the potential to reach spatially dispersed opportunities, with a focus on travel costs and transport policy (Páez et al., 2012). In health studies, accessibility of medical facilities is one of the five dimensions (accessibility, availability, accommodation, affordability, and acceptability) that describe the relationship between health facilities and patient utilization (Penchansky & Thomas, 1981). Guagliardo (2004) deconstructs the concept of health accessibility into two stages (potential and realized) and two dimensions (spatial and aspatial). The former refers to the difference between potential opportunity simulation and actual utilization, while the latter considers spatial factors and socioeconomic attributes.

The many definitions of 'accessibility' lead to a variety of accessibility-modelling methodologies. The initial container method takes accessibility as the number of facilities in a given unit (Talen & Anselin, 1998). The minimum distance and travel cost methods prioritize transportation in determining facility utilization (Guy, 1983). The Kernel density method estimates the relationship between facility density and population density (Yang et al., 2006). However, few models consider user behavior in their measurements. For example, residents' facility utilization can extend beyond their communities, and has a declining frequency as travel distance increases (Higgs, 2004). This is due to so-called 'spatial barriers' (Guagliardo et al., 2004; Neutens, 2015). To account for this, the gravity model introduces a distance decay function in assessing population demand and defines accessibility as the sum of facilities' supply-demand ratios related to a given community. FCA methods are special applications of the gravity model that use catchment areas to simulate the geographical sphere of facility utilization and calculate the supply-demand ratios within catchments (Luo & Wang, 2003).

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[6] Parts of this section have been published: Zhang, L. (2021). Trap of weights: The reuse of weights in the floating catchment area (FCA) methods to measuring accessibility. *F1000Research*, *10*(751). https://doi.org/10.12688/f1000research.51483.1

As this study aims to examine the influence of reusing weights in the last step of the FCA methods, the complexity of modelling accessibility increases the difficulty of selecting appropriate evaluation dimensions for their impact. Despite the mentioned influencers, the study chose two dimensions---model type and resources---as the evaluation dimensions for the impact of the reusing weights. (Bunel & Tovar, 2013) identified the model type as a key issue that can generate different empirical results in accessibility measurements. Although the methodological improvements have driven the reuse of weights, it is a conceptual transform in the FCA methods (Wan, Zhan, et al., 2012). This conceptual shift should be investigated in a variety of FCA variants for its legitimacy. Moreover, the FCA methods are applied in measuring various resources' accessibility, including health facilities, jobs, and urban parks (Delamater et al., 2019; Kawabata & Takahashi, 2005; Xie et al., 2018).The wide application of the FCA methods to different resources reflects the fact that the rationality of the methodology can transcend the resource characteristics. This means that differences in resource types do not affect the validity of the method. Thus, comparing the same method across resources allows further testing of the methodological generality. This study introduces a dimension of model type to test the legitimacy of reusing weights and a dimension of resources to examine its generality. The following section reviews how methodological improvements have driven the reuse of weights in FCA methods, as well as the potential limitations of reusing weights.

#### 4.5.2.1.2 The development of FCA methods: The ‘omnipotent’ weights

Distance weights play a major role in the development of FCA methods (Langford et al., 2012). A series of methodological improvements have focused on changes in the application of weights for varied purposes (Luo & Qi, 2009; Wan, Zhan, et al., 2012; Wan, Zou, et al., 2012). The original 2SFCA has two calculation stages: first, the population demand within the supplier's catchment area is summed to calculate the supply-demand ratio for each supplier. Second, these supply-demand ratios are then summed within the catchment based on the neighbor tracts, which is the value of access (see Equation 4-1).

Equation 4-1

$$A_i^{2S} = \sum_{j \in C_i} R_j = \sum_{j \in C_i} \frac{S_j}{\sum_{k \in C_j} D_k}$$

$A_i^{2S}$ represents the access at tract $i$ based on the 2SFCA method, $C_i$ is the catchment centred at tract $i$, $R_j$ is the supply-demand ratio of supplier $j$ which falls in the catchment centred at tract $i$, $S_j$ is the supply capacity of supplier $j$, $C_j$ is the catchment centred at

supplier *j*, and $D_k$ is the population demand of tract *k*, which falls in the catchment centred at supplier *j*.

The E2SFCA method enhances the stimulation of population demand in 2SFCA (Luo & Qi, 2009). It applies a distance decay function in the population demand to change it from a dichotomous calculation to a continuous variable. is the distance decay function in the form of a power function. The distance weight and population demand decline as the distance increases.

Equation 4-2

$$A_i^{E2} = \sum_{j \in C_i} R_j^{E2} = \sum_{j \in C_i} \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot D_k}$$

Equation 4-3

$$w_{kj} = d_{kj}^{-\beta}$$

$A_i^{E2}$ represents the access at tract *i* based on the E2SFCA method, $R_j^{E2}$ is the supply-demand ratio of supplier *j* which falls in the catchment centred at tract *i* calculated by the E2SFCA method, $w_{kj}$ is the distance weight between tract *k* and supplier *j*, $d_{kj}$ is the distance between tract *k* and supplier *j*, $\beta$ is the decay coefficient, and the other variables are the same as in Equation 4-1.

Furthermore, the M2SFCA method argues that not only population demand decreases with distance, but also service effectiveness of suppliers (Delamater, 2013). In M2SFCA, the effectiveness is calculated using distance weights plus the supply capacity for each pair of tracts and suppliers (see Equation 4-4). $A_i^{M2}$ represents the access at tract *i* based on the M2SFCA method, $w_{ij}$ is the distance weights between tract *i* and supplier *j*. Equation 4-5 is the distance decay function, $d_{ij}$ is the distance between tract *i* and supplier *j*, and the other variables are the same as in Equation 4-2 and Equation 4-3.

Equation 4-4

$$A_i^{3S} = \sum_{j \in C_i} R_j^{3S} = \sum_{j \in C_i} \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot w_{kj}^s \cdot D_k}$$

Equation 4-5

$$w_{kj}^s = \frac{w_{kj}}{\sum_{m \in C_k} w_{km}}$$

Unlike M2SFCA, the 3SFCA method tries to solve the exaggeration of population demand in the E2SFCA (Wan, Zou, et al., 2012). As in Equation 4-2, the population of tract *k* is calculated multiple times in accordance with the number of suppliers within tract *k*'s catchment. The solution is to introduce the supplier weights into population demand. For certain tract *k*, its supplier weight of supplier *j,* $w_{kj}^{S}$, equals its distance weights $w_{kj}$ divided by the sum of the distance weights of all suppliers within its catchment. In Equation 4-4, $A_i^{3S}$ represents the access at tract *i* based on the 3SFCA method. Equation 4-5 is the calculation of supplier weight $w_{kj}^{S}$ between tract *k* and supplier *j*, where supplier *m* is the supplier's fall in the catchment of tract *k*, and $w_{km}$ is the distance weights between tract *k* and supplier *m*.

Figure 4.17 shows the development of four FCA methods, as well as their differences. For various intents, the adaptation of geographic weights has continued throughout the FCA improvement process. Based on the original 2SFCA, the E2SFCA introduces distance weights in population demand to model spatial barriers in resource utilization, which results in declining population demand as the distance between the supplier and the consumer increases. Further to this, the M2SFCA has placed distance weights on the supply capacity to model distance barriers in resource effectiveness. The 3SFCA improves on the E2SFCA's population demand calculation by factoring in the supplier weight. For a distance between a census unit and a supplier, its supplier weight equals its distance weight divided by the sum of the distance weights of all suppliers that are located in the catchment area of the unit. The supplier weight distributes population demand in accordance with spatial barriers and simulates the competition among suppliers. Especially in the M2SFCA and the 3SFCA, the reuse of weights is the main method to achieve their improvement goals.

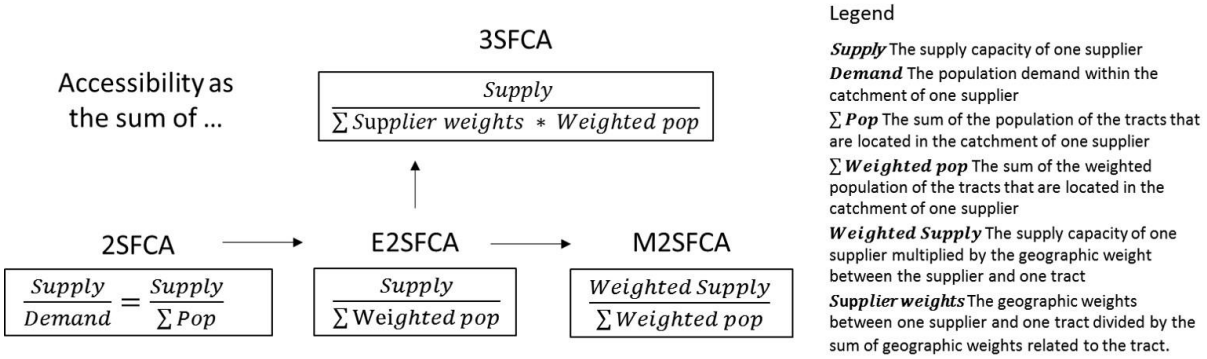



Figure 4.17 The development of floating catchment area (FCA) methods, where E2SFCA is enhanced two-step FCA, M2SFCA is the modified two-step FCA, 3SFCA is the three-step FCA, and 2SFCA is the flow-based method. The adaptation of geographic weights has continued throughout the improvements.

Similarly, geographic weights are the solution to the high sensitivity of the distance decay coefficient, which is a common problem in the methods described above (Xing et al., 2018). The value of the distance decay coefficient $\beta$ an significantly change the

accessibility distribution, even from a monocentric to a decentralized structure. This raises two questions: how should a suitable value for the decay coefficient be determined, and to what extent should it influence the accessibility distribution? For the first question, the normal arbitrary value of $\beta$ ranges from 1.0 to 2.2 (Luo & Qi, 2009; Luo & Wang, 2003). One practical and rationale way to determine the coefficient values for the different facilities is to use questionnaires to simulate the spatial barriers in facility utilization (Giles-Cortia & Donovan, 2002). For the second question, Wan, Zhan, et al. (2012) argue that accessibility distribution should remain stable regardless of the coefficient value. This is because the decay coefficient describes how utilization intention and service effectiveness declines with increasing distance. For example, when $\beta$ equals 1, the distance weight for a census tract 5 km from the hospital equals 0.2, while when $\beta$ is 2, the weight equals 0.04 (Equation 4-3). Both values can be appropriate according to divergent individual preferences. However, it is difficult to deal with the uncertainty around the individual use of facilities in the place-based FCA methods. Their solution is to retain the distance-decaying nature, but to remove the influence of $\beta$ by taking accessibility as the sum of weighted supply-demand ratios, i.e., the access ratio. The distribution of access ratio is relatively stable, with similar patterns under different values of the distance decay coefficient.

Table 4.8 shows the comparison of access Ai and access ratio $A_i^R$ of the three methods. The difference between 'access' and 'access ratio' is whether to multiply the suppliers' supply-demand ratios ($R_j$) by distance weights ($w_{ij)}$ in the final step. The differences between E2SFCA, M2SFCA, and 3SFCA is the way to calculate the suppliers' supply-demand ratios ($R_j$). The E2SFCA calculates Rj as supplier capacity divided by weighted population. The M2SFCA argues that the supplier capacity also decreases while distance increases and multiplies supplier capacity by the distance weight. The 3SFCA reveals the double-counted population demand and multiplies population demand by the distance weight and the supplier weight.

Defining accessibility as the sum of weighted ratios has been widely applied in various FCA methods due to its relatively simple implementation (Fransen et al., 2015). In the measurements of access ratios ($A_i^R$), there is limited consideration of the decay coefficient value or the stability of the accessibility distribution. However, this weighted ratio has not been examined for its impact on the FCA variants. There is a potential misidentification of the ‘omnipotence’ of weights in FCA methods. For example, reused weights in population demand, which is the population multiplied by the supplier weight and the distance weight in the 3SFCA, are not equivalent to the row normalization of the previous population (see Figure 4.18). The next section discusses the possible side effects of reusing weights in FCA methods.

Table 4.8 Model formulas of access (Ai) and access ratio (AiR), where E2SFCA is the enhanced two-step floating catchment area (FCA), M2SFCA is the modified two-step FCA, and 3SFCA is the three-step FCA.

| Methods | Access ($A_i$) | Access ratio ($A_i^R$) |
|---|---|---|
| | Accessibility as the sum of ratios | Accessibility as the sum of weighted ratios |
| E2SFCA | $A_i = \sum_{j \in C_i} R_j^{E2}$* | $A_i^R = \sum_{j \in C_i} w_{ij} \cdot R_j^{E2}$ |
| M2SFCA | $A_i = \sum_{j \in C_i} R_j^{M2}$** | $A_i^R = \sum_{j \in C_i} w_{ij} \cdot R_j^{M2}$ |
| 3SFCA | $A_i = \sum_{j \in C_i} R_j^{3S}$ | $A_i^R = \sum_{j \in C_i} w_{ij} \cdot w_{ij}^S \cdot R_j^{3S}$*** |

*$C_i$ is the catchment centred at tract $i$. $R_j^{E2}$ is the supply-demand ratio of supplier $j$ which falls in the catchment centred at tract $i$ calculated by the E2SFCA method.
**The main difference between E2SFCA, M2SFCA and 3SFCA is the way in which suppliers' supply-demand ratios are calculated, as Figure 1 shows.
***$w_{ij}$ is the distance weight between tract $i$ and supplier $j$. $w_{ij}^S$ is the supplier weight between tract $i$ and supplier $j$.

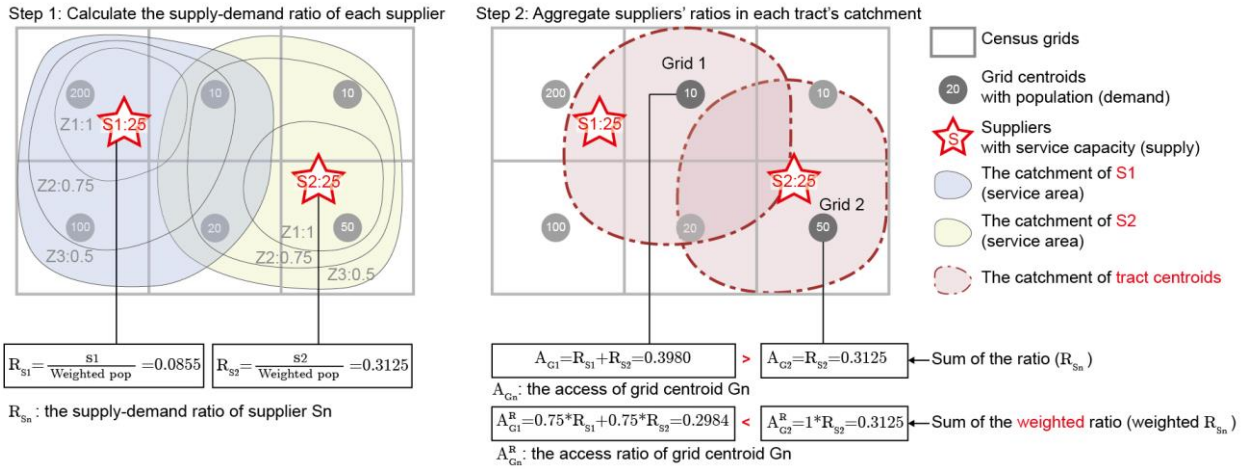



Figure 4.18 Comparison of accessibility values as the sum of supply-demand ratios ($A_i$) and the sum of weighted supply-demand ratios ($A_i^R$). $A_i^R$ enlarges the resource acquisition of grids closer to supplier's location.

#### 4.5.2.1.3 Side effects of reusing weights

Although researchers have discovered several limitations of FCA methods, the reuse of weights has not gained sufficient attention. Among those identified limitations (i.e., catchment sizes, overestimation of population, and the MAUP) the application of weights focuses on the value of the distance decay coefficient and the function type of distance decay (Geertman & Ritsema Van Eck, 1995; McGrail, 2012). Evidently, the impacts of distance weights have been simplified to only consider the differences between decay coefficient β values and common forms of distance decay, including the exponential function, the inverse-power function, and the Gaussian function (Kwan, 1998; Neutens, 2015).

However, the manipulation of weights can also have a substantial impact on modelling accessibility. Delamater (2013) has discovered one side effect of reusing weights in the 3SFCA. He modelled a simple dynamic topology that gradually moved one faraway unit closer to a facility-adjacent area. During this process, the 2SFCA method

calculates the accessibility for this unit as monotonically increasing, while the 3SFCA method calculates the accessibility as first decreasing and then increasing. This is because reusing weights in population demand, which considers supplier weights and distance weights simultaneously, generates a non-monotonically varying distance decay function in the 3SFCA. Although, the non-monotonic variation in the 3SFCA may have a limited impact in complex topologies.

The use of weighted ratios can produce additional problematic results. Figure 4.18 illustrates one side effect of defining accessibility as the sum of weighted ratios. The grey quadrilaterals are census tracts, and the red pentagrams are supplier locations. To simplify the calculation, this example applies the E2SFCA method and a piecewise function as the distance decay function. The weights of zone 1, zone 2, and zone 3 equal 1, 0.75, and 0.5, respectively. The first step calculates the supply-demand ratio of each supplier (S1 and S2), which is the weighted population of tracts divided by the suppliers' capacity. The second step aggregates the supply-demand ratio of suppliers within the catchment of each grid centroid. Detailed calculations are provided below:

$R_{Sn}$: the supply-demand ratio of supplier Sn.

$$R_{S1} = \frac{S1}{Weighted\ Pop} = \frac{25}{1 * 200 + 0.75 * 110 + 0.5 * 20} = \frac{25}{292.5} \approx 0.0855$$

$$R_{S2} = \frac{S2}{Weighted\ Pop} = \frac{25}{1 * 50 + 0.75 * (10 + 10 + 20) + 0.5 * 0} = \frac{25}{80} = 0.3125$$

$A_{Gn}$: the access of grid $G_n$ (accessibility as the sum of supple-demand ratios).

$$A_{G1} = R_{S1} + R_{S2} = \frac{25}{292.5} + \frac{25}{80} \approx 0.3980$$

$$A_{G2} = \frac{25}{80} = 0.3125$$

$A_{Gn}^{R}$: the access ratio of grid Gn (accessibility as the sum of weighted ratios).

$$A_{G1}^{R} = 0.75 * R_{S1} + 0.75 * R_{S2} = 0.75 * \frac{25}{292.5} + 0.75 * \frac{25}{80} \approx 0.2984$$

$$A_{G2}^{R} = 1 * R_{S2} = 0.3125$$

As shown in Figure 4.18, the access ($A_i$) of Grid 1 is greater than that of Grid 2, while their access ratios ($A_i^R$) are reversed. Grid 1 has a reduced access ratio because of its location within two suppliers' Z2 catchments, while Grid 2 lies within only one supplier's Z1 catchment. Defining accessibility as the sum of weighted ratios may exaggerate a community's resource consumption when it lies in close proximity to suppliers. In this instance, it remains uncertain which census tract contains higher service capacities. Still, this example reveals that access ratios exaggerate the accessibility of population units with closer proximities to suppliers and, therefore, greater geographic weights.

The exaggeration of the access ratio in units with closer proximities to amenities should be examined in the context of complicated topologies. There remains the possibility that this exaggeration is either imperative for the precise description of resource

distribution, or irrelevant in the context of complex geography. Moreover, how this distortion of the access ratio relates to the modelling approach and the type of resource in question needs to be further investigated. Access ratios produced by various applications of distance weights in the FCA methods could alter its impact on accessibility results. Furthermore, due to their diverse topologies, varied resources with distinct differences in user behaviors appropriate to the size and attributes of their catchments may also influence the effect of weighted ratios. As mentioned above, there are two levels of weighting applications. The differential applications of geographical weights in supply-and-demand simulations shape FCA variants, while the access ratio helps quantify accessibility. Accordingly, this study focuses on the impact of the access ratio and attempts to build a systematic evaluation by comparing $A_i$ and $A_i^R$, with consideration of the aforementioned influencing factors.

#### 4.5.2.2 Study Design

This study examines the role of weighted ratios in accessibility measurements from two dimensions. The study is based on the contrast between access ($A_i$) and access ratios ($A_i^R$), as shown in Table 4.8. Their difference lies in whether to multiply the suppliers' supply-demand ratios by the distance weights in the last step of the FCA methods. The first dimension is the different FCA metrics. The E2SFCA, M2SFCA, and 3SFCA models were chosen because of their prevalence and multiple weight applications with various aims. Methodological comparisons assess whether the impacts of access ratios change across different models. Therefore, the purpose of this study is to examine the relationship between the type of FCA model and the side effects of reusing geographic weights.

The second dimension is the impact of access ratios for different types of resources, including primary schools, jobs opportunities, and major hospitals. These empirical comparisons evaluate how access ratios perform in realistic and complex topology.

Table 4.9 shows the detailed characteristics of the three objects, including their catchment areas and spatial distributions. Primary schools are distributed dispersedly in accordance with neighborhood locations, as pupils have limited capabilities for long-distance travel, and will therefore usually attend the school closest to their residence. In contrast, jobs and major hospitals are distributed in a centralized way, as workers and patients can typically endure longer distances to obtain income and medical services. Furthermore, healthcare-related behaviors are more tolerant to increased distance than work-related commuting behaviors because obtaining healthcare is typically a matter of necessity and occurs less frequently. Even with the same distance radius, the catchments of hospitals involve more flexible behaviors than those of job opportunities. Therefore, primary schools have a catchment radius of three kilometers for their limited-service areas, while job opportunities and major hospitals both have a 20-kilometer radius.

Table 4.9 The characteristics of three resources

| Resources | Catchment radius (km) | Number of POIs | Distance tolerance | Spatial distribution |
|---|---|---|---|---|
| Primary School | 3 | 828 | Low | Dispersed |
| Job opportunities | 20 | 13,488 | Medium | Centralized |
| Major hospitals | 20 | 277 | High | Centralized |

To be more specific, there are some important nuances in the tested formulae of each object in the three methods. First of all, it is crucial to realize that every tiny parameter change can lead to significant accessibility distributions, including the different sizes of catchments, different distance decay equations and different values of the distance decay coefficient *β*. However, due to different facilities usage habits, it is impossible to keep all parameters the same crossing different objects. This study tries to maintain the same parameter according to the object type. Equation 4-6 and Equation 4-7 are the tested formulae of 'access' and 'access ratio' in the E2SFCA method. To avoid irrelevant influences, this study uses the Gaussian function as the distance decay equation in all three FCA methods, as Equation 4-8 shows.

Equation 4-6

$$A_i^{E2} = \sum_{j \in C_i} R_j^{E2} = \sum_{j \in C_i} \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot D_k}$$

Equation 4-7

$$A_i^{R(E2)} = \sum_{j \in C_i} w_{ij} \cdot R_j^{E2} = \sum_{j \in C_i} w_{kj} \cdot \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot D_k}$$

Equation 4-8

$$w_{ij} = \begin{cases} 1, d_{ij} \le d_0 \\ e^{-(d_{ij}-d_0)^2/\beta}, d_0 < d_{ij} \le d_c \\ 0,\ d_{ij} > d_c \end{cases}$$

$A_i^{E2}$ and $A_i^{R(E2)}$ respectively represent the 'access' and 'access ratio' calculated by the E2SFCA method, $R_j^{E2}$ is the supply-demand ratio of supplier *j* which falls in the catchment centred at tract *i* calculated by the E2SFCA method, $S_j$ is the supplier capacity, $D_k$ is the population demand of tract *k*, $w_{kj}$ is the distance weight between tract *k* and supplier *j*, $d_{kj}$ is the distance between tract *k* and supplier *j*, *β* is the decay coefficient, $d_c$ is the catchment radius and $d_0$ is the inner critical radius of the catchment, which means the tract population can be fully counted if the tract is close enough to the supplier, i.e., the distance between tract and supplier is less than $d_0$. For jobs and major hospitals, $d_0$ equals 2 km and their catchment radius $d_c$ is 20 km. Their distances are

calculated as the network distance in the driving mode. While pupils usually have low tolerance to distance, $d_0$ for primary school is 500 m and $d_c$ equals 3 km. To ensure the Gaussian equation has the same decay dimension as the power function in Equation 4-3 and provides a slow changing trend at the same time (Delamater et al., 2019), $\beta$ equals 110 in measurements of job opportunities and major hospitals, which is 185 in measurements of primary schools.

Equation 4-9 and Equation 4-10 are the 'access' and 'access ratio' calculated by the M2SFCA method. The distance decay function and coefficient remain the same as in Equation 4-8.

Equation 4-9

$$A_i^{M2} = \sum_{j \in C_i} R_j^{M2} = \sum_{j \in C_i} \frac{w_{ij} \cdot S_j}{\sum_{k \in C_j} w_{kj} \cdot D_k}$$

Equation 4-10

$$A_i^{R(M2)} = \sum_{j \in C_i} w_{ij} \cdot R_j^{M2} = \sum_{j \in C_i} w_{ij} \cdot \frac{w_{ij} \cdot S_j}{\sum_{k \in C_j} w_{kj} \cdot D_k}$$

$A_i^{M2}$ and $A_i^{R(M2)}$ are the 'access' and 'access ratio' calculated by the M2SFCA method, $R_j^{M2}$ is the supply-demand ratio of supplier *j* which falls in the catchment centred at tract *i* calculated by the M2SFCA method, and the other variables are the same as in Equation 4-6 and Equation 4-7.

Analogously, Equation 4-11 and Equation 4-12 are the 'access' and 'access ratio' under the 3SFCA method. Besides the same distance decay function (Equation 4-8), Equation 4-13 is the calculation of supplier weights, which is also the main difference between $R_j$ under the M2SFCA and 3SFCA methods.

Equation 4-11

$$A_i^{3S} = \sum_{j \in C_i} R_j^{3S} = \sum_{j \in C_i} \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot w_{kj}^S \cdot D_k}$$

Equation 4-12

$$A_i^{R(3S)} = \sum_{j \in C_i} w_{ij} \cdot R_j^{3S} = \sum_{j \in C_i} w_{ij} \cdot \frac{S_j}{\sum_{k \in C_j} w_{kj} \cdot w_{kj}^S \cdot D_k}$$

Equation 4-13

$$w_{kj}^S = \frac{w_{kj}}{\sum_{m \in C_k} w_{km}}$$

$A_i^{3S}$ and $A_i^{R(3S)}$ are the 'access' and 'access ratio' calculated by the 3SFCA method, $R_j^{3S}$ is the supply-demand ratio of supplier *j* which falls in the catchment centred at tract *i* calculated by the 3SFCA method, $w_{kj}^{S}$ is the supplier weight between tract *k* and supplier *j*, where supplier *m* is the supplier's fall in the catchment of tract *k*, and $w_{km}$ is the distance weights between tract *k* and supplier *m*, and the other variables are the same as in Equation 4-6 and Equation 4-7.

#### 4.5.2.3 Results

As a continuation of the previous study design outlined in the Methods, the analysis examines methodological and empirical implications of the results by comparison of $A_i$ and $Ai^R$. Figure 4.19 presents the access results ($A_i$), meanwhile, Figure 4.20 presents the results of access ratios ($Ai^R$). In Figure 4.19, the three FCA metrics generate significantly different spatial structures, whereas Figure 4.20 shows similar structure of access ratios for the resources.

##### 4.5.2.3.1 Weighted ratios: Pattern stability beyond model types

From a methodological perspective, weighted ratios produce stable accessibility patterns regardless of the FCA model type. Compared to the non-weighted maps (Figure 4.19), weighted ratios (Figure 4.20) result in similar global spatial structures of accessibility distribution. The weighted ratios produce stable patterns not only under different values of the distance decay coefficient (Wan, Zhan, et al., 2012), but also under various FCA methods. Particularly for resources with a low distance tolerance, such as primary schools, weighted ratios produce maximum accessibility to the same locations. As the tolerance of user behavior increases, the nuances between the three methods become more pronounced. The 3SFCA creates more local differences in global structure between job accessibility and health accessibility compared to E2SFCA and M2SFCA. This implies that user behaviors in resource utilization and the aggregation of original POIs can affect the stability of the weighted ratios.

One possible explanation for this pattern stability is the side effect of weighted ratios shown in Figure 4.18. Weighted ratios overestimate the accessibility to resources of communities with high distance weights and a close proximity to suppliers, as higher access ratios are observed in peripheral areas rather than city centers (see Figure 4.20). Units in peripheral areas tend to have fewer suppliers in their catchments, resulting in high supplier weights. For those units with only one facility and close proximity to it, their access ratios ($Ai^R$) are almost the same as their access values ($A_i$). Conversely, units in the city center with multiple suppliers have access ratios lower than their access values because of their relatively small distance weights multiplied several times. Therefore, access ratios of units with fewer suppliers in the periphery are relatively enlarged.

However, there remains a common point between weighted and non-weighted ratios. Both results show that the accessibility distribution differs depending on the type of amenity. It is logical that accessibility structures for primary schools, jobs, and main

hospitals are dissimilar, as each object has its own distinguishing distribution. This suggests that the accessibility maps have an evidence-based foundation in addition to methodological influences.

Although weighted ratios eliminate the effect of the decay coefficient values, the validity of model stability across model types remains contentious. In Figure 4.20, the nuances between three FCA methods exist in partial districts and at the local level. Those subtle differences make it difficult to verify the intended characteristics of FCA methods and further leads to the dispute over the necessity of improvements. On the contrary, Figure 4.19 visualizes the different model improvements in results. The improvement of the M2SFCA, that is, the distance decay of service effectiveness, converts the uniform value of accessibility into a gradual value (especially A3 and B3 in Figure 4.19). The enhancement of the 3SFCA, which models demand division among suppliers, reduces the overestimation of the population in the facility cluster and produces a more concentrated distribution (see B1, C1, B2 and C2 in Figure 4.19). On the other hand, it could also be considered a methodological advantage of weighted ratios to create stability across FCA methods. To determine which calculation, using either non-weighted or weighted ratios, is rational, one possible approach is to apply the evidence-based foundation and introduce empirical judgements.

#### 4.5.2.3.2 An epistemological trap

Although their results vary, both calculations of access and access ratios are supported by methodological rubrics. Despite these methodological rationalizations, the variability of results leads to diametrically opposed empirical judgements. These contrasting discernments could make it easier to choose a more rational method, based on experiences. Therefore, the evidence-based foundation of accessibility measures may also provide empirical criteria for the choice between $A_i$ and $A_i^R$, by linking the mapped results with common sense.

While there are varying degrees of variability between access and access ratios for different resources, they show a common characteristic among the resources. Maps of access ratios ($A_i^R$ in Figure 4.20) share similar structures with those of the access calculated by the M2FCA (*Ai* B-maps in Figure 4.19). This is due to the reuse of weights in the M2SFCA, as described in the formulas shown in Table 4.8. Furthermore, the reused weights divide accessibility distribution into two kinds of judgements. In the case of primary schools, the access ratios in Figure 4.20 indicate that the central city contains a shortage of primary education resources, while the north-eastern island (Chongming Island) has the greatest abundance of those resources. However, the 3SFCA method in Figure 4.19 concludes the opposite: that the city center is the most resource-rich, while Chongming Island lacks basic education facilities. Similarly opposed conclusions are the polycentric and monocentric structures of accessibility to job opportunities and major hospitals generated from $A_i$ *and* $A_i^R$.

The difficulty in judging the validity of opposing results lies in the ratio attribute of accessibility. The provision of services and the needs of the population are reflected in

visual and definitive indicators of their quantity. Each facility points have certain indicator of its service capacity, such as the number of physicians in a hospital. Each residential unit obtains an accurate number for its population. However, the relationship between supply-and-demand is indirect, uncertain, and dynamic. The maximum supply-demand ratio could occur in the suburbs, or the city center based on empiricism.

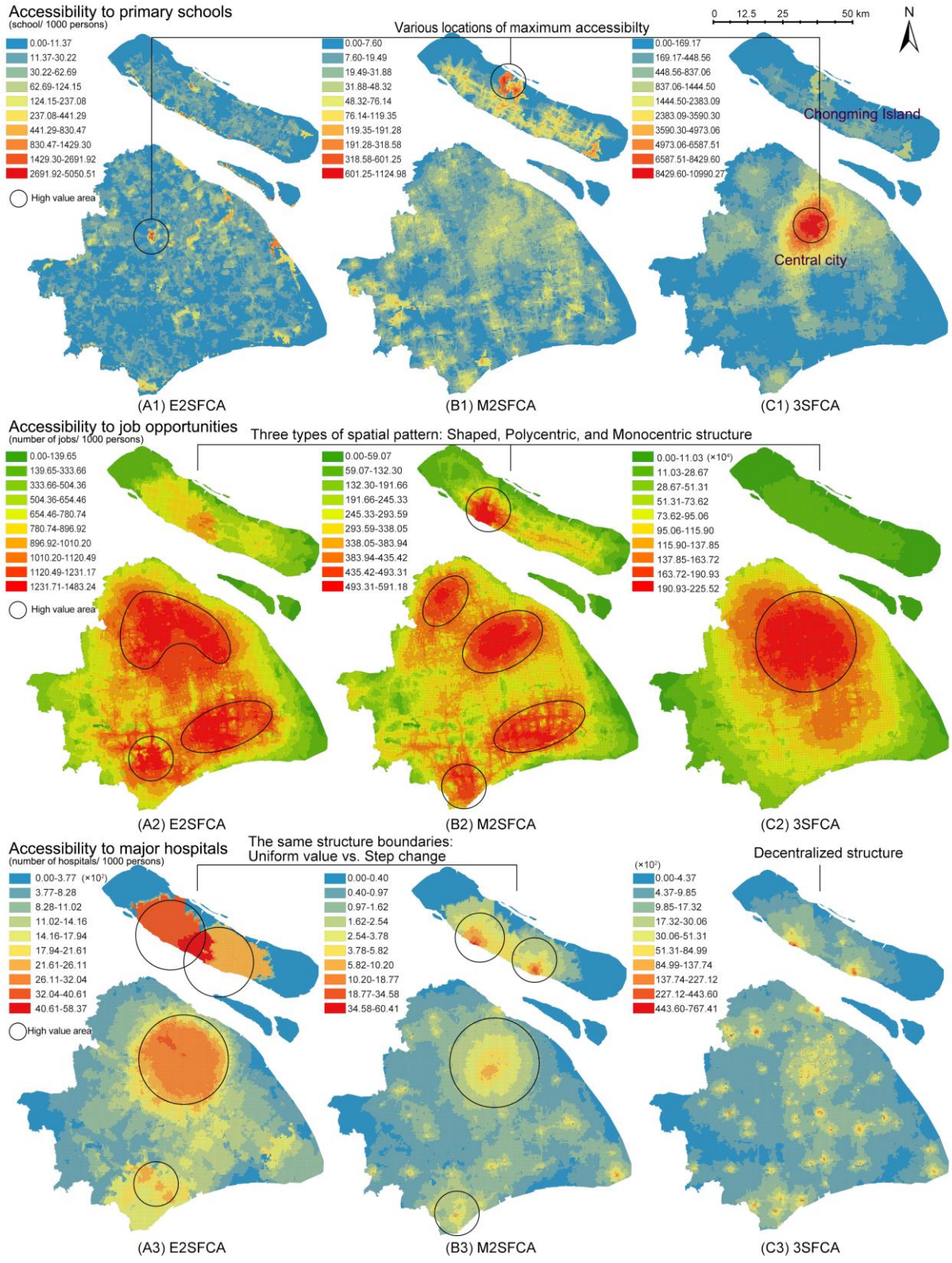



Figure 4.19 Access as the sum of supply-demand ratios ($A_i$). Three FCA methods generate significantly different spatial structures of accessibility. (A) enhanced two-step FCA (E2SFCA), (B) modified two-step FCA (M2SFCA), and (C) three-step FCA (3SFCA).

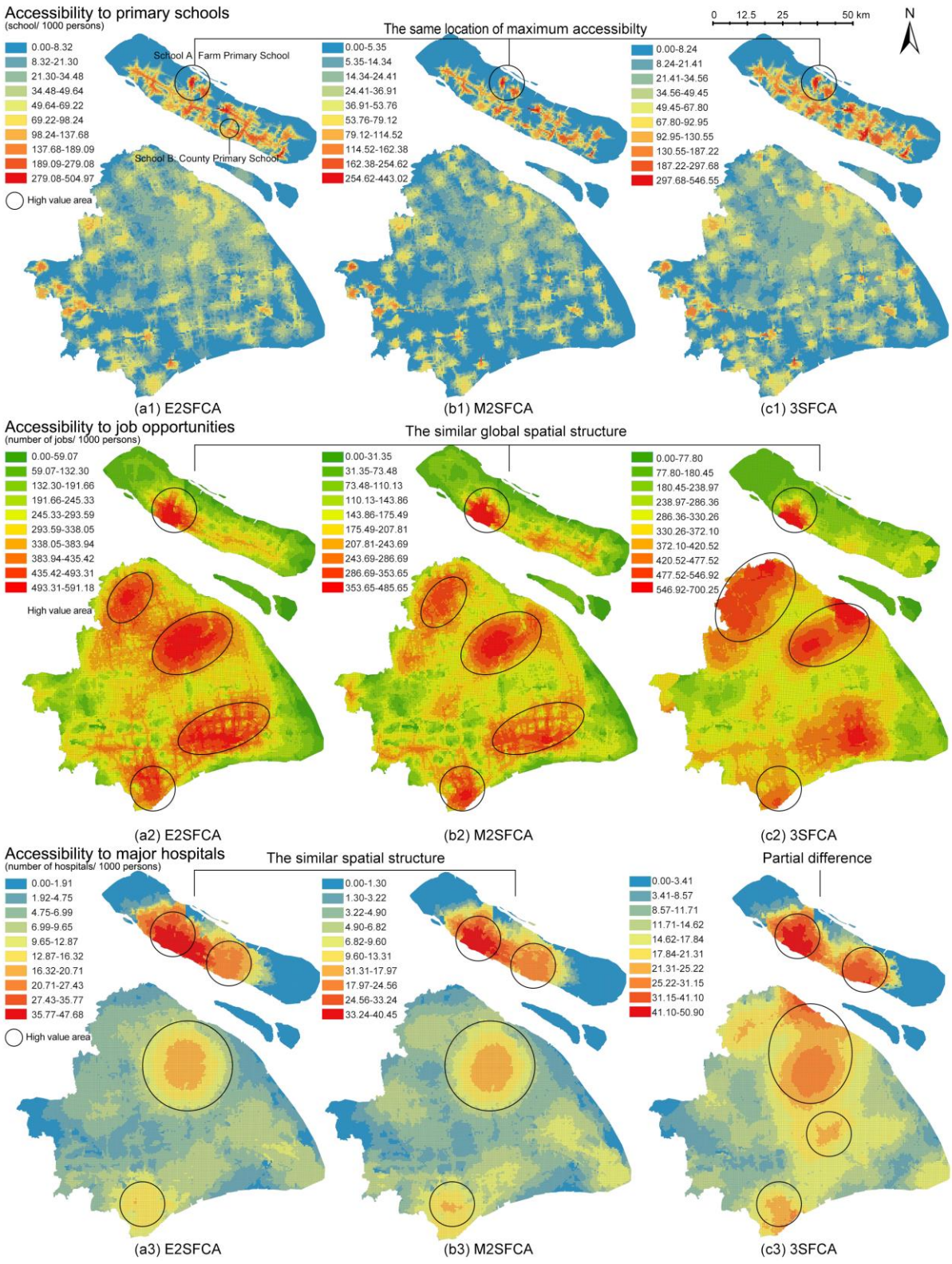



Figure 4.20 Access ratios as the sum of weighted supply-demand ratios ($A_i^R$). Three FCA methods generate similar spatial distribution of accessibility according to resources. (A) enhanced two-step FCA (E2SFCA), (B) modified two-step FCA (M2SFCA), and (C) three-step FCA (3SFCA).

One possible solution is to apply Kantian "***a priori*** knowledge", which combines empiricism and rationalism. First, key locations are contrasted to provide actual and intuitive measurements. Field research on the key locations provide empirical evidence for the resource distribution. Second, the overall judgements of resource distributions in previous studies are discussed to choose the most accurate global structure of accessibility. These previous studies provide the "***a priori*** knowledge" of resource distributions based on actual utilizations.

Fieldwork may provide insight into the comparison of the accessibility values of key points and thus inform model recommendations. In accessibility to primary schools, the catchment of School A at Chongming Island (see (a1) in Figure 4.20 has one of the highest access ratios $A_i^R$, although the island is famous for its agricultural products and natural landscapes. School B is one of the medium values also located on the island. Field research reveals that School A serves only its collective farm, which is a socialist legacy with limited productivity and a decreasing population. School B, on the other hand, is located in a more densely populated area and provides a higher level of educational resources for the children in the county. It is counter-intuitive that the catchment area of School A is more accessible than School B.

Furthermore, the urban-rural dichotomy regarding quality of life caused by the Chinese dual system has been a long-standing issue (Chan & Wei, 2019; Ma et al., 2020). In the dichotomy, population and land management systems are both separate and unequal between urban and rural areas. The socialist governance system leads to the concentration of public resources in the urban areas, while rural areas lack the same resources. Xiao et al. (2017) identified that high access to urban parks occurred mainly in downtown Shanghai. Zhao and Cao (2020) investigated 81 million trips that used transit smart cards to identify the gradual decrease of job accessibility from the city center towards the outer suburbs. In the case of hospitals, the urban-rural dichotomy of medical resources has already been identified, revealing a lack of medical resources in suburbs (Meng et al., 2015). In 2009, the Shanghai Municipal Government launched the '5+3+1' project to promote the construction of high-quality hospitals in the periphery. Using this "***a priori*** knowledge", it seems impossible that the most abundant resources are located in the agricultural island in all three categories. Therefore, the 3SFCA model with non-weighted ratios might be the most appropriate method to reflect the accessibility distribution in Shanghai.

In summary, the reuse of weights, including the M2SFCA method (Figure 4.19 b-maps) and defining accessibility as the sum of weighted ratios (Figure 4.20), can generate an epistemological trap. The outcomes of access ratios can produce pattern stability incongruous with model features and resource types, when compared to the access results. Moreover, the side effect of reusing weights, which exaggerates accessibility for units with closer proximities and fewer suppliers, can produce counter-intuitive results. The reuse of weights may lead to methodologically plausible, but common-sense-defying distributions of accessibility. It is therefore necessary to combine

empiricism and rationalism in the evaluation of accessibility methods; similarly, the use of geographic weights needs to be cautious and epistemologically consistent.

#### 4.5.2.4 Discussion and conclusions

Spatial equity and distributive justice have been controversial issues due to their elusive concepts and complex assessments (Guagliardo, 2004; Hay, 1995) Identifying spatial inequity requires recognizing the areas with shortages of social resources. Accessibility, as a fundamental indicator of spatial equity, assesses the distribution of urban resources by integrating supply-demand ratios and distance decay into FCA metrics. However, varying parameters and flexible applications of FCA metrics could generate methodologically logistical but empirically counter-intuitive results.

This section reveals that the reuse of weights might lead to an epistemological trap and misperceptions of resource distribution. The reuse of weights in FCA metrics, which is the multiple use of weights in simulating the decay of supply capacity, population demand, and the supply-demand ratios, may exaggerate accessibility in marginal communities that are within fewer suppliers' catchments. Whereas past researchers have found that catchment size should be set with caution (McGrail & Humphreys, 2009), the present study has shown the use of distance weights may also require vigilance. Comparing the results of access (the sum of supply-demand ratios) and access ratios (the sum of weighted supply-demand ratios) across three different resources shows that weighted ratios produce pattern stability beyond the model features of the E2SFCA, M2SFCA, and 3SFCA methods. On the contrary, non-weighted ratios may help to visualize the model characteristics most accurately. Linking the model results with empirical judgements, this section suggests that the 3SFCA method using non-weighted ratios can achieve the most realistic accessibility distribution among three resources in Shanghai.

There are at least three potential limitations concerning the results of this study. First, the results are limited by the city-level spatial scale and the topographic features of Shanghai. Smaller spatial scale and less complex environments could alleviate the exaggeration of weighted ratios. Shanghai's polycentric city structure, as well as its islands, might also contribute to the problematic dispersed resource distributions. Further, the assessment is based on the local-level POI data and contains numerous supplier points, which can cause methodological fallacies in this specific combination of resource distribution, city structure, and unit aggregation. Fewer suppliers, even with divergent catchment areas, still generate simple topologies and may not encounter the trap of weights (Pan et al., 2018). Lastly, this section still produces place-based assessments with the FCA metrics, which lacks detail of the individual differences in facility utilization. Further studies can explore the solutions for identifying individual preferences in facility utilization and dealing with personal uncertainties.

Despite these limitations, this section provides insights for a better understanding of accessibility and GIS modelling. For accessibility measurements, this examination of reused weights in FCA metrics raises the issue of evaluation criteria for improving

methods. The socioeconomic attribute of accessibility measurement includes social and cultural factors in the use of facilities and the organization of resources. This socioeconomic attribute requires assessing improvements that have not only a methodological logical necessity, but also a practical implication. This study reveals that sensible logic for the application of distance weights needs further exploration. Since the first law of geography argues that near things are more related than distant things (Tobler, 1970), the applications of distance weights have been a crucial method to represent this relationship. The study will prove useful in expanding our understanding of how distance weights should be applied in GIS models. Last but not least, the present study distinguishes the gap between methodological rational and empirical judgements in GIS modelling. It is difficult to discern whether the results of GIS models generated by rational techniques reflect the real situation. Understanding this reality is a matter of epistemology. Methodological fallacies, such as the trap of weights, need to be examined with empiricism and rationalism in further studies.

### 4.5.3 Evaluation Criteria for Accessibility Methods

The above sections show the diversity in methodologies of accessibility methods. However, this diversity leads to an absence in the evaluation criteria for accessibility methods. On one hand, it is hard to find a general criterion to evaluate diverse accessibility methods with different research focuses. On the other hand, there is a gap between accessibility methods and the reality of distribution. The rational method may still produce counterintuitive results. The 'real' distribution of spatial equity remains inaccessible despite the variety of methods (Guagliardo et al., 2004; McGrail, 2012). Moreover, the lack of evaluation criteria for accessibility methods reduces the necessity of certain advanced improvements. The improvement in transit mode or distance decay functions may or may not be necessary. The potential fallacies in accessibility methods are hard to figure out in the absence of the evaluation criteria.

As a result, the evaluation criteria for accessibility methods can be based neither on empirical experience nor on methodological logic. If the criteria are empirically based, accessibility results that aim to validate those known conclusions may lack the need for new findings and the application of accessibility measurements. If the criteria are based on methodological logic, it is difficult to identify possible methodological fallacies and the accessibility results may be less reliable than empirical ones.

This section then tries to develop the evaluation criteria for accessibility methods based on the empirical performances of spatial production (Lefebvre, 1992). For brevity, this section chose the accessibility to primary and secondary in Shanghai as the case study, as these educational facilities have limited spatial service areas. Taking Shanghai as the geographical background provides the complexes in topologies and the great differences between urban and rural areas, which might improve the generalizability of the evaluation criteria.

#### 4.5.3.1 The Current Evaluation Criteria for Accessibility Methods

We will first review the evaluation criteria applied in previous accessibility studies, then analyze an underlying epistemic dilemma in the existing evaluation paths, and finally propose a triple empirical performance based on spatial production mechanism as the evaluation criteria for accessibility methods.

##### 4.5.3.1.1 State of Art: Four typical paths

As the technology of computer science develops and more sources of Big Data, the study focusing on the accessibility to various facilities have proliferated in the last three decades (Neutens, 2015; Talen & Anselin, 1998). The aim of this section is to review the evaluation criteria and analysis methods in the previous accessibility studies. However, there are many studies promoting new accessibility models mainly based on their research ideas, which is a deductive path. For example, Zhao and Cao (2020) use the realized data of smart transit cards to recognize the job distribution and define the number of jobs decayed with distance as job accessibility. Cheng et al. (2020) examine the accessibility to hospitals, especially for older adults. Ortega et al. (2021) designed four scenarios to explore the relationship between walking needs and walking accessibility. These profound research ideas and deductive explanations vary with facility types and geographical backgrounds. It is then difficult to compare each model's deductive idea as evaluation criteria.

Table 4.10 The four typical analysis types of the evaluation criteria for accessibility methods in the previous studies

| Analysis type | Indicators/Details | Evaluation Criteria |
|---|---|---|
| Pattern analysis | Pattern difference between divergent methods;<br>Spatial autocorrelation (Moran's I test);<br>Official shortage area | Pattern variability / stability/ continuousness as accuracy;<br>Consistent with the district/city/region structure |
| Statistical analysis | Min., Max., Avg., Std., Dev.;<br>Gini index; Lorenz curve;<br>Statistical difference between divergent methods | Data heterogeneity |
| Relationship analysis | Spatial autocorrelation;<br>Pearson/ Spearman correlation;<br>Local indicators of spatial association (LISA), including population, land use, unemployment rate, and other socio-economic indicators;<br>Regression model | Relationship between accessibility and socioeconomic indicators |
| Realized analysis | Realized transit/facility utilization behaviors;<br>Questionnaires; GPS trajectories | Observed utilization patterns/behaviors |

Therefore, two selection standards of accessibility research are applied in this study: the research should include more than one method of parameter/model, and it should also involve the evaluation of different methods. Beginning with the very first evaluation of four playground accessibility methods (Talen & Anselin, 1998), this study contains 26 accessibility researches, whose details can be found in Table 8.2 of Appendix C.

Table 4.10 shows the four typical analysis paths of the previous accessibility evaluation: pattern, statistical, relationship, and realized analysis. The first pattern analysis refers to the analysis of accessibility maps, including the overall spatial structure and specific areas of accessibility values. As the accessibility model generates divergent maps, the pattern analysis occurs almost in all the listed studies in. A generalized way is to compare the spatial structure of accessibility results with district/city/region structure (Ni et al., 2019; Schuurman et al., 2010; Wan, Zou, et al., 2012). The underlying criterion here is that the greater the city/the more central the space, the higher the level of resource per capita. Another criterion is the pattern continuousness, in which numerical mutation of accessibility on the map is considered an abnormal/ error (McGrail & Humphreys, 2009). The pattern comparison between accessibility maps and the official map is also one way, such as Luo and Qi (2009) use the healthcare shortage area published by the US Department of Health and Human Services as a relative standard.

We can also find contradictory criteria in the pattern analysis. In early studies, the technology to get detailed raw data and generate detailed accessibility maps was limited. Therefore, the pattern variability was taken as the evaluation criteria (Luo & Wang, 2003; Omer, 2006). The more different details the accessibility map shows, the more accurate the accessibility method is. However, with the development of computer technologies, there is a variation of accessibility methods beyond analysis ability. Wan et al. (2012) later promote a method of standardized accessibility, 'spatial access ratio (SPAR)', due to its spatial stability. The SPAR map generates a stable spatial structure of the accessibility maps regardless of the distance decay coefficient values. However, these two criteria, which are pattern heterogeneity and homogeneity, are both problematic and will be discussed in the following section.

The second analysis type, statistical analysis, is mainly used to describe the distribution of accessibility values and the difference between compared methods. Despite general parameters (such as the minimum, maximum, mean, and standard deviation of accessibility values), the statistical analysis also involves the Gini index and Lorenz curve to analyze the evenness of accessibility scores (Talen, 2001; Xing et al., 2018). Statistical analysis also reflects data variance along with pattern analysis.

The third relationship analysis consists of the correlation, local indicators of spatial association (LISA), and the regression model. The correlation can either focus on the spatial autocorrelation of the accessibility itself (Talen & Anselin, 1998) or its correlation of accessibility with other socioeconomic indicators (Smoyer-Tomic et al., 2004). The LISA has a variety of indicators, including population age, ethnicity, car-ownership, house-ownership, and unemployment rate (Cervero et al., 1998; Du & Zhao, 2022;

Mao & Nekorchuk, 2013; Omer, 2006; Talen, 2001). Its corresponding criterion is then the perceived relationship between resource distribution and socioeconomic indicators. For example, the disadvantaged tend to have inferior public transport resources (Langford et al., 2012).

The fourth path is called realized analysis, which mainly refers to the applied evaluation indicator as a realized/positive one (Páez et al., 2012). Delamater et al. (2019) collect the actual number of visitors in the hospital and compare the accessibility results of different models to evaluate the accuracy of accessibility models. Pan et al. (2018) take the taxi GPS trajectories as the catchment boundary of the hospital. Similarly, Ni et al. (2019) determine the possibility of different transit modes through an online transportation questionnaire. The main difference between the realized analysis and the other three lies in its objective realized basis, while the other three can be regarded as different forms of empirical results.

#### 4.5.3.1.2 Empirical Results as Criteria: An Epistemic Dilemma

The empirical result is the understanding and judgment generated from empirical experiences. It depends on individual experience and acknowledgment, which is inevitably subjective. For example, one might consider the city structure as monocentric as she always lives in the outer suburbs. On the contrary, the other might argue that the city has multiple centers as she lives in the downtown area and recognizes more commercial centers than the previous person. This study regards the first three analysis paths, pattern, statistical, and relationship analysis, as different forms of empirical results. They all take the perceived understandings and judgments as the evaluation criteria for accessibility models. It includes the comparison between the accessibility pattern and the spatial pattern of population/socioeconomic indicators, the accessibility variance/stability, and the perceived relationship between resource distribution and socioeconomic indicators.

It is difficult to establish a logical and objective criterion from the empirical results. The discussed contradictory criteria, taking pattern stability and variance as model accuracy is a typical example. Why can an accessibility model be regarded as more accurate as it has more different values or it remains all the same with various parameter functions? This is because that pattern variance and stability are the intuitive representation of advanced technology in different backgrounds and technological development processes. It is also another intuition that advanced technology leads to more accurate and better accessibility results.

Furthermore, taking empirical results as evaluation criteria for accessibility methods produces an epistemic dilemma. If we take what we already knew or the intuitive judgment as our criterion of the methods, then we can hardly acquire new findings which exceed our current understanding or validate what we have known. However, they are the original aims to optimize various accessibility models, that is, the new understanding and validation of the real situation. For instance, if the officially published shortage area of healthcare facilities has errors/mistakes, then the errors cannot be found by

accessibility results as its evaluation criterion ((Luo & Qi, 2009). On the contrary, if the official shortage area has no error, then the accessibility methods are unnecessary. It is also a similar situation that taking official supply-demand ratios or service populations to determine the catchment size of a certain facility (Dewulf et al., 2013; Du & Zhao, 2022).

The empirical results lack an objective benchmark, which cannot provide the validity of the conclusion nor the necessity of each methodological improvement. Bunel and Tovar (2013) take the original accessibility model as a benchmark. Ni et al. (2019) examines the difference between designed differentiated accessibility models. While these differences between accessibility models lack an objective basis and realized explanation. Langford et al. (2012) conclude that deprived areas have a better provision of public transport than certain affluent areas, which contrasts with previous studies. This finding can hardly be validated because of the lack of an objective benchmark of accessibility results. Another example is the application of multiple transport modes. Xing et al. (2018) integrate the multi-mode in the measurement of accessibility to green parks. It is controversial the possibility of driving mode in the daily utilization of green parks, especially in a relatively high density of green space. Therefore, it becomes a question of whether it is necessary to introduce the multi transit model in accessibility to green parks in specific areas.

As a result, scholars call for the realized data to support the necessity of accessibility method improvement. McGrail (2012) identifies the lack of available empirical data on 'real' health service access behavior and its geographical relationship in his research. Tang et al. (2017) also recognize the lack of realized health service data. However, this realized facility utilization requires permissions from different data owners, which are hard to access. As an alternative, the empirical performances might be a practical way.

#### 4.5.3.1.3 The Triple Empirical Performance

Social space is a social product. And every society produces its own space (Lefebvre, 1992). Lefebvre reveals that despite physical space (Cartesian absolute space) and mental space (Kantian's space as a tool of knowledge), there is social space that solidifies time and is a social production of history, politics, and culture. This section argues that within each society, empirical results might be subjective and vary from country to country, from city to city, and from person to person. While the empirical performances of space production are independent of human will, with a certain level of objectivity. Therefore, this study promotes the triple empirical performance–physical space, social spatial changes, and spatial utilization– as the evaluation criteria for accessibility methods, which are based on the mechanism of space production.

These triple empirical performances align with the three levels of space production. The first level is the absolute physical space, an objective reality that does not change with individual recognition. The physical space involves topographical features and manual infrastructures such as railways and highways. The second level is the spatial

changes under the influence of time. The second rule tries to follow the objective law of space changing with time. In the case of accessibility as supply-demand ratios, the spatial changes can be applied in the way that the improvement of accessibility to public resources can be a result of the increase of public resources and the decrease in population. The third rule argues that spatial utilization, which is how people use facility facilities in time and space, is also objective. The mechanism of spatial organization, although varied by multiple influencing factors, has objective stability in a certain space-time background. A simple example will be one pupil's visit frequency to a clinic and primary school. One pupil might have to go to her primary school every day while there is less possibility for her to daily visit the clinic.

There is an increase in the level of abstraction from physical space to spatial utilization. Physical space is tangible, while spatial changes might have material characterization according to time. Moreover, spatial utilization is generally intangible on account of its many invisible influencers, such as sociocultural factors. Due to the abstract nature of the triple empirical performances, this study then provides three cases of the application of the triple empirical performances to evaluate the accessibility methods.

#### 4.5.3.2 Study Design

To simplify, the research object is the primary school, which has a limited-service area according to the pupil's mobility. This section chose four floating catchment area (FCA) methods that have the same focus on the usage of distance weights: the E2SFCA, M2SFCA, 3SFCA, and M3FCA methods. The E2SFCA, M2SFCA, and 3SFCA methods apply the same equations in the previous sections, as Equation 4-1, Equation 4-2, and Equation 4-4. This section continues Delamater's train of thought and adds the distance decay of supplier capacity into the 3SFCA method. It is called as modified three-step floating catchment area (M3SFCA) method (Equation 4-14).

Equation 4-14

$$A_i^{M3} = \sum_{j \in C_i} R_j^{M3} = \sum_{j \in C_i} \frac{w_{kj} \cdot S_j}{\sum_{k \in C_j} w_{kj} \cdot w_{kj}^S \cdot D_k}$$

$A_i^{M3}$ represents the access at tract $i$ based on the M3SFCA method, $C_i$ is the catchment centered at tract $i$, $R_j^{M3}$ is the supply-demand ratio of supplier $j$ which falls in the catchment centered at tract $i$, $S_j$ is the supply capacity of supplier $j$, $C_j$ is the catchment centered at supplier $j$, $w_{kj}^S$ is the supplier weight between tract $k$ and supplier $j$, where supplier $m$ is the supplier's fall in the catchment of tract $k$ (see Equation 4-13), $w_{km}$ is the distance weights between tract $k$ and supplier $m$, and $D_k$ is the population demand of tract $k$, which falls in the catchment centered at supplier $j$.

Although the formula of the four FCA methods is quite complex, their improvements in accessibility models all focus on the application of distance weights. However, the distance weight can have various functions. In this study, the accessibility to primary

and secondary schools (the application of Rule Three) is calculated according to Equation 4-3, which is a simple power function, and the distance decay coefficient *β* equals 1. While the accessibilities to primary schools (the cases of Rule One and Rule Two) apply the Gaussian function (Equation 4-15) to stimulate a gentle distance decay.

Equation 4-15

$$w_{kj} = \begin{cases} 1, d_{jk} \le d_0 \\ e^{-(d_{jk}-d_0)^2/\beta}, d_0 < d_{jk} \le d_c \\ 0,\ d_{jk} > d_c \end{cases}$$

$w_{kj}$ is the distance weight between facility *j* and tract *k*, $d_{jk}$ is the distance between facility *j* and tract *k*, $d_c$ is the outer radius of the catchment of tract *k*, which means the residents at tract *k* will not go to facilities farther than facilities $d_c$, $d_0$ is the inner critical radius of the catchment, which means the tract population can be fully counted if the tract is close enough to the supplier. In this study, the catchment inner critical radius ($d_0$) is 500 meters and the outer radius is 3 km ($d_c$), and the distance decay coefficient equals 185 in the Gaussian function to get a similar decay dimension as the power function in Equation 4-3 .

Figure 4.21 shows how $w_{kj}$ changes as the distance increase according to Equation 4-3 and Equation 4-15. The horizontal axis is the distance between tract *k* and facility *j*, and the vertical axis is their weight $w_{kj}$. The blue line is how weight changes in the power function (Equation 4-3). The other lines are how weight changes in the Gaussian function according to different distance decay coefficient *β* (Equation 4-15), where $d_0$ equals 6. As Figure 4.21 shows, the Gaussian function provides a softer and more consistent weight change than the power function. This section chose the value of the distance decay coefficient *β* based on whether it can provide similar maximum and minimum values of weights $w_{kj}$ calculated by the power function. The aim of the choice is to avoid significant impacts led by the different distance decay functions.

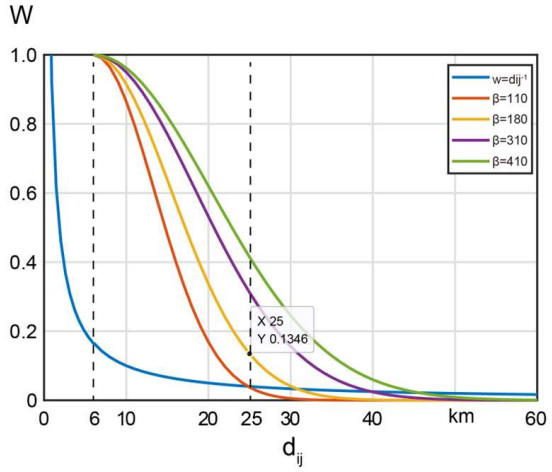



Figure 4.21 Different coefficient values lead to different distance decay variation

### 4.5.3.3 Results

#### 4.5.3.3.1 Empirical Performance One: Physical Reflection

Figure 4.22 shows the accessibility to primary schools in 2010 and 2017 in Shanghai. The four FCA models generate diverse distributions of primary schools, while they applied the same data basis and analysis tools according to time. It also verifies the research of Bunel and Tovar (2013) that different models have different accessibility results. The results of the ESFCA and M2SFCA methods distribute dispersed, while the other two have a monocentric spatial structure. Therefore, it is crucial to evaluate the accuracy of each method, which leads to discriminative conclusions about the distribution of Shanghai primary schools.

This section applies the first empirical performance to evaluate these four accessibility models. The empirical performance one takes the physical reflection as the evaluation criterion. We could take the largest river in Shanghai, the Huangpu River, as the evaluation criterion. It is in the center of download Shanghai, which forms landmarks such as the Bund and Lujiazui Financial Centre. In the results of the M2SFCA (b1 and b2 in Figure 4.22) and the M3SFCA (d1 and d2 in Figure 4.22), the spatial structure of Huangpu River appears in the red dotted ellipses with a relatively clear spatial boundary. Because there is no population demand on the river and access to the river is limited. The spatial accessibility to primary schools on the river should have no or relatively low values, which are the blue pixels in Figure 4.22. According to the first empirical performance, then the M2SFCA and the M3SFCA methods are relatively more accurate. However, they have inconsistent spatial structures that cannot be regarded as physical reflections. We then apply the second empirical performance to evaluate these FCA models.

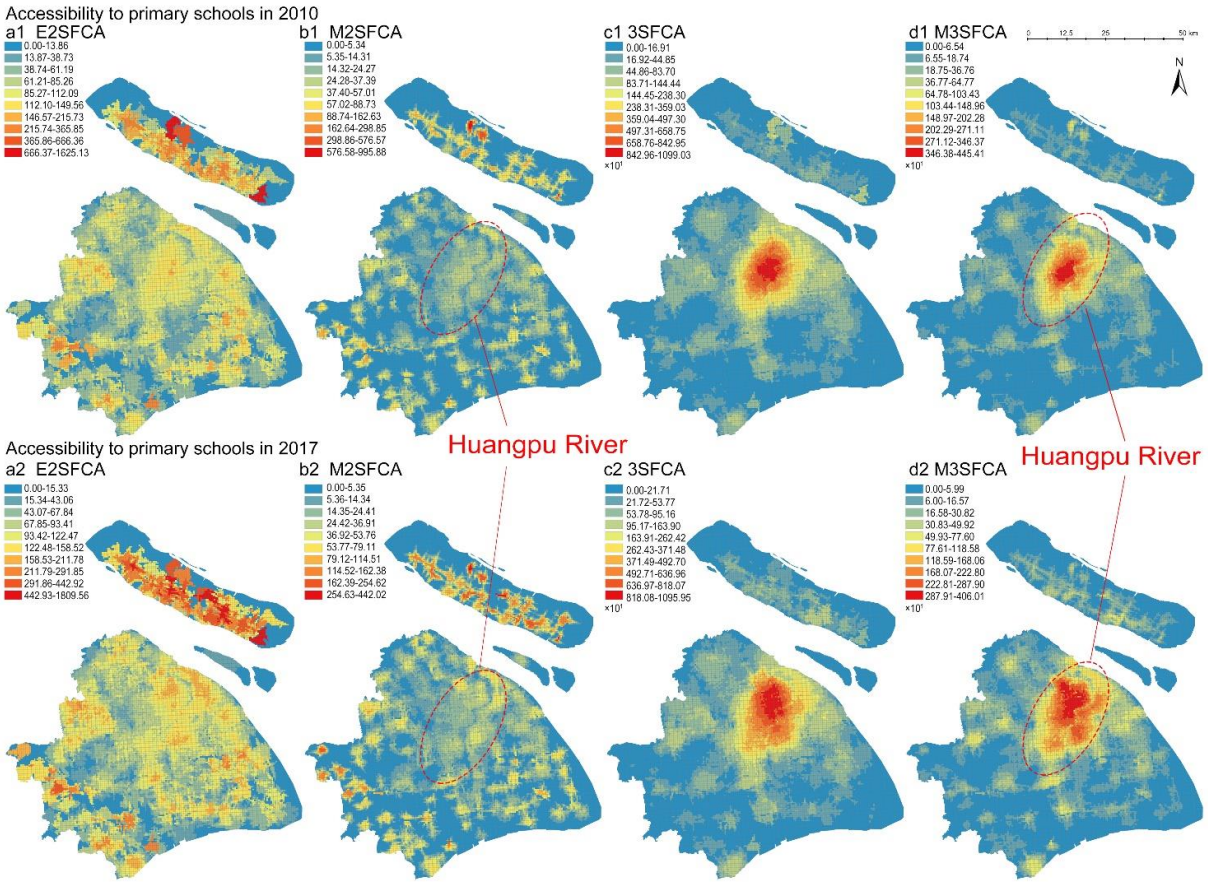



Figure 4.22 Accessibility to Shanghai primary schools in 2010 and 2017 by four FCA methods. Different methods produce different results

#### 4.5.3.3.2 Empirical Performance Two: Social Spatial Change

Figure 4.23 shows the spatial changes in the accessibility to primary schools from 2010 to 2017. In Figure 4.23, the spatial changes of the four methods are generated by subtracting 2010 from the 2017 maps in Figure 4.22. The spatial changes in population and primary schools from 2010 and 2017 are taken as the benchmark. The FCA methods define accessibility as the supply-demand ratio. Then the accessibility should increase with more primary schools and fewer residents in certain areas.

Looking at the enlarged area in the northeast corner, we will find that all four methods reflect the increase in accessibility to primary schools. Due to the decreased population and many newly opened primary schools, it is logical that the accessibility in this enlarged area increased. Specifically, the M3SFCA reflects the most corresponding details compared to the changes in population and primary schools' distributions. The M3SFCA is then the most accurate method among the four models in the measurements of the accessibility to primary schools in Shanghai according to the second empirical performance, that is, social spatial changes.

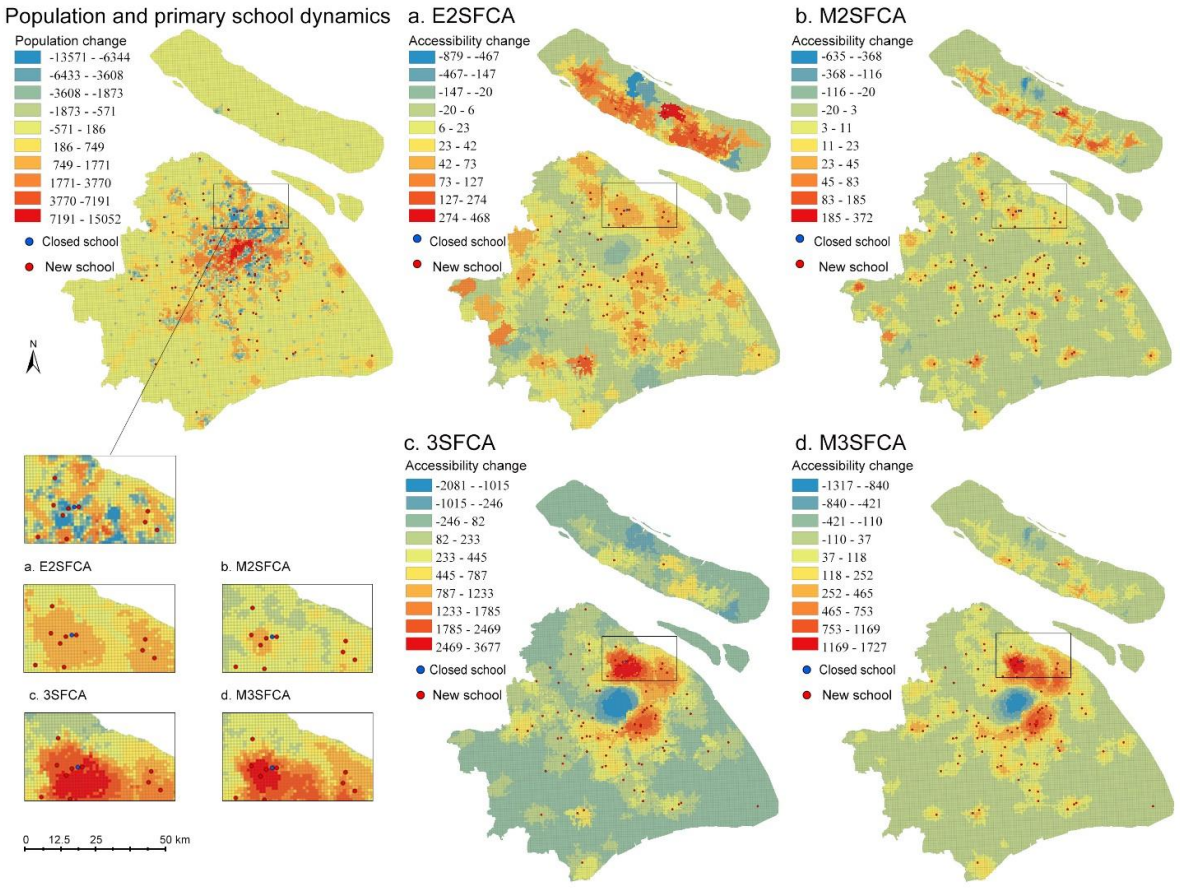
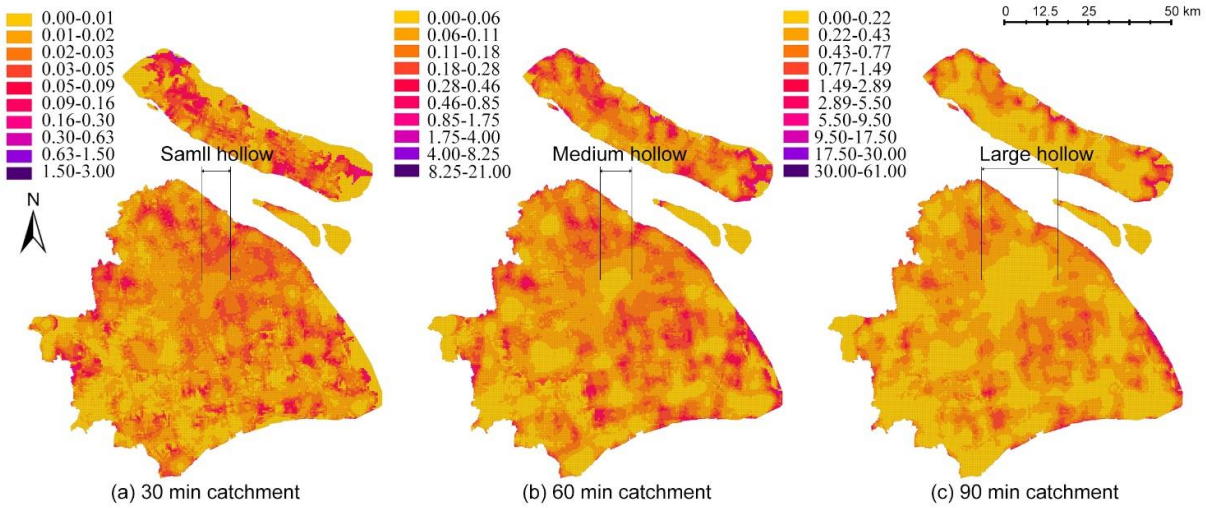



Figure 4.23 The changes in accessibility to Shanghai primary schools from 2010 to 2017. The M3SFCA method matches the most corresponding spatial changes in primary school and population in the enlarged area

#### 4.5.3.3.3 Empirical Performance Three: Spatial Utilization

It is difficult to distinguish the amount of physical reflection in the first empirical performance and get available data sources at different time points in the second empirical performance. The third empirical performance takes spatial utilization as the objective criterion of accessibility methods, which might be applied to more general situations. Figure 4.24 could be seen as a practical foundation and an application case for the third empirical performance. It shows the accessibilities to primary and secondary schools with three different catchment sizes in the E2SFCA method in 2010.

In Figure 4.24, the catchment radius of primary and secondary schools is proportional to the accessibility hollow scale of the city center. The downtown area with the low accessibility values (the yellow cells) has a growing radius when the catchment radius of primary and secondary schools grows from 30 min to 90 min. As we already knew, the E2SFCA method might have low accuracy in the measurement of accessibility to primary and secondary schools. However, this comparison of catchment sizes shows the objectivity of spatial utilization.




(a) 30 min catchment (b) 60 min catchment (c) 90 min catchment

Figure 4.24 Accessibility to primary and secondary school in 2010 with different catchment sizes. The catchment size is proportional to the hollow scale of accessibility values in the city center

As minors in primary and secondary schools have limited mobility compared to adults and school attendance is a high-frequency event, minors are less likely to spend 90 minutes a day at school. We then can regard the greater the catchment radius as the more unreasonable the catchment radius. Through the previous two cases, we can also realize that the distribution of primary schools in Shanghai is monocentric, which is in line with the intuition that the downtown area has more educational resources than the hybrid area. Therefore, the larger the hollow in the center of Shanghai, the more unreasonable the accessibility distribution. If we link spatial utilization with the accessibility results, then we will find that an unreasonable spatial utilization generates an unreasonable accessibility distribution. It reflects the objectivity of spatial utilization. The real-world utilization behavior should be the basis of the accessibility modeling, including the model function, the size of catchment areas, and the decay function (Wang, 2012).

#### 4.5.3.3.4 Conclusion and Discussion

Accessibility to public resources is an essential indicator to measure spatial equity (Neutens, 2015; Talen, 2001). Scholars have endeavored multiple accessibility methods to measure the spatial distribution of public resources (Apparicio et al., 2008; Delamater et al., 2019; Luo & Qi, 2009). However, there is a lack of evaluation criteria for accessibility methods, which leads to the absence of the accuracy of accessibility results and the lack of necessity of certain methodological improvements. This study then constructs the triple empirical performances based on the mechanism of spatial production to evaluate the accuracy of accessibility models, as Figure 4.25 shows. The triple empirical performances align with three levels of space production, that is, physical space, time influence, and social influence. This study calls for objectivity in the measurement of spatial equity and emphasis that the normative standards of methodological evaluation are crucial to access the resource distribution.

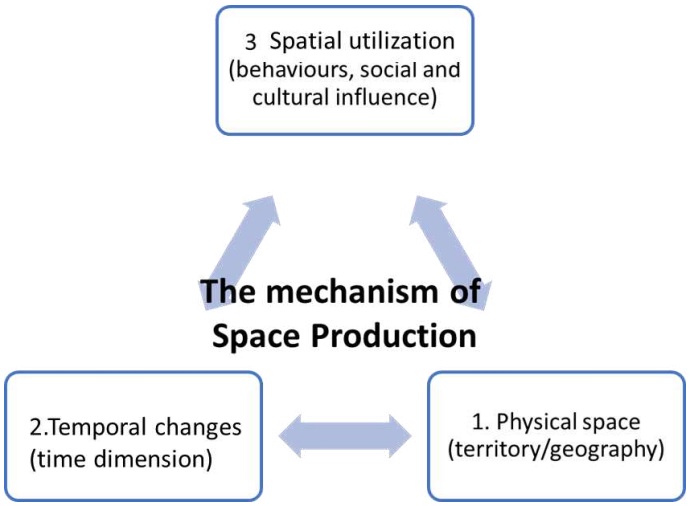



Figure 4.25 The triple performances based on the mechanism of space production

This section applies the triple empirical performances to the four prevalent accessibility methods (i.e., the E2SFCA, the M2SFCA, the 3SFCA, and the M3SFCA methods) in measuring the accessibility to primary and secondary schools in Shanghai. The results show that physical reflection, spatial changes, and spatial utilization can be the objective criteria for accessibility methods. The M3SFCA method might be the most accurate model among the four in the case of accessibility to primary schools in Shanghai. In the cases, we will find that the new primary school in 2017 is not related to the increase in population. It shows that the practice of public resources requires advanced quantity analysis.

There are two limitations of this section. First is the lack of quantitative analyses of the amount of physical reflection and spatial changes. Secondly, the reliability of spatial utilization lacks certain empirical surveys and practical research as a basis. However, the objectivity of spatial production, albeit with great variety in its organization mechanism, is the core of the quantitative spatial measurement evaluation criteria, which requires further exploration.

### 4.5.4 The measurement of Accessibility

There are three stages of accessibility measurement: data pre-processing, generation of the distance matrices, and the calculation stage. The first pre-processing stage provides the basic datasets for the distance matrices. The distance matrices refer to the network distance between each population grid and each POI. The calculation stage computes the values of access and access ratios for each grid.

The first stage processes the population grid and the POI datasets in the software Quantum Geographic Information System (QGIS 3.16.6). This study first generated the population density from the 2017 cell phone signaling data for the population grid. It then used the default Zonal Statistics plug-in in QGIS to transfer the population density into a 250*250 *m* population grid (28,037 units) in conjunction with the Statistical Yearbook data (Statistics, 2018). For the POIs downloaded from UDP (or OpenStreetMap), it is necessary to delete wrong and duplicate points in the QGIS.

Specifically, the number of companies (over two hundred thousand points) is too large to generate distance metrics in QGIS. Therefore, the job opportunities are estimated in the 250*250 m grid by multiplying the company size and the number of companies. Major hospitals are those whose official level is greater than Grade II. All service capacities are calculated as the number of objects. For datasets downloaded from OpenStreetMap and WorldPop, it is crucial to ensure they have the same coordinate systems and projections.

The second stage is to form the distance matrices between population grids and POIs datasets. The QNEAT3 plug-in in QGIS generated the distance matrices between the population grid's geometric center points and the POIs based on the road networks. In this study, the distance is computed in the car-drive mode.

Based on the distance matrices, the third stage calculates the spatial accessibilities to different resources within the 3SFCA model. Wang (2021) provided theoretical proof to reject the need of added complexity of calculation model. Due to the data availability and limited computing power, the 3SFCA method was finally implemented in the final result. Python (3.7.0) is used to calculate the accessibility of each population grid in the 3SFCA method. Using the custom codes (Lina Zhang, 2021) can realize the calculations of accessibility in the 3SFCA method. Table 4.11 shows the catchment radius, the number of POIs in 2010 and 2017, the distance tolerance, and spatial distribution of the five social goods. The accessibility distribution of each social good will be clarified with more details in the next chapter.

Table 4.11 The characteristic of the five social goods

| Social goods | Catchment radius (km) | Number of POIs | | Distance tolerance | Spatial distribution |
|---|---|---|---|---|---|
| | | 2010 | 2017 | | |
| All medical facilities | 20 | - | 5144 | High | Dispersed |
| Main hospitals | 20 | 260 | 277 | High | Centralized |
| Primary schools | 3 | 738 | 828 | Low | Dispersed |
| Job opportunities | 20 | - | 13,488 | Medium | Centralized |
| Parks | 30 | 379 | 432 | High | Centralized |
| Buses | 1 | - | 3,0031 | High | Dispersed |

## 4.6 The Other Indicators' Measurements

Compared to accessibility assessment, the other three indicators' measurements are clearer and more straightforward. Availability refers to the number of facilities available in a certain living area or residential area. Proximity refers to the nearest distance from a residential community. Affordability checks whether residents are affordable to use the resources, including the price and social institutions of facility utilization.

### 4.6.1 Availability

Since availability refers to the number of facilities in a certain living area of a residential place, it is important to define a proper distance for daily life. Scholars have discussed the proper allocation of public facilities, including the category of public facilities and the proper distance for daily life (Chen, 2007; Zhao & Lin, 2002). For brevity, this study only references the official standards for public facilities.

There are national standards and local standards for the public facilities of residential areas. For example, the national standard "Design Standard of Urban Residential Areas (GB 50180-93)" released in 1996 defines a three-level classification of residential areas (see Table 4.12) and sets up the amount and type of public facilities according to the resident scale. This discontinued standard even defines the number of restaurants and markets according to the resident scale, which reflects a strong socialist influence.

For Shanghai local standards, there are two versions of "Standards for public facilities of urban residential areas and district in Shanghai": (DGJ 08-55-2006) and (DGJ 08-55-2019). Here I use the former standard since it is the actual implementation specification during the research time. The Standard DGJ 08-55-2006 follows the framework of the national standard "GB 50180-93" and defines a detailed proper allocation of public facilities including 67 kinds of public facilities. For medical and health, it states that there should be four community health centers in one residential area, with each of 3000 m². For a community, it states that a primary school with 1125 pupils and 9.6 m² per capita architecture area is required, along with a middle school with 900 students and 11.5 m² per capita architecture area. The standard also states the number of commercial facilities, including shops and supermarkets. While in planning practice, this strict standard of facility allocation cannot be implemented in suburban area.

In 2008, there is a new version of national standards "Planning and Design Standards for Urban Residential Areas (GB 50180-2018)" released. It puts up a concept of a daily living circle, which replace the residence scale to be the setting standard of the public facility. Table 4.13 shows the must-equipped public facility in the three kinds of living circles. Although the standard is looser compared with the previous version, it remains a socialist allocation, including the highly-marketization commercial facilities.

Table 4.12 The residence scale in “Design Standard of Urban Residential Areas (GB 50180-93)”

| | Residential area | Community | Nationhood group |
|---|---|---|---|
| Number of households (households) | 10,000-16,000 | 3,000-5,000 | 300-1,000 |
| Population (person) | 30,000-50,000 | 10,000-15,000 | 1,000-3,000 |

The previous socialist system led to a top-down totalism, which formed the residential area as generally a gated community. A gated community refers to an aggregation of living units (apartment buildings and housings) with clear and conclusive fences and gates. Therefore, it is possible to generate a clear boundary of the community, which is the basic analysis unit for availability and proximity measurements.

In this study, availability is calculated as the number of facilities that fall in the 1500- and 3000-meter buffer with the center of the community polygon centroid. The concept of a daily living circle is adopted since it is a reasonable method to calculate the basic resource distribution. Because the average human walking speed is about 5 km/h, walking for 15 minutes is about 1.25 kilometers. For the convenience of calculation, the size of the buffer zone is taken as an integer of 1.5 km. In addition, because the research scope includes the city center and the outer suburbs, the scope of the living circle is expanded to 3km. Figure 4.26 shows the spatial distribution of community polygon in 2017 Shanghai. Figure 4.27 shows the 1500- and 3000-meter buffers which center at the community polygon centroid.

Based on the community polygon, the availability is calculated at the number of resources and facilities that fall in the two different sizes of buffers. The “join data” function in ArcGIS (Figure 4.28) can support such a calculation. The function will generate a new layer that indicates each buffer including how many resources and facilities. Later we will compare the resource acquisition between normal community and shared ownership housing.

Table 4.13 Must equipped public facility in 5-, 10-, and 15-minute of living circle (GB 50180-2018)

| Minutes of living circle | Population | Must-equipped public facility |
|---|---|---|
| 15 | 50,000-100,000 | Middle schools, large multi-functional sports venues, cultural activity centers, health service centers (community hospitals), nursing homes, nursing homes for the elderly, subdistrict offices, community service centers (subdistrict level), judicial offices, shopping malls, catering facilities, banking, telecommunications, postal outlets |
| 10 | 15,000-25,000 | Primary schools, medium-sized multi-functional sports venues, vegetable markets or fresh supermarkets, small commercial finance, catering, and bus terminals |
| 5 | 5,000-12,000 | Community service stations, cultural activity stations, small multi-functional sports venues, outdoor comprehensive fitness venues, kindergartens, day care centers for the elderly, community commercial outlets (supermarkets, pharmacies, laundromats, hairdressers, etc.), recycling points for renewable resources, domestic garbage collection stations, and public toilets |

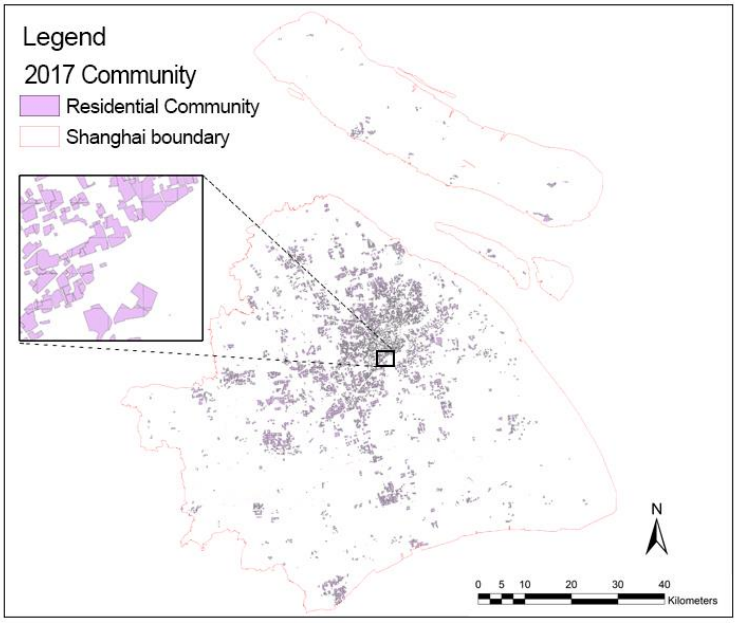



Figure 4.26 The 2017 community distribution in Shanghai

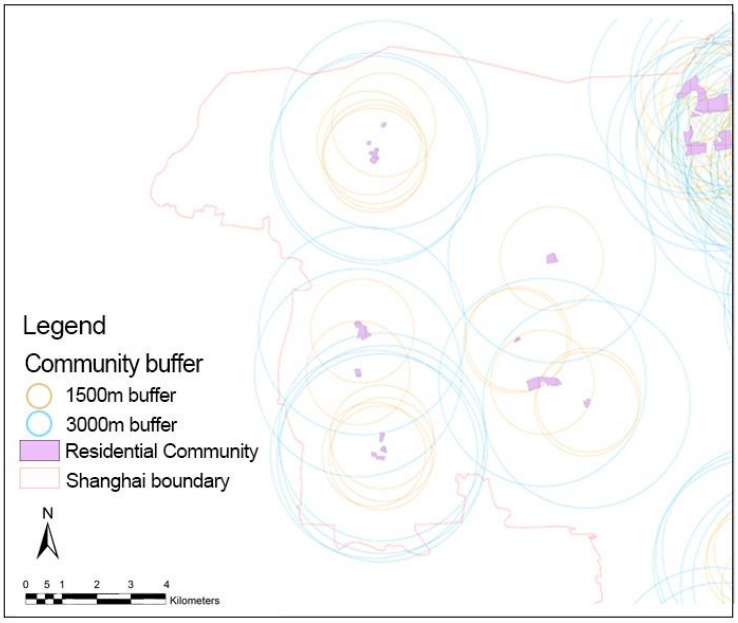



Figure 4.27 The 1500- and 3000-meter buffers for availability calculation

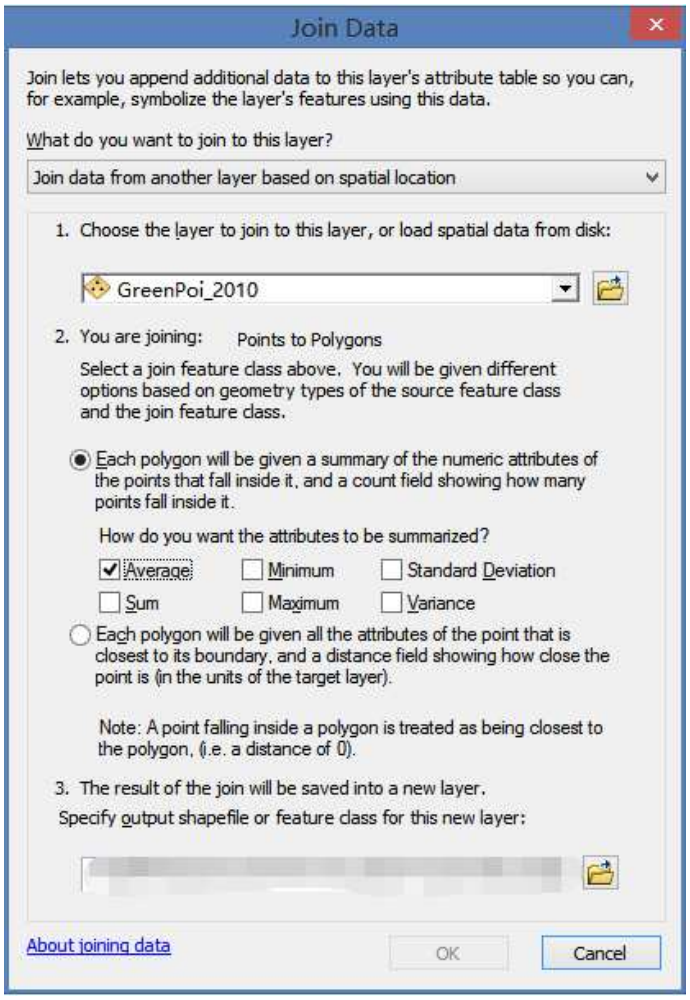



Figure 4.28 the “join data” function in ArcGIS

### 4.6.2 Proximity

Based on the measurement of availability, proximity uses the same function “join data” to generate the nearest distance from the residential community and POIs. The POI includes bus stations, main hospitals, primary schools, middle schools, green parks, and firms. One difference between proximity and availability measurements lies in the basic analysis unit. In availability, it is the 1500- and 3000-meter buffer with the center of the community polygon centroid. In proximity, it is the original community polygon is the analysis unit (Figure 4.26), which provides a more precise calculation.

### 4.6.3 Gini Coefficient

The Gini coefficient is a common indicator used to measure income inequality within a population. In 1912, the Gini coefficient was firstly defined by Italian statistician Corrado Gini. To calculate the Gini coefficient, a Lorenz curve is constructed (Figure 4.29). The Lorenz Curve plots the cumulative percentage of the population on the horizontal axis against the cumulative percentage of income they possess on the vertical axis. The Gini coefficient is derived from the area between the Lorenz curve and the line of perfect equality. The Gini coefficient ranges between 0 and 1, where 0 represents perfect equality, indicating that everyone in the population has an equal share of income or wealth. The smaller the Gini coefficient is, the less inequality exists in income distribution.

Equation 4-16

$$G = 1 - \sum_{k=1}^{n} (P_k - P_{k-1})(A_k + A_{k-1})$$

where *G* is the Gini coefficient, *n* is the total population, $P_k$ is the ratio of cumulative percentage of the population, $A_k$ is the ratio of cumulative percentage of the accessibility.

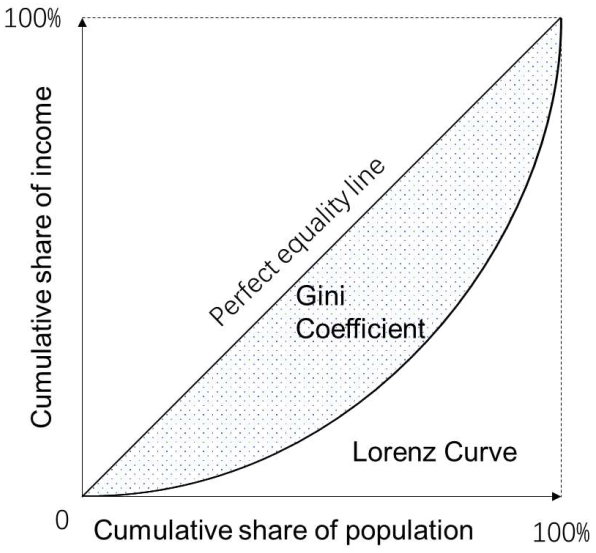



Figure 4.29 The Gini coefficient and a Lorenz Curve

This study tries to apply the Gini coefficient to resource distribution, namely accessibility, which is similar to the acquisition of income and wealth. Equation 4-16 shows the formular of the Gini coefficient of accessibility. The Gini system evaluation standard of resource accessibility in this study refers to the Gini system index table of named income stipulated by relevant United Nations organizations: below 0.2, the income is absolutely average; 0.2-0.3 is relatively average; 0.3-0.4, the income is relatively reasonable; 0.4-0.5, the income gap is large; above 0.5, the income gap is huge.

# 5 Assessing Spatial Equity: Resource Comparison

Chapter 5 indicates the spatial equity of five basic social goods, including health resources, educational resources, job opportunities, parks, and public transport. Four indicators form the evaluation of spatial equity, including accessibility, availability, proximity, and affordability. Instead of a focus on measurement in Chapter 4, Chapter 5 puts emphasis on the empirical result of resource distribution, including social institution and cultural impact.

## 5.1 Horizontal Comparison: Health Resources

The health and medical resources in Shanghai have two features, one is the characteristics of the Chinese health system, and the other is the regional characteristics of Shanghai. We will first go through the Chinese health system, and then the distribution of medical resources in Shanghai.

Under Chinese health legislation, the Chinese health system consists of three subsystems: a health supervision system, a health-service delivery system, and a health financing system (Meng et al., 2015). Figure 5.1 shows the Chinese health supervision system, which has five-level governance according to the administrative level: state level, provincial level, city level, country/district level, and township level. Each level of administration owns its own health supervision, including the Health and Family Planning Commission (HFPC), the Food and Drug Administration (FDA), and the Administration of Traditional Chinese Medicine (ATCM). Actually, this five-level governance exists not only in the health and medical system, but also education, development, landscaping, and transportation services. There are three kinds of relations between the five-level administration: subordination, business management, and business guidance and coordination. The subordination mainly exists between the upper and lower levels of government, while the business management of different-level hospitals belongs to the local HFPC. Therefore, the allocation of Shanghai municipal health and medical resources is mainly in charge of the Shanghai HFPC.

This study mainly focuses on the various institutions that provide health and medical services in the health service delivery system. The institutions can be divided into three categories: hospitals, Primary Health Care (PHC) institutions, and specialized public health institutions. Chinese hospitals are the major health and medical service providers, including both inpatient and outpatient services. PHC institutions provide basic and simple medical services and have two different forms in urban and rural areas. In urban areas, PHC is allocated based on communities, which is a primary administration for residents (population control) and community services. In rural areas, PHC is flexibly allocated based on the population of the township and village. In general, the condition of PHC in urban areas is better than that in rural areas. Specialized public health institutions include disease control and prevention centers, institutions for specific diseases, and maternal and children health centers. Table 5.1 shows the increase in different health institutions in Shanghai between 2010 and 2017.

Chinses hospitals have been categorized into three levels, and each level has three internal qualification levels (A, B, and none). The highest level of a hospital is the tertiary hospital, which means they can provide regional health and medical services, with over 500 ward beds. Among tertiary hospitals, the highest level is the 3A hospitals. For example, the biggest 3A hospital in Shanghai is Zhongshan Hospital, whit over 6000 employers in 2017 and country-wide patients. The second level is secondary hospitals, which offer comprehensive medical and health services and provide 100-499 ward beds. Primary hospitals offer preventive, clinical treatment, health care, and rehabilitation service with less than 100 ward beds.

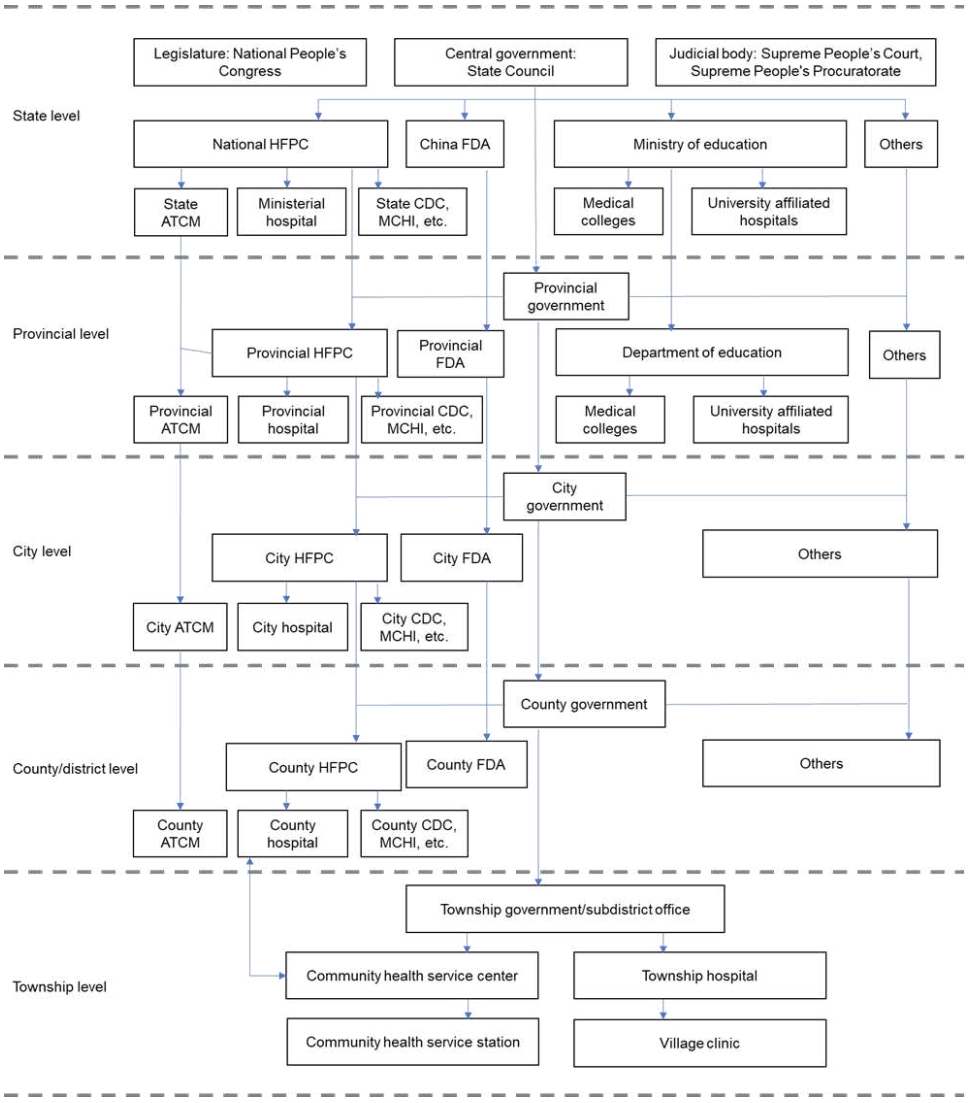
As one of the country-wide economic and cultural centers, Shanghai owns high-quality health and medical resources of the first echelon. These high-quality health institutions serve not only local residents in Shanghai but also inpatients from other regions and areas. In 2012, the number of non-residents' inpatient stays accounted for 22.7% of the total number of inpatient stays and 26.2% of total inpatient expenditure in Shanghai. The non-residents' patients mainly came from the near provinces (Wang et al., 2014). Another characteristic of Shanghai health-service delivery is that patients tend to go to the highest-level hospitals (3A) regardless of disease type (Zhang & Dong, 2009). The 3A hospitals took over a huge amount of health and medical services, while the PHCs had fewer patients and could not serve as primary health institutions. Other scholars figured out that the 3A hospitals spatially concentrated in the city center and rural areas lacked high-quality health resources (Li, 2022; Luo et al., 2009).

This study divides Shanghai's health resources into two categories: main hospitals and all medical facilities. The main hospitals refer to those hospitals with a higher than 2 level, including secondary and tertiary hospitals. All medical facilities involve not only hospitals, but also PHCs, specialized public health institutions, and private health facilities. Due to the limited data source, the study collected the POIs of main hospitals both in 2010 and 2017, albeit all medical facilities only in 2017. The number of main hospitals in 2010 and 2017 is about 300, and all medical facilities in 2017 exceeds over 4,000. Figure 5.2 shows the available POIs of the main hospitals and all medical facilities.

The following section examines four indicators to analyze how medical resources changed between 2010 and 2017 and the difference in medical resource acquisition between the shared ownership housing. The former three indicators–accessibility, availability, and proximity–focus on the geographical distribution of physical medical resources, while affordability puts emphasis on social institutions, especially medical insurance, and medical expenses.

Table 5.1 The number of different health intuitions in Shanghai in 2010 and 2017(Statistics, 2018)

| Year | Hospitals | PHC Institutions | Specialized Public Health Institutions | Others | Sum |
|---|---|---|---|---|---|
| 2010 | 306 | 2823 | 79 | 62 | 3270 |
| 2017 | 363 | 4574 | 112 | 95 | 5144 |




* Others include Ministry of Finance, Ministry of Health and Family Planning Commission, Ministry of Civil Affairs, Insurance Regulatory Commission, etc.

HFPC: Human Resources and Social Security

FDA: Food and Drug Administration;

ATCM: Administration of Traditional Chinese Medicine;

CDC: Center of Disease Control;

MCHI: Maternal and Children Health Institution.

Figure 5.1 A simplified version of the organizational structure of Chinese health system (modified from (Meng et al., 2015))

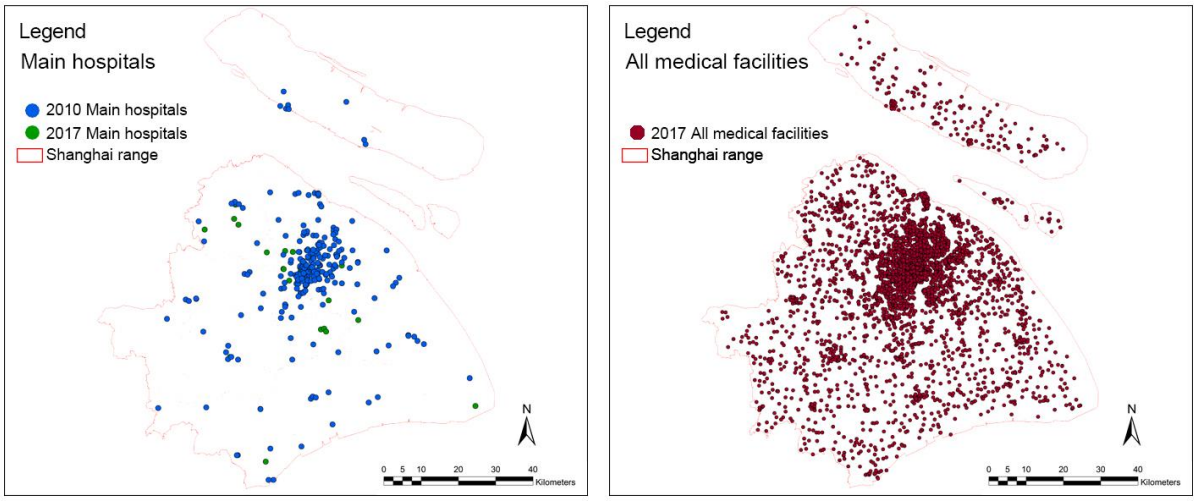



Figure 5.2 The distribution of main hospitals and all medical facilities in Shanghai

### 5.1.1 Accessibility

As stated, accessibility refers to the resource acquisition per capital regarding facilities utilization and distance barrier. The accessibilities to all medical facilities and main hospitals in Shanghai show a structural similarity: mainly monocenter with subcenters in the suburban area. The suburban area, which is located within the Ring Expressway, has a majority (over 80% area) of middle-level accessibility to all medical facilities and main hospitals. The subcenters in the suburban area are the planned new town, including Jiading New Town and Songjiang Newtown. If we compare the accessibility map of all medical facilities and main hospitals, we will find that the spatial range of the highest accessibility (the red color) to main hospitals is somehow smaller than that to all medical facilities. We then can conclude that the allocation of high-quality health facilities is more concentrated in the city center than all.

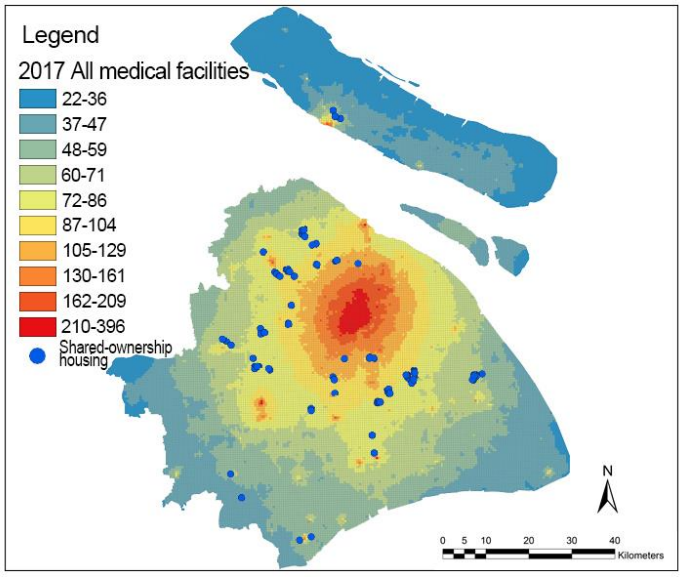



Figure 5.3 The accessibility to all medical facilities in Shanghai in 2017

If we directly compare the accessibility map of main hospitals in 2010 and 2017, we will find that there is not a huge change in the spatial structure. As Figure 5.4 shows, only the middle-level (the bright yellow and light yellow) accessibility expanded in different directions. Since the accessibility maps in 2010 and 2017 share the same unit, we can simply minus the 2010 map from the 2017 map and generate the change of accessibility to the main hospital from 2010 to 2017. Figure 5.5 shows that the city center is where having the most increased population area, with an organic pattern of the decreased population area. We could also find that the population grows in the direction of the sublines and the shared ownership housing is generally in the population growth area. Furthermore, many population growth patches are located outside the Middle Ring Rd. and within the Ring Expressway.

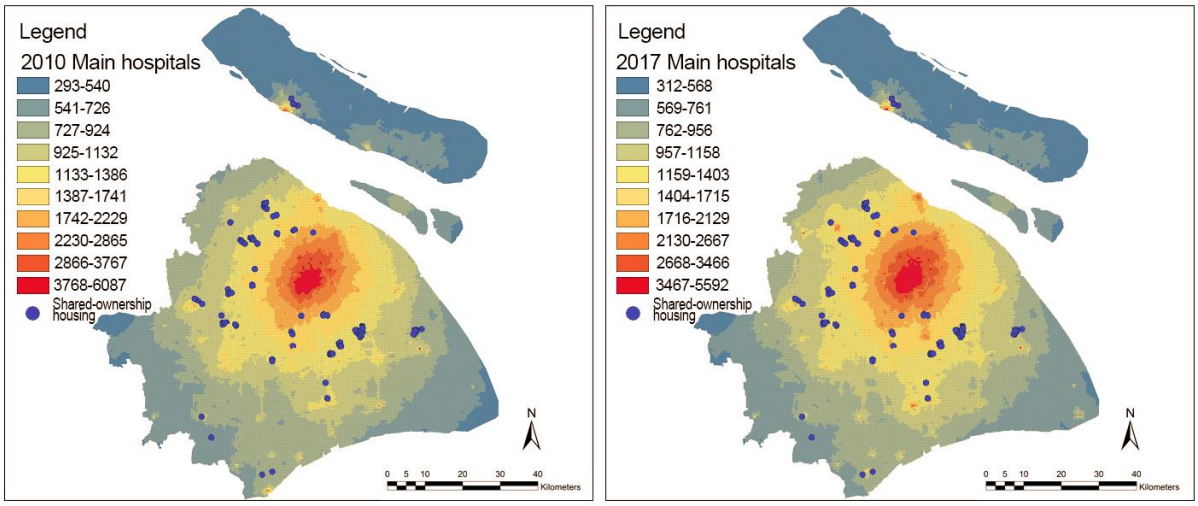



Figure 5.4 The accessibility to main hospitals in Shanghai in 2010 and 2017

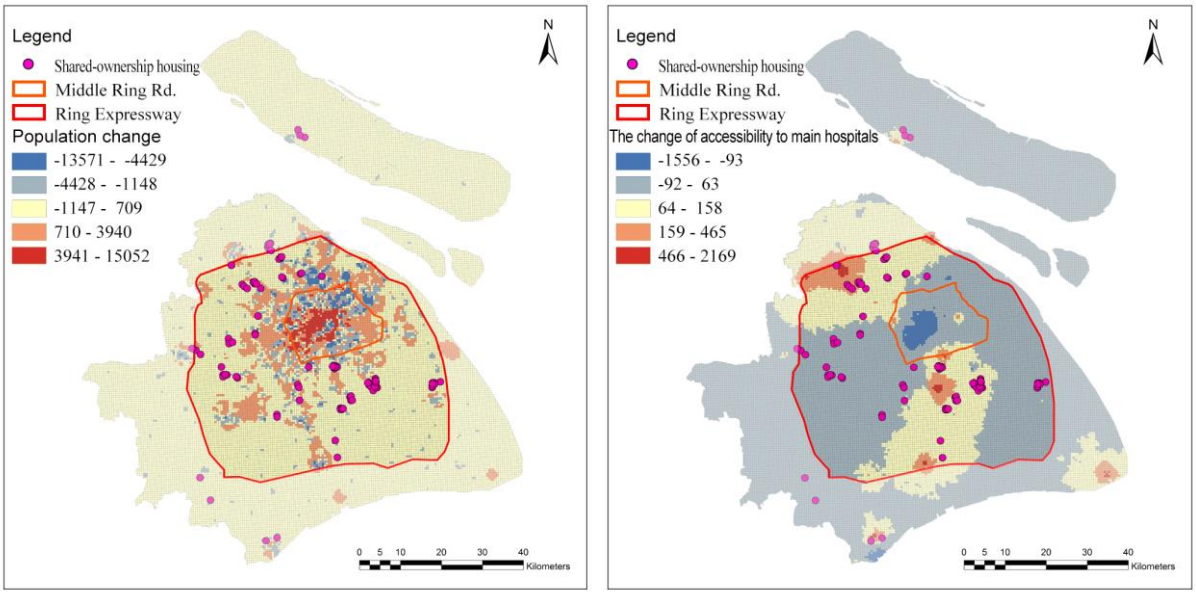



Figure 5.5 The change of population and accessibility to main hospitals from 2010 to 2017

The accessibility change of main hospitals reflects the great influence of the “5+3+1” project (see the right image in Figure 5.5). The “5+3+1” project was launched in 2008 and aimed to build high-quality hospitals in the suburban and rural areas of Shanghai. “5” refers to five famous 3A hospitals (Huashan, Ruijin, Renji, Liuyuan, and Changzheng), which were planned to construct their branches in the four suburban districts (Baoshan, Jiading, Pudong, and Minhang districts). Each suburban branch was planned to own 600 ward beds. “3” refers to upgrading three secondary hospitals in rural districts (Chongming, Qingpu, and Fengxian districts) into tertiary hospitals. The upgrade includes the strength of hospital staffing, technical level, and construction of hardware facilities, with each 1,000 ward beds. “1” refers to the relocation of the tertiary hospital in Jinshan (the southernmost populated area), with 700 ward beds planned. This project of high-quality medical resources relocation substantively increased the acquisition of health and medical resource in suburban areas in Shanghai.

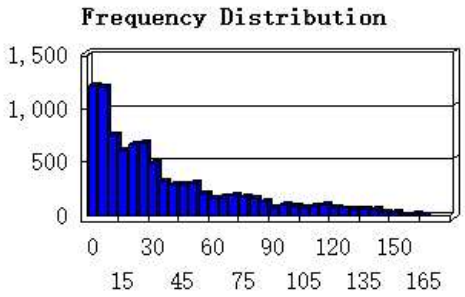
### 5.1.2 Availability

Different from accessibility’s overall structure, availability is calculated based on the polygon of communities (as in Figure 4.26). There are in total 8,785 community polygons in 2017, including 91 shared ownership housing communities. Since the polygon layer of the community only in 2017 is collected, the availability in 2010 is calculated as the buffer centered at the 2017 community polygons with the number of medical facilities in 2010. As the 2010 situation is estimated, we will leave the temporal comparison in the vertical comparison in Chapter 6.

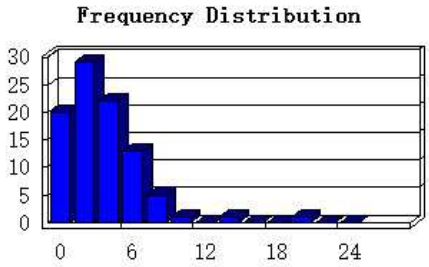
Table 5.2 The health availability of all communities and shared ownership housing in 2017

| | | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|---|
| | | Mean | St.d. | Mean | % | St.d. |
| 1500m Buffer | Availability of all medical facilities | 35.73 | 35.23 | 4.02 | 11.25% | 3.88 |
| | Availability of main hospitals | 3.15 | 4.09 | 0.34 | 10.79% | 0.75 |
| 3000m Buffer | Availability of all medical facilities | 126.27 | 120.71 | 19.86 | 15.73% | 15.49 |

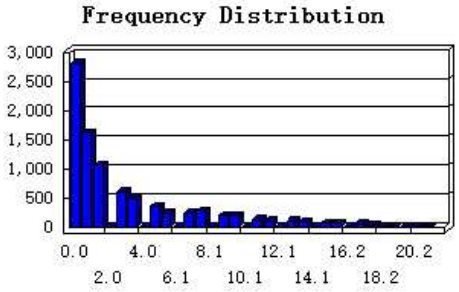
| | | | | | |
|---|---|---|---|---|---|
| Availability of main hospitals | 11.233 | 13.62 | 1.30 | 11.57% | 1.33 |



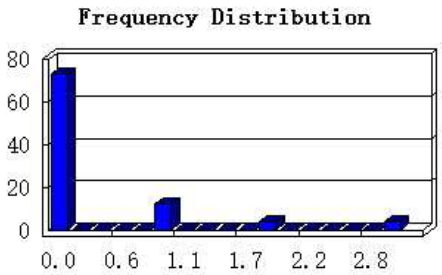

A1. The availability of all communities for all medical facilities in 1500m buffer.



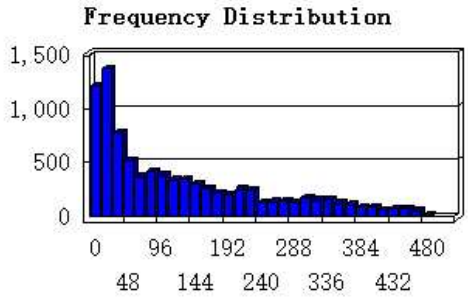

B1. The availability of shared ownership housing for all medical facilities in 1500m buffer.



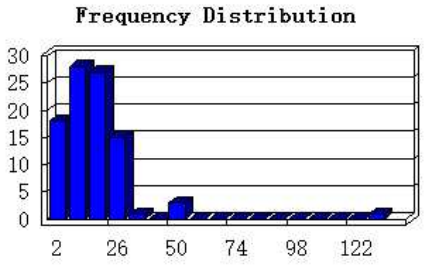

A2. The availability of all communities for main hospitals in 1500m buffer.



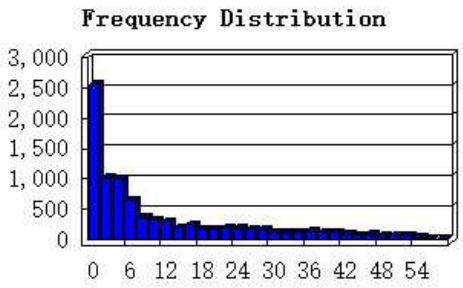

B2. The availability of shared ownership housing for main hospitals in 1500m buffer.



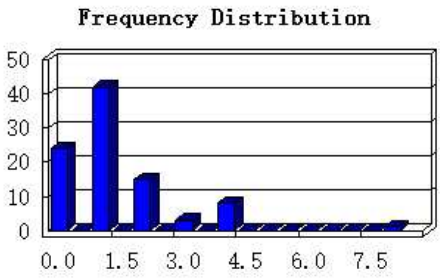

A3. The availability of all communities for all medical facilities in 3000m buffer.




B3. The availability of shared ownership housing for all medical facilities in 1500m buffer.




A4. The availability of all communities for main hospitals in 3000m buffer.




B4. The availability of shared ownership housing for main hospitals in 3000m buffer.

Figure 5.6 The frequency distributions of health availability of all communities and shared ownership housing

For the situation in 2017, Table 5.2 shows the comparison of health availability in all communities and shared ownership housing. There are two buffer sizes with 1500-meter and 3000-meter radiuses. The mean health availability of shared ownership housing is about 10-15% of the mean of all communities. The health availability for the main hospital is slightly inferior to that for all medical facilities. Another feature is that the standard deviation (St.d.) of the communities for different health facilities almost equals the according mean, which implies a great data variation in health availability.

Figure 5.6 shows the frequency distribution of the 8 health availability situations in Table 5.2. Figure B2 shows that a majority of shared ownership housing has no main hospitals located in their 1500m buffer. In general, the health availability of shared ownership housing is inferior to that of all communities. The main hospitals' amount is generally smaller than all medical facilities. The frequency of the main hospital available decreases more sharply than that of all medical facilities. Furthermore, a certain amount of shared ownership housing has at least two medical facilities available in the 3000m buffer. The 3000m buffer tends to have more health availability than the 1500m buffer.

### 5.1.3 Proximity

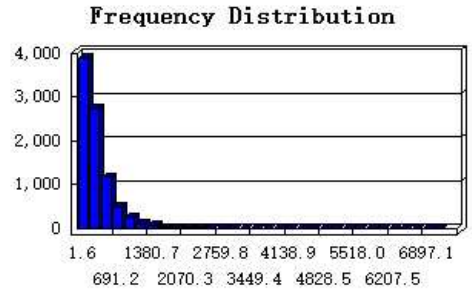
Proximity refers to the distance from the community polygon to the nearest health facility. There are three situations: proximity to all medical facilities (2017), proximity to main hospitals in 2017, and proximity to main hospitals in 2010. Due to the lack of community distribution in 2010, the data of 2010 main hospital proximity remains an estimated value. Table 5.3 shows the health proximity of all communities and shared ownership housing. From the time dimension, the proximity to the main hospital decreased from 2010 to 2017 both for all communities and shared ownership housing. It reflects that the situation of the health proximity was generally improved in the seven years. However, the nearest distance to all medical facilities shows a larger gap between all communities and shared ownership housing than that to main hospitals. The

former (proximity to all medical facilities) shared ownership housing has more than twice the distance of all communities, while the latter (proximity to main hospitals) shared ownership housing has less than twice. This might be due to the higher level of marketization in all medical facilities, which tends not to be located in low- and middle-income residential areas.

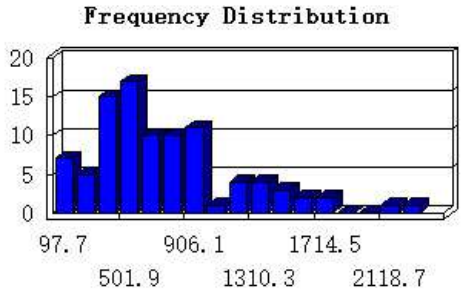
Figure 5.7 shows the according frequency distributions of Table 5.3. A significant feature is that the frequency distribution of shared ownership housing is more dispersed than that of all communities. A distinct proportion of all communities have a near distance of health resources, while shared ownership housing has a higher possibility of long distance to the nearest health facilities. In the case of main hospitals, the situation of shared ownership housing has been significantly improved.

Table 5.3 The health proximity of all communities and shared ownership housing

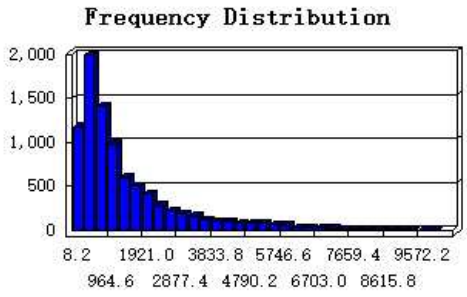
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | % | St.d. |
| Proximity of all medical facilities in 2017 | 355.65 | 342.29 | 778.13 | 218.79% | 450.02 |
| Proximity of main hospitals in 2017 | 1449.06 | 1491.42 | 2418.61 | 166.91% | 1240.71 |
| Proximity of main hospitals in 2010 | 1536.29 | 1561.73 | 2850.11 | 185.52% | 1388.73 |



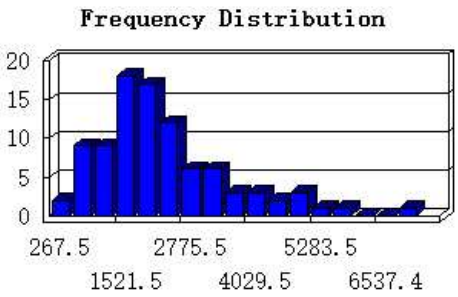

A1. The proximity of all communities for all medical facilities in 2017.



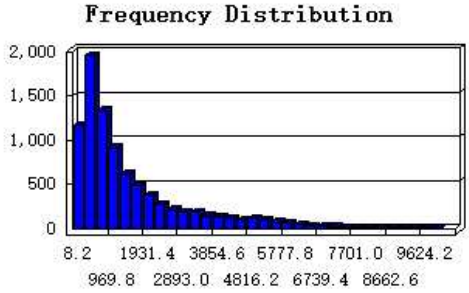

B1. The proximity of shared ownership housing for all medical facilities in 2017.



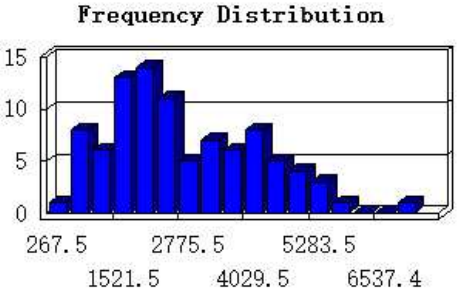

A2. The proximity of all communities for main hospitals in 2017.




B2. The proximity of shared ownership housing for main hospitals in 2017.




A3. The proximity of all communities for main hospitals in 2010.




B3. The proximity of shared ownership housing for main hospitals in 2017.

Figure 5.7 The frequency distributions of health proximity of all communities and shared ownership housing

### 5.1.4 Affordability

There are three basic social health insurance schemes in China: rural cooperative medical scheme, urban employee-based health insurance scheme, and urban resident-based health insurance schemes. It is not hard to find that the three distinct health insurance schemes are based on the social status of the residents: rural residents, urban employed residents, and urban unemployed residents. In fact, China's basic social health insurance schemes are based on the *Hukou* system, which classifies the social status of the residents. When it comes to medical expenses, there are five different payers changing with the medical service provider. As Table 5.4 shows, the five payers include the local government, local social medical insurance fund, (individual) private or commercial medical insurance, cost sharing, and direct payment. The proportion of each payer differs according to the type of health and medical services.

Table 5.4 Provider payment mechanisms (Meng et al., 2015)

| Providers \ Payers | Local government | Local social medical insurance fund* | Private or commercial medical insurance | Cost sharing | Direct payment |
|---|---|---|---|---|---|
| Public primary hospitals | Financial subsidy | Mixed1 (global budget, capitation, case payment, FFS, etc.) | FFS | FFS | FFS |
| Secondary and tertiary public hospitals | Financial subsidy | Mixed1 (global budget, FFS) | FFS | FFS | FFS |
| Private medical institutions | None | Mixed1/ None | FFS | FFS | FFS |
| Retail pharmacies | None | FFS | None | FFS | FFS |
| Public health service institutions or prevention services provided by hospitals | Financial subsidy | None / FFS | None/ FFS | None/ FFS | FFS for paid services |

* Generally, capitation is applied to outpatient services and case payment to inpatient services. Global budgets and FFS can be applied to both outpatient and inpatient services.
1 “Mixed” means that in a certain insurance scheme (i.e., NRCMS), a mixed form of payment method is used for different kinds of expenses (e.g., capitation for outpatient visits and global budget for hospital admissions).
FFS: Fee for service

Table 5.5 The burden reduction policy of urban employee-based health insurance scheme in Shanghai (Hu & Chen, 2011)

| Crowd classification | Object | Burden reduction range | Burden reduction standard | Sources of funds |
|---|---|---|---|---|
| Seriously ill patients | Uremic dialysis patients | Personal payment portion of dialysis medical bills | Reduced from 8-20% to 4-10% | Government special funds |
| | Psychopath | The portion of the deductible below the payment standards for hospitalization incurred at designated institutions covered by the general medical insurance fund | 85% reduction for current employees, 92% reduction for the retirees | Government special funds |
| | The low-income families with urban employee-based health insurance | The portion of the deductible below the payment standards for hospitalization or emergency expenses incurred at designated institutions covered by the general medical insurance fund | 85% reduction for current employees, 92% reduction for the retirees | Local supplementary medical insurance fund |
| The low-income | Completely incapacitated, low-income and difficult employees who cannot enjoy medical insurance benefits when they retire because they are underage[1] | same as above | 50% reduction | Local supplementary medical insurance fund |
| | The low-income who have lost most of their labor capacity with urban employee-based health insurance | same as above | 50% reduction | Local supplementary medical insurance fund |
| Patients who pay high medical expenses | Persons whose annual out-of-pocket medical expenses accumulatively exceed a certain percentage of their annual income[2] | The portion of annual accumulated out-of-pocket medical expenses exceeding the standard | 90% reduction | Local supplementary medical insurance fund |

1 All in-service employees participating in the basic medical insurance for urban employees who suffer from serious illness or serious illness and are identified by the Municipal Labor Ability Appraisal Center as extremely poor persons who have completely lost their ability to work, males 48 years old and above, and females 43 years old and above, can enjoy other benefits in the same way. Relevant medical insurance treatment when I retire.
2 As the income ratio increases (30%-50%), the upper limit of income is three times the average wage in society.

Due to historical reasons, Shanghai's social health insurance schemes include two other schemes: small-town residents' health insurance scheme and freelancer health insurance scheme (Hu & Chen, 2011). Therefore, these five kinds of social health insurance schemes are mainly distinguished according to social characteristics (the nature of *Hukou*, the nature of the occupation, and the nature of their employer *Danwei*). Despite the five basic social health insurance schemes, the Shanghai government launched a series policy to reduce the medical cost of low-income and seriously ill patients. Table 5.5 shows the burden reduction policy of the urban employee-based health insurance scheme in Shanghai. The policy had three targeted audiences: seriously ill patients, the low-income, and the patients who pay high medical expenses. Its sources of funds came from Shanghai Municipal Government.

From the point of medical service receiver, Shanghai's social health insurance system provides comprehensive medical coverage to all citizens and supports vulnerable groups. The burden reduction policy aimed at reducing the cost of healthcare for low-income households, impoverished families, and special needs patients. This ensures that low-income and vulnerable households can access essential medical care without worrying about the financial burden of treatment. In fact, the Shanghai social health insurance system is widely recognized as one of the most advanced and comprehensive systems in China. In this case, we could regard the affordability of shared ownership housing residents for health and medical service as above the average level in China.

## 5.2 Horizontal Comparison: Educational Resources

Shanghai's education system has been regarded as the first tier of China's high-quality education system. In the 2009 and 2012 Program for International Student Assessment (PISA), the students in Shanghai performed outstandingly and achieved the highest score in the areas of reading, science, and mathematics. The Organization for Economic Co-operation and Development (OECD) organized the PISA by testing the capabilities of the worldwide 15-year-old in reading, science, and mathematical literacy. Based on Shanghai students' impressive results, Liang et al. (2016) analyze Shanghai's successful experience from a systematic view, including its educational policies, teaching force, financing, autonomy and accountability, and student assessment system.

Besides, the high quality of Shanghai's education system has also been influenced by its pioneering position in China's education system reform. One example is the localized college entrance examination (Gaokao in Chinese). Since 1985, Shanghai has organized the college entrance examination under its own jurisdiction (OESD, 2016). Different from other places in China, Shanghai's college entrance examination has taken the form of "3+X" since 2001. "3" refers to the three core subjects: Chinese,

English, and mathematics. “X” refers to one supplement subject, which can be chosen from politics, history, geography, physics, chemistry, and biology. Due to the localized form of college entrance examination, Shanghai students take localized Gaokao papers and accordingly score criteria. Therefore, the entrance barriers to college are relatively low compared to the other provinces (excluding Beijing) in China.

Figure 5.8 shows Shanghai’s education structure, with four-level education. The first level is early childhood education, aiming at children 3-6 years old. The second level is the nine-year basic and compulsory education, including primary education and junior secondary education. After the compulsory education, students can choose to continue study either in senior secondary or in secondary Technical and Vocational Education Training (TVET). The students in both types of secondary schools can take the college entrance examination and further enter the higher (college) education or tertiary TVET. The students in secondary schools can also choose directly attending the labor market or continuing education.

However, there is a key factor in the Shanghai education system: *Hukou*. Since Shanghai owns its localized and good-quality education resources, especially advantaged college entrance examinations. There is a strict entrance control of the college entrance examination, which requires local Shanghai *Hukou*. In fact, Shanghai *Hukou* is a basic requirement in basic compulsory education as well. But for certain primary and junior secondary schools, monetary compensation, or policy preference (i.e., preferential policies for the schooling of migrant workers' children) can allow certain migrants’ children to get educated. Shanghai *Hukou* is hard to obtain since it is tied to property ownership, with the soaring housing price in Shanghai. There are additional requirements and details of the entrance of Shanghai basic and compulsory education, which will be further discussed in the affordability section.

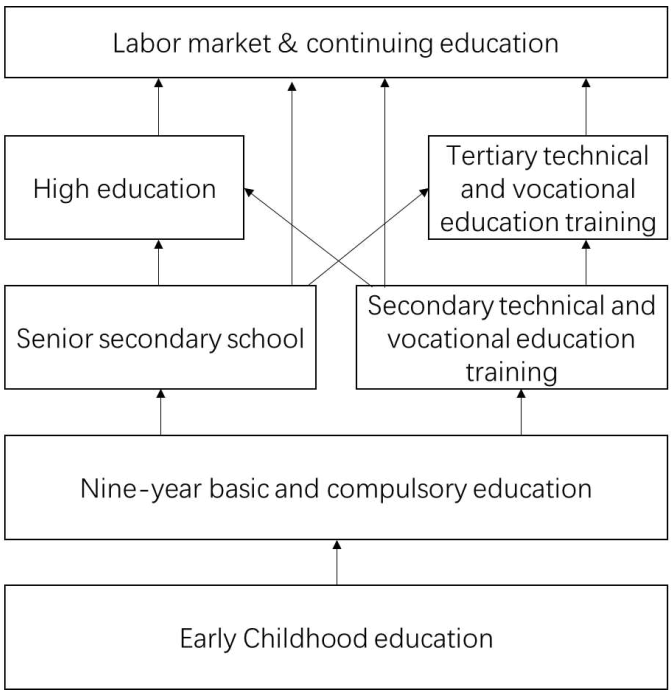


Figure 5.8 Shanghai Education Structure ( modified from (Liang et al., 2016))

Since this study focuses on the spatial justice of basic and fundamental educational resources, the main research object is the schools in the nine-year basic and compulsory education. The China Compulsory Education Law requires each child in China should receive nine years of free basic education. It then ensures the national-wide equality of basic educational resources and built up Chinese compulsory education system. The system is divided into two stages: primary education and junior second education (hereinafter referred to as “middle school”). In Shanghai, the compulsory education system differs from the other places: primary education lasts for five years, starting at the age of seven, while middle education lasts for four years. In other places, it is normal that primary education takes six years and middle education lasts for three years. The next section will analyze the accessibility, availability, proximity, and affordability of primary and middle schools in Shanghai.

### 5.2.1 Accessibility

This section analyzes the accessibility to primary schools and middle (junior secondary) schools in Shanghai in 2010 and 2017. Figure 5.9 shows the accessibility to primary schools, and Figure 5.10 shows the accessibility to middle schools. From 2010 to 2017, we can find both accessibility to primary and middle schools has expanded to high-accessibility areas (the red and orange grids). It reflects that primary schools and middle schools both increase their service provision along with the urban sprawl process.

Although all these accessibility maps show a monocentric structure, they are divergent in detail. For primary schools, we can find discontinuous patches around the center core. While the accessibility maps of middle schools are continuous “pizza”. It seems that the distribution of middle schools is more concentric than that of primary schools. It is reasonable since middle schools provide a higher level of education than primary schools. Compared to the accessibility maps of all medical facilities (Figure 5.4), the middle-accessibility district (the light-yellow and yellow grid) obtains much less geographic area. The overall distribution of basic educational resources seems to be less spatial equity than that of medical resources.

The situation of shared ownership housing also differs from the medical resources. In medical accessibility, a majority of shared ownership housing is located in middle-level accessibility. While most shared ownership housing obtains low-middle accessibility to primary and middle schools.

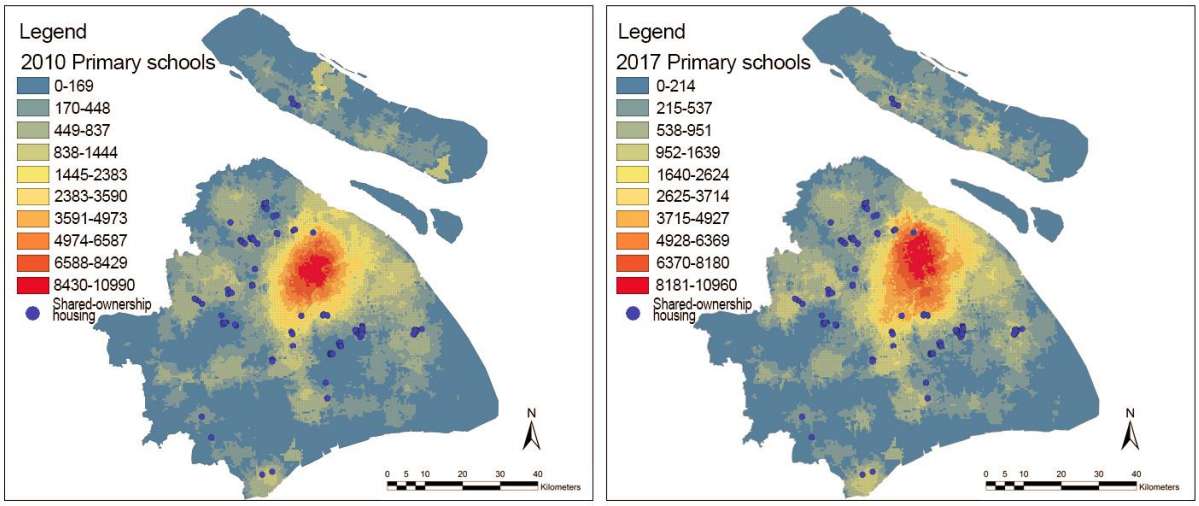



Figure 5.9 The accessibility to primary schools in Shanghai in 2010 and 2017

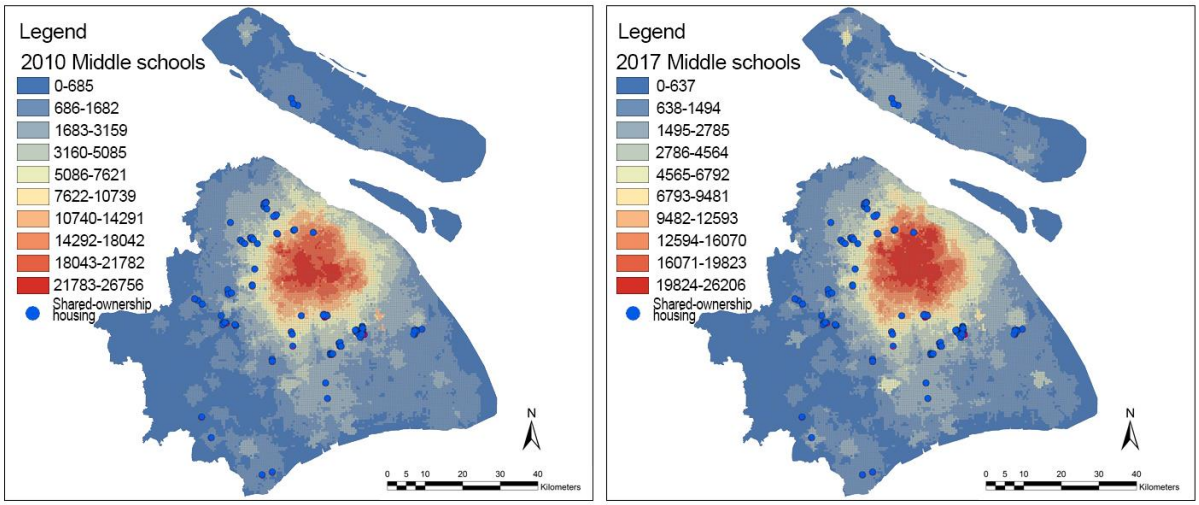



Figure 5.10 The accessibility to middle schools in Shanghai in 2010 and 2017

Figure 5.11 shows how educational accessibility changed from 2010 to 2017. Since the central city had a largely increased population (see Figure 5.5) and few new schools, it is logical that the central city had gone through a great extent decrease in accessibility. We also can find that the north-east and south-east of the central city had an increase in accessibility, mainly because of the increase in school provision. These two areas belonged to two districts, the Baoshan and Pudong district, which had endeavored to open various types of schools, including private schools and university affiliate schools. For example, the Baoshan district imported private primary schools attached to high schools and universities, i.e., the private primary school of No.2 High school of East China normal university and Baoshan world foreign language school.

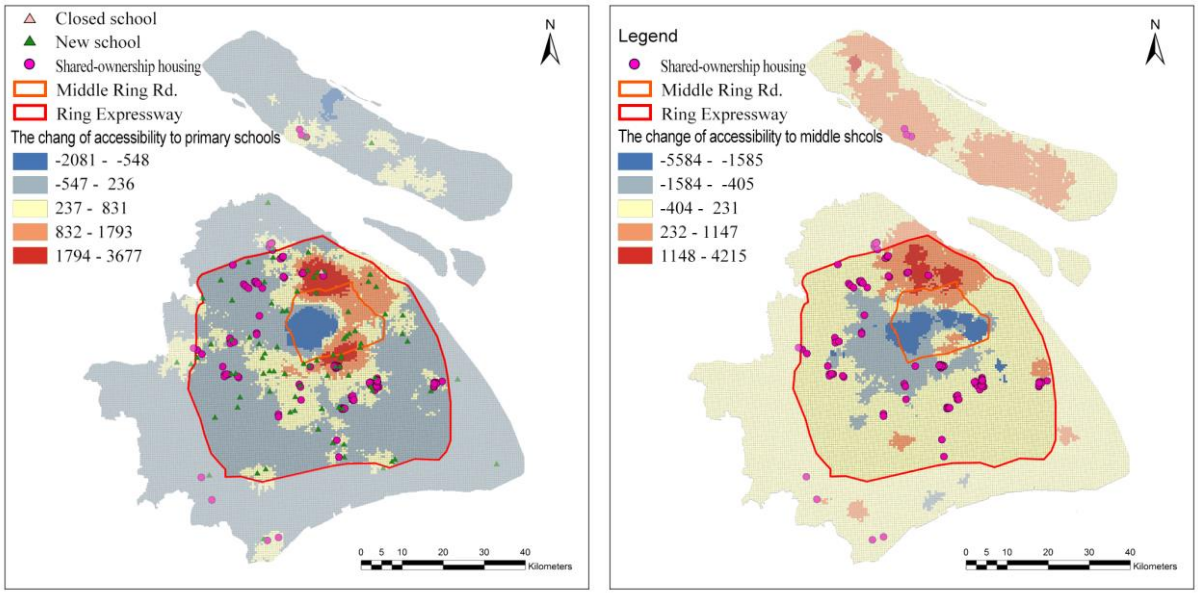



Figure 5.11 The change of population and accessibility primary schools and middle schools from 2010 to 2017

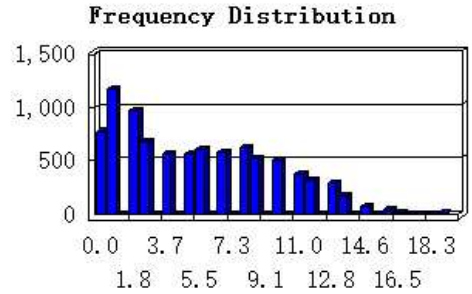
### 5.2.2 Availability

The educational availability is the number of basic education facilities located in certain living circles of residential communities. Due to individual mobility and long school hours, the educational availability focuses on primary schools in Shanghai. The mobility of the students in primary schools and middle schools differs to a great extent. For daily school life, primary school students can only commute short distances due to their limited mobility, but middle school students have significantly improved mobility. For students in primary schools in Shanghai, school time generally begins around 7:30 a.m. and ends around 5:00 a.m. For students in middle schools, the school time maybe even later because of self-study sessions in the evening. Based on the long school time and the short-distance commuting characteristics of primary school students, the availability of primary school facilities is relatively important within the 1500m and 3000m buffer of residential communities.

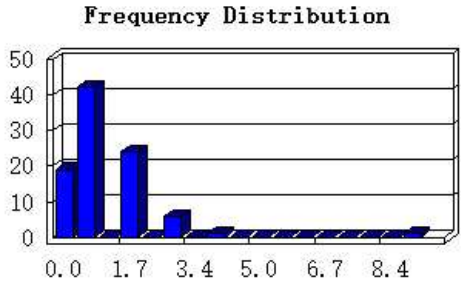
Table 5.6 shows the mean and standard deviation of primary school availability in all communities and shared ownership housing in 2017. We can find the mean of all communities is 5.48, which means that each community can choose about 5 primary schools in the distance of 1500m buffer. While shared ownership housing can only choose 1.30 primary schools in general, with only 23.73% of all communities. In the case of a 3000m buffer, all communities can have about 19 choices while shared ownership housing only has about 5 choices of primary schools. Even if the 3000m buffer is a relatively far away distance for students in primary schools. We can find there is a significant disadvantage for the students at primary schools living in shared ownership housing.

Table 5.6 The primary school availability of all communities and shared ownership housing in 2017

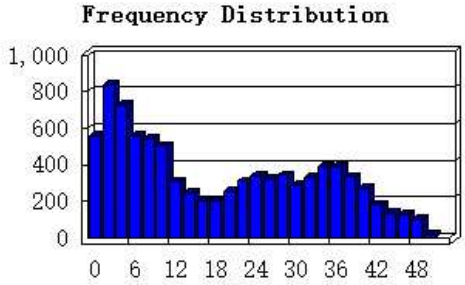
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean | St.d. | Mean | % | St.d. |
| 1500m Buffer | 5.48 | 4.14 | 1.30 | 23.72% | 1.18 |
| 3000m Buffer | 19.13 | 14.24 | 5.22 | 27.29% | 4.48 |



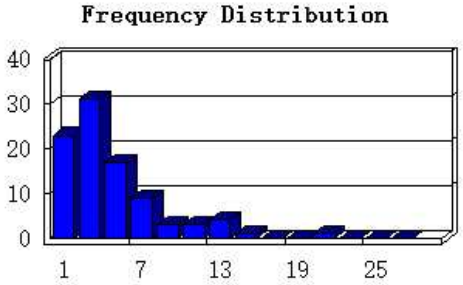

A1. The availability of all communities for primary schools in 1500m buffer.




B1. The availability of shared ownership housing for primary schools in 1500m buffer.




A2. The availability of all communities for primary schools in 3000m buffer.




B2. The availability of shared ownership housing for primary schools in 3000m buffer.

Figure 5.12 The frequency distributions of primary school availability of all communities and shared ownership housing in 2017

In the aspect of the frequency distribution of primary school availability (see Figure 5.12), the students in shared ownership housing are also confronted with significant disadvantages. In the case of 1500m buffer, there is no shared ownership housing obtain more than 3.4 primary schools while a great number of residential communities obtain 3.7-11.0 primary schools. In the case of 3000m buffer, the gap between these two residential areas is narrowed. A certain number of residential communities and shared ownership housing has no primary school either within its 1500m or 3000m buffer. It is obvious that shared ownership housing has a lower level of basic education opportunity than the average. Moreover, the education quality and school size of primary schools are not considered in the availability analysis. It is possible that students

living in shared ownership housing suffered a much worse situation regarding the availability of basic education opportunities.

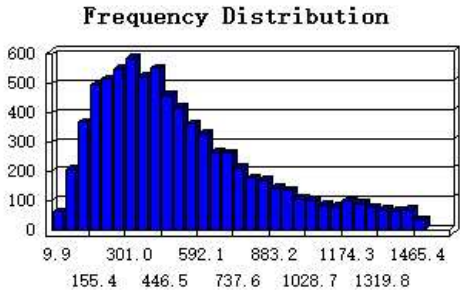
### 5.2.3 Proximity

Table 5.7 shows the primary school proximity of all communities and shared ownership housing in 2010 and 2017. In 2010, the mean of proximity (the nearest distance) of shared ownership housing was almost twice of the general communities. In 2017, the mean proximity of all communities remained almost the same as in 2010. While the mean proximity of shared ownership housing reduced significantly and was only 1.5 times that of all communities. It reflects that there were new primary schools near some shared ownership housing.

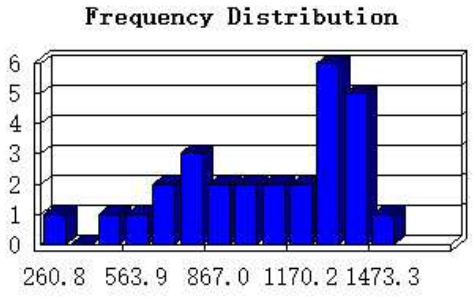
The frequency distributions of primary school proximity also confirmed the increase of primary schools around shared ownership housing. As Figure 5.13 shows, the frequency distribution of all communities' proximity for primary schools remained similar from 2010 to 2017, while that of shared ownership housing changed remarkably. Its majority of proximity was located between 1172m to 1473m in 2010, which later overall left shifted and turned to a scattered distribution. In 2017, more shared ownership housing has a less than 1147m distance to the nearest primary schools.

Table 5.7 The primary school proximity of all communities and shared ownership housing

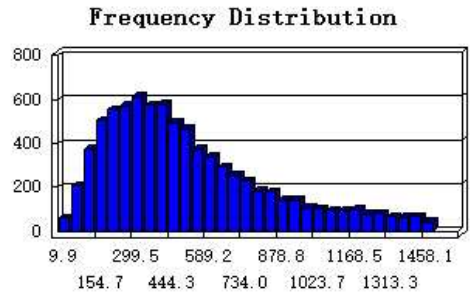
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | % | St.d. |
| Proximity of primary schools in 2010 | 523.74 | 329.60 | 1082.97 | 206.78% | 311.54 |
| Proximity of primary schools in 2017 | 519.87 | 324.81 | 784.22 | 150.85% | 389.12 |



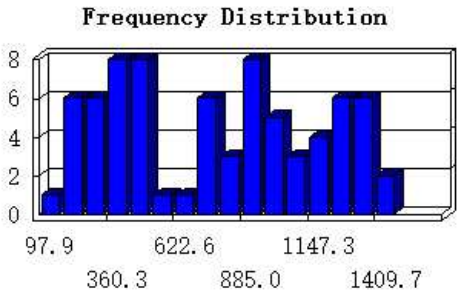

A1. The proximity of all communities for primary schools in 2010.




B1. The proximity of shared ownership housing for primary schools in 2010.




A2. The proximity of all communities for primary schools in 2017.




B2. The proximity of shared ownership housing for primary schools in 2017.

Figure 5.13 The frequency distributions of primary school proximity of all communities and shared ownership housing

### 5.2.4 Affordability

Educational affordability changes along with the level of education resources. It is logical that a higher level of education requires higher affordability. However, this study focuses on the basic education based on the concept of human basic liberty. Educational affordability thus takes primary school and middle school in the basic and compulsory education as the two objects. These two schools they can be divided into public schools and private schools according to the running body. The main bodies of public schools are governments at all levels, state-owned enterprises, and institutions, etc., and the assets are publicly owned. Appropriated by the national government department or its competent unit. In other words, there is no shortage of money, and the fees are relatively low. The main body of private schools is private or non-governmental organizations, and the assets are privately owned. The finances are entirely personal; therefore, the fees are relatively high.

In general, the affordability of Shanghai basic education resources can be divided into two types: economic cost and social institutional regulation. Between 2010 and 2017, public schools had strict institutional regulations and relatively low fees. On the contrary, private schools had loose institutional regulation and relatively high tuition fees. Although the situation changed quite a lot after “the Law of the People's Republic of China on the Promotion of Privately-run Schools” in 2021, we will go through the economic affordability within the study period at first.

For public schools in basic and compulsory education, there is no tuition fee according to the China Compulsory Education Law. But there are still other fees required by each different school, such as school uniform fees, basic medical insurance, meal expense, extracurricular education activities, and school bus fee. For the other public schools, i.e., senior secondary, higher education, secondary and tertiary TVET, their tuition fees are determined by “the price information guide for citizens” annually promulgated by the Shanghai Municipal Government. In 2016, the charging standard of a normal senior secondary school (high school) is 900 yuan per semester; key high school at the district level is 1200 yuan per semester; key high school at city level is

1500 yuan/semester; and boarding high school is 2000 yuan per semester. For private schools, the tuition fee was a price peak in 2017. In 2016, there were 62 private primary schools in Shanghai with an average tuition fee of 18971 yuan per semester; in 2017, there were 68 private schools in the city with an average tuition fee of 24507 yuan per semester, an increase of 29%. The highest tuition fee came from YK Pao School, reaching 78000 yuan per semester which is more than 86 times that of the public high school. To control the soaring price of private schools, “the Law of the People's Republic of China on the Promotion of Privately-run Schools” requires the percentage of students in private schools cannot exceed 5%. As the large number of private schools in Shanghai, the Shanghai government introduced a policy, in which government buy the study position in private school to turn it into a public study position. This policy significantly reduced the tuition fee of private schools.

This extreme fee gap between public schools and private schools is accompanied by the gap in social institutional regulation. Social institutional regulation differs at the city level, district level and school level. At the city level, the admission policy aims at a balanced development of compulsory education and standardized school enrollment. However, public schools can only enroll the student living in their district while certain private schools can enroll students across the city.

In different districts, the enrollment standard differs to a great extent. For public schools, the social institutional regulation contains the geographical boundary and social status of students and their parents. For local Shanghai *Hukou* residents, limited communities’ residents can only apply for the study position in its matched schools. To own the study position, it is crucial to buy the ownership of certain flats in the matching area, which further exacerbated the rise in housing prices. Moreover, there is an enrollment policy called “Five-year one flat” applied in some districts: each flat can only apply for one position in its matched public school every five years. This time limitation prevents the monetization of the study position. For non-Hukou migrants, the student and one of the parents have to own residence permits with a continuous living time in Shanghai for certain period. Some high-quality primary school requires continuous living time is more than three years. Another unwritten rule is that the priority of enrollment order: local *Hukou* living in the same flat > local *Hukou* living in other flat > collectively *Huko*u and residence permits (migrants). Collective *Hukou* refers to the *Hukou* located at state-owned enterprises and do not own any flat. In this case, migrants without any economic and institutional advantages tend to obtain middle-low basic education resources. However, the residents of shared ownership housing had to obtain Shanghai *Hukou* during 2010 and 2017, who certainly fulfil the enrollment requirements of compulsory education.

To sum up, the free tuition of basic and compulsory education for shared ownership housing residents is highly affordable based on the strict enrollment requirements. For the other residents, especially migrants, the affordability of basic and compulsory education requires either strict social institutional regulation or high private school expenses.

## 5.3 Horizontal Comparison: Job Opportunities

As stated in Rawlsian Second Principle, the fair equality of opportunity to offices and positions open to all is crucial in the theory of justice. This section examines how job opportunities changed in terms of geographical and social distribution in Shanghai. In general, Shanghai's GDP increased more quickly than the quantity of whole social employees (Table 5.8), as the former increased by 76% and the latter by 26%. During 2010 and 2017, the different sections have distinct performances. As the employee quantity of primary industry increased by about 5,3500 persons, its according GDP decreased by about 700 million yuan. The situation in the secondary industry is the opposite: decreased quantity of employees with increased GDP. The tertiary industry owned the most increased quantity of employees (increased by 2.90 million persons/48%) and GDP (increased by 112 billion yuan/113%).

To measure the accessibility, availability, and proximity of job opportunities, this study collects the company location and types in Shanghai. Due to the limitation of data sources, only companies in 2017 are collected. Figure 5.14 shows the POI of 2017 companies in Shanghai. The original data was collected from amap, including all kinds of companies. The job opportunity is estimated by the company type and average quantity of employees. In Figure 5.14, we can a significant mono-centric spatial structure of the quantity of companies, even regardless of the number of employees.

Table 5.8 The quantity of whole social employees and GDP in different section (2010 and 2017) (Statistics, 2018)

| | The quantity of whole social employees (10000 persons) | | Gross Domestic Product (100 million yuan) | |
|---|---|---|---|---|
| | 2010 | 2017 | 2010 | 2017 |
| Total | 1090.76 | 1372.65 | 17436.85 | 30632.99 |
| Primary industry | 37.09 | 42.44 | 117.79 | 110.78 |
| Secondary industry | 443.74 | 430.51 | 7376.81 | 9330.67 |
| Tertiary industry | 609.93 | 899.70 | 9942.25 | 21191.54 |

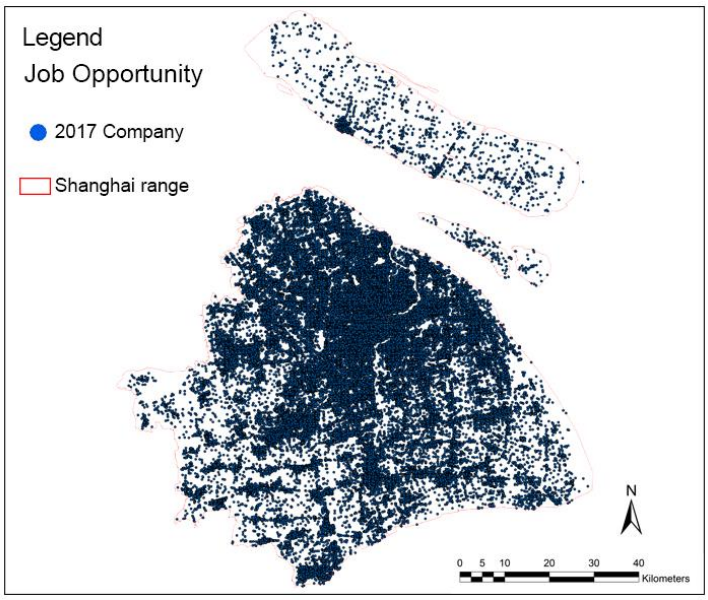



Figure 5.14 The distribution of company in Shanghai in 2017

### 5.3.1 Accessibility

The accessibility to job opportunities requires general commuting habits to access the relationship between supply-and-demand. The supply-demand ratio is a catchment-sensitive indicator. Because the amount of job opportunities will increase significantly as the catchment area increase. In 2020, Baidu Map Eyes jointly published “China's Major Cities Commuting Monitoring Report” with the PRC Ministry of Housing and Urban-Rural Development and the China Academy of Urban Planning and Design. The report selected 36 major cities and analyzed the commuting habits based on Baidu map location service and mobile communication operator data. The report constructed a spatial ellipse that covers 90% of the commuting population in the central urban area and lives in employment distribution. The spatial radius with the long axis of the ellipse in Shanghai is 39 km. The distribution of employees is centered at the city center. Therefore, this study chose 20 km as the catchment radius of the accessibility to job opportunities.

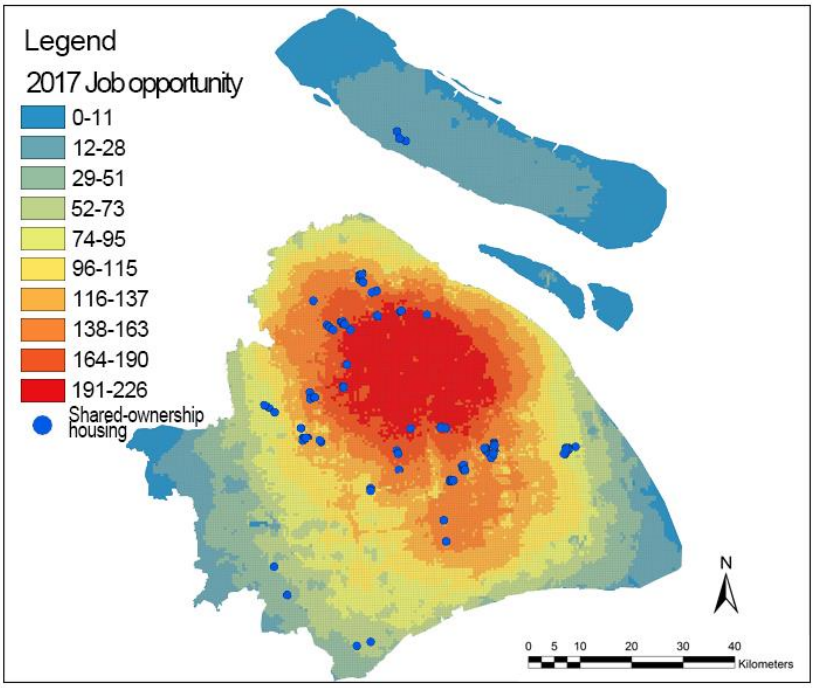



Figure 5.15 The accessibility to job opportunity in Shanghai in 2017

Figure 5.15 shows the result of accessibility to job opportunities in Shanghai in 2017. Job accessibility remains a monocentric spatial structure with an expanded geographic boundary of the top accessibility area. Different from the distribution of health and education resources, the distribution of job accessibility enables about 10 shared ownership housing located at the edge of the top-accessibility area (the red area). We could also find a majority of shared ownership housing is between the middle-high job accessibility area. Since Shanghai developed secondary and tertiary industries, a large number of companies including secondary-industry factories are located in the suburban area. Besides, the amount of job opportunities available in the daily living circle of shared ownership housing is also an important factor, which will be discussed in the next section.

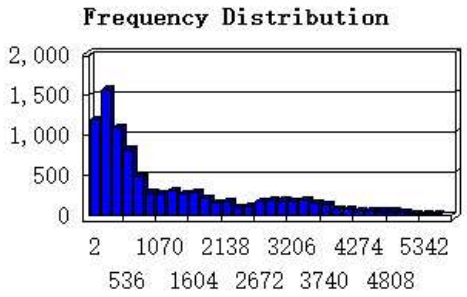
### 5.3.2 Availability

Table 5.9 shows the number of job opportunities in the 1500m and 3000m buffer of all communities and shared ownership housing. The total amount of job opportunities reached a quite large number compared to health and educational resource. Even for shared ownership housing, the mean availability of job opportunities is about 180, which is 14% of the mean of communities. Although the absolute number is large, the percentage of shared ownership housing of all communities is lower than 20%, which is lower than the situation in health and educational resource. This figure reflects that shared ownership housing may tend to have more disadvantaged situations in job opportunities than health and education resources in comparison with all communities.

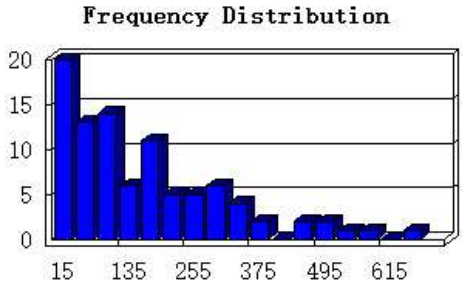
Table 5.9 The job availability of all communities and shared ownership housing in 2017

| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean | St.d. | Mean | % | St.d. |
| 1500m Buffer | 1227.28 | 1257.40 | 180.46 | 14.70% | 144.93 |
| 3000m Buffer | 4734.30 | 4415.50 | 907.69 | 19.17% | 482.74 |

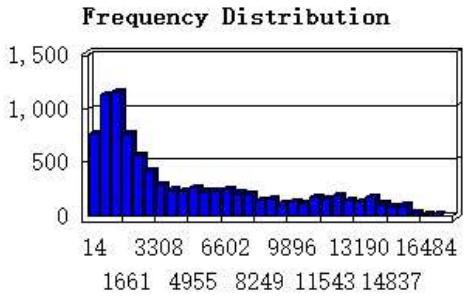
Figure 5.16 shows the frequency distributions of job availability of all communities and shared ownership housing in 1500m and 3000m buffers. As the buffer area enlarges, more job opportunities are available both for all communities and for shared ownership housing. An interesting point is that the frequency distribution only shows a dispersed pattern for the job availability of shared ownership housing in a 3000m buffer, and the other three all show approximate decline curves. This result reflects that in a 3000m life circle, the job availability of shared ownership housing may be in a similarly disadvantaged situation.



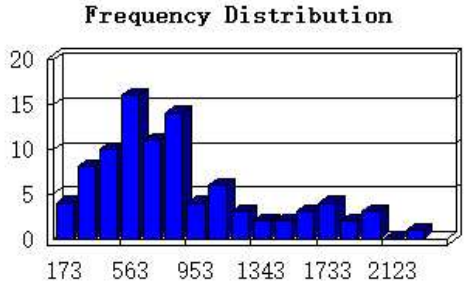

A1. The job availability of all communities in 1500m buffer.




B1. The job availability of shared ownership housing in 1500m buffer.




A1. The job availability of all communities in 3000m buffer.



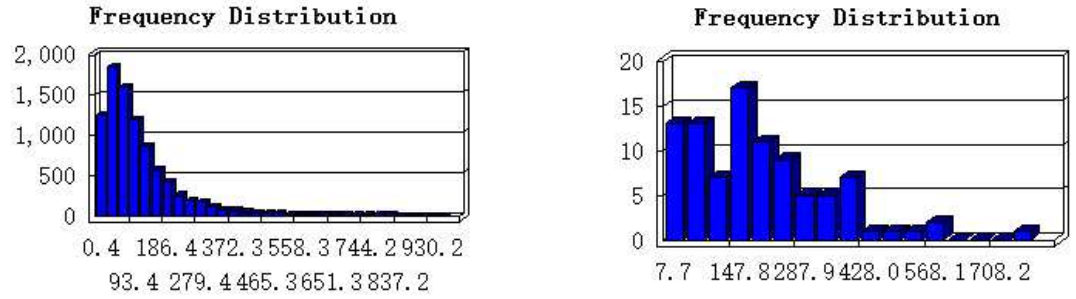

B1. The job availability of shared ownership housing in 3000m buffer.

Figure 5.16 The frequency distributions of job availability of all communities and shared ownership housing in 2017

### 5.3.3 Proximity

Table 5.10 The job proximity of all communities and shared ownership housing

| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | % | St.d. |
| Proximity of job opportunities in 2017 | 113.43 | 98.14 | 210.16 | 185.28% | 146.77 |




A. All communities B. Shared ownership housing

Figure 5.17 The frequency distribution of job proximity of all communities and shared ownership housing in 2017

The job proximity shows a significantly small number compared to other resources (see Table 5.10 and Figure 5.17). For all communities, the mean of the nearest job opportunities is only 113m far away. For shared ownership housing, it is also only 210m far away from the residential area. In the frequency distribution, we can also find a large amount of job proximity is less than 200m for all communities and less than 300m for shared ownership housing.

### 5.3.4 Affordability

Although the job availability and proximity present a less disadvantaged situation of shared ownership housing, there is one key problem: the match between job opportunities and residents' capability. For the shared ownership housing residents, their original jobs tend to be low-skilled jobs in retail and service industries (Lin, 2011). While shared ownership housings lack this kind of job. The high job availability and proximity of shared ownership housing are based on the impossible adaptability of job positions. As the low-skilled jobs in the tertiary industry are concentrated in the city center, the residents of shared ownership housing had to commute a long distance daily for jobs. Due to their limited mobility, their commute deeply relied on public transportation. Therefore, job affordability is related to public transportation affordability. For the

commute circles, researchers analyzed the phone signaling data and found out that 85% of residents commuted within the urban area; 5% of residents lived in the urban area while working in the sub-urban and rural area; 9% of residents lived in the sub-urban and rural area while worked in the urban area in Shanghai in 2020; the other lived or worked outside Shanghai (Maps, 2020).

For the public transportation of daily commutes, Zhao and Cao (2020) analyzed 28 million transit smart cards (for public transportation) and according to 81 million trips in 2015 and found that 20% of commuters spent more than 60 min commuting each way daily in Shanghai. Large numbers of workers living in disadvantaged areas characterized by low rent or poor job accessibility tended to have long commutes. On the contrary, the areas with large migrant populations have fewer long commutes. The result suggests that the development of sprawling housing and development in the suburbs may benefit low-income migrants. As local *Hukou* residents, such as the shared ownership housing residents, moved from the city center to the suburban, the migrants can move into the city center and stimulate the vitality of the city center. It seems then the shared ownership housing residents became more disadvantaged in terms of job affordability due to the long commutes.

However, another point of view is that the large city size of Shanghai benefits the low-skilled employees (Lu et al., 2012). Since the enlarged city size and urban expansion increased job opportunities in the tertiary industry, low-skilled employees tend to have more job opportunities in larger cities than those in small ones. Although job centers can help the residents obtain high vocational skills and more job opportunities, this study cannot proceed with an individual-level analysis because of the lack of individual data. It remains uncertain the effect of job centers on the job affordability of the shared ownership housing residents.

### 5.4 Horizontal Comparison: Parks

Parks play a pivotal role in modern urban life, which provides a multitude of benefits than contribute to the overall well-being of individuals and the sustainability of cities. The question of how the park distributes across different social groups in Shanghai turns out to be a major concern of spatial justice. Xiao et al. (2017) analyzed the relationship between residents' socio-economic statuses and the spatial access to urban parks within the Ring Express in Shanghai. Figure 5.18 shows how the distribution pattern of park access is related to the percentage of welfare housing in the analysis unit. The first description ("high" or "low") is the percentage of welfare housing within the analysis unit and the second description is the park access of the unit. The result shows that high park access areas located in the inner city and low-income social groups are not disadvantaged in terms of access to urban parks.

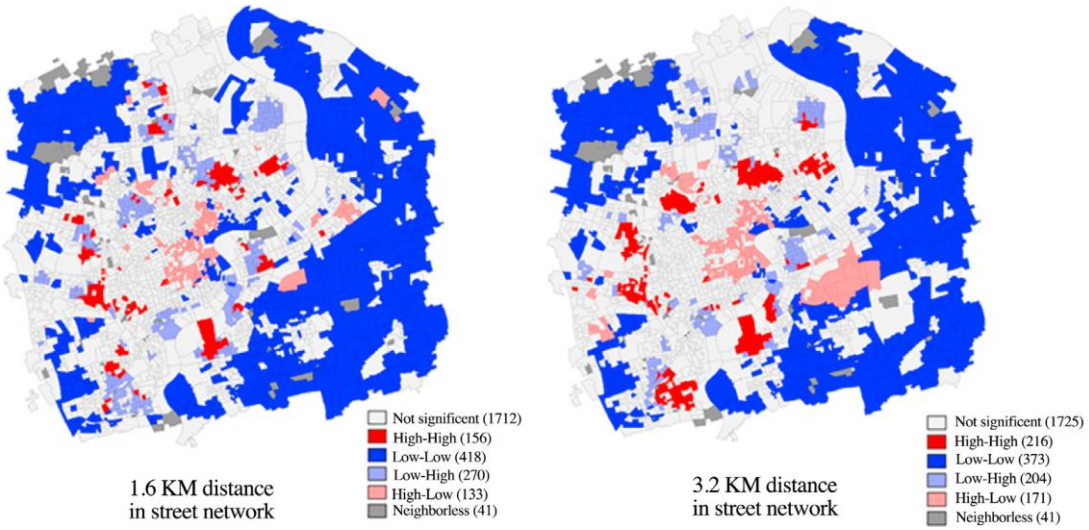



Figure 5.18 Welfare housing percentage and park access (Xiao et al., 2017)

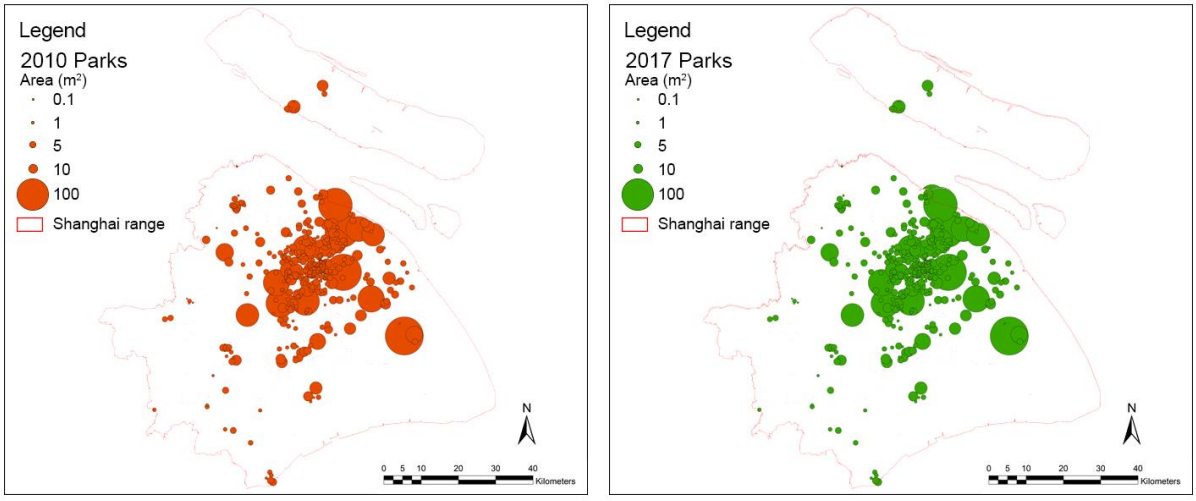



Figure 5.19 The distribution of parks in Shanghai in 2010 and 2017

However, how the park distributes across the entire administrative area might have different conclusions. This section takes the officially recognized parks as the object and analyzed its according provision. Figure 5.19 shows the location of park POIs in Shanghai in 2010 and 2017. The size of the circle marks shows the area size of each park. There were 379 urban parks in 2010 and 432 in 2017. From the POI distribution, we can find that there is a concentration of parks in the inner city and the parks with large areas tend to be located in the suburbs.

### 5.4.1 Accessibility

Although the accessibility measurement has been confirmed in the previous section, the estimation of park accessibility has a specific problem in the facility utilization mode, including frequency and catchment area. The park POIs include all kinds of parks, such as community parks, botanical gardens, and Shanghai Disneyland. For the former, residents can go to nearby parks as a daily routine to relax. The according facility utilization may have high frequency and a small catchment area. For the latter, residents

can choose the botanical garden or Disneyland Park as a travel destination. Its utilization pattern tends to be low frequency and large catchment area. For example, the visitors to Shanghai Disneyland might be across the nation. The two distinct utilizations of parks can lead to different parameter settings in accessibility measurements and accessibility results. As availability and proximity measure the daily utilization of parks, it is logical that accessibility measures the low frequency and travel-mode utilization of parks to provide an overall description of park distribution.

Figure 5.20 shows the park accessibility results of the 20km catchment radius. The size of the catchment radius is referred to the job accessibility. As the daily commute has an average of 20km travel distance, it is rational that low frequency and travel-oriented park visits also obtain a similar distance. The spatial structure of park accessibility is a typical concentric circles structure. The shared ownership housings are located in the middle-high accessibility area, which is consistent with the conclusions of previous scholars' research. Figure 5.21 shows how park accessibility changed between 2010 and 2017. As there was a series of large-size parks newly opened around the Ring Expressway, the areas with increased park accessibility are outside the inner city. In detail, the northeast area in Shanghai became the most increased park accessibility and the southeast area was the most decreased area.

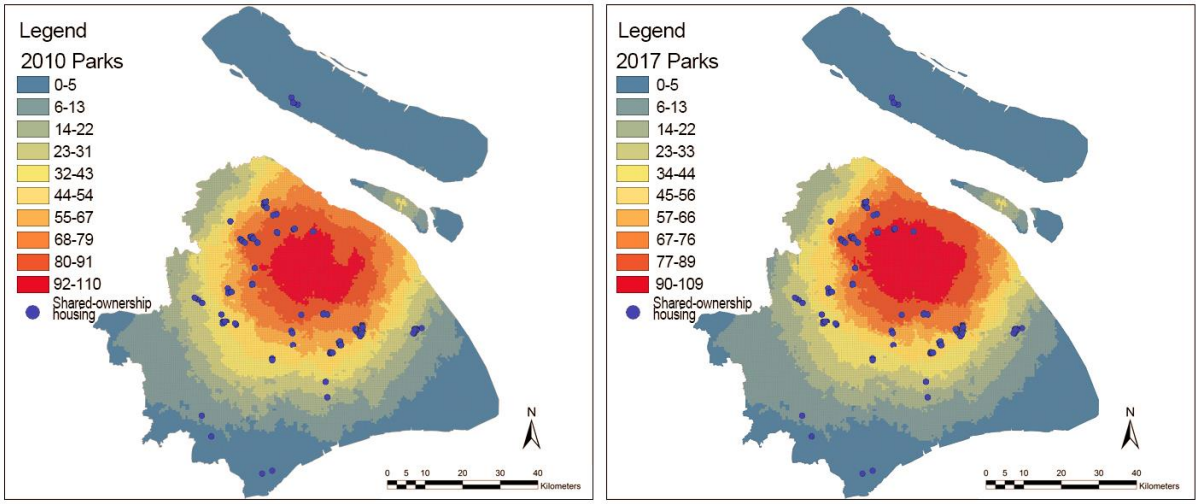



Figure 5.20 The accessibility to parks in Shanghai in 2010 and 2017

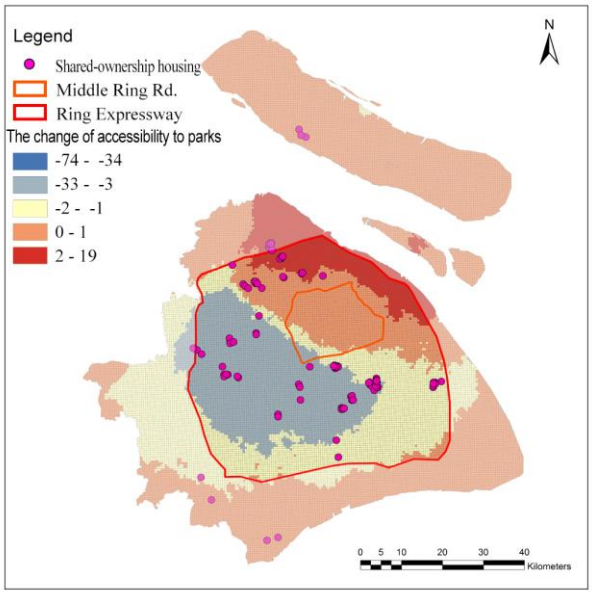



Figure 5.21 The change of accessibility to parks from 2010 to 2017

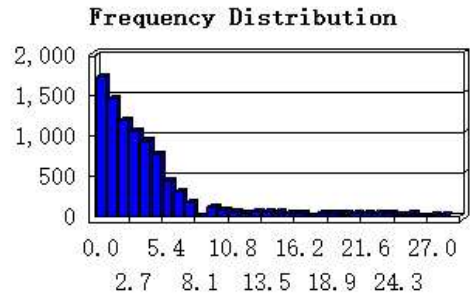
### 5.4.2 Availability

Table 5.11 shows the number of parks located in the 1500m and 3000m buffer of all communities and shared ownership housing. Due to the limited total amount of parks, the mean park availability of all communities in 2017 was only 3.62, which is 0.49 for the shared ownership housing in the 1500m buffer. In the case of a 3000m buffer, the mean for both increased significantly: 13.15 for all communities and 2.07 for shared ownership housing. Although the radius of the buffer doubled, the ratio of the mean of shared ownership housing divided by that of all communities remained similar, which is around 13-15%. Compared to the health and educational resources, the park availability of shared ownership housing was in an inferior situation.

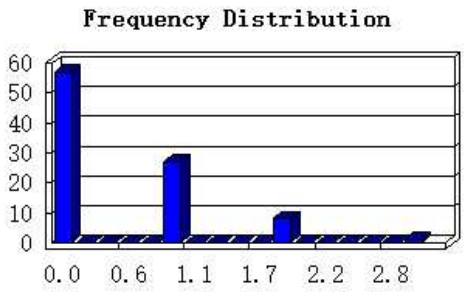
The according frequency distribution (Figure 5.22) shows that a significant number of shared ownership housings had no parks available either in its 1500m buffer or 3000m buffer. For all communities, the situation was the same. From a general point of view, the overall park availability remained at a relatively low level compared to health and educational resources.

Table 5.11 The park availability of all communities and shared ownership housing in 2017

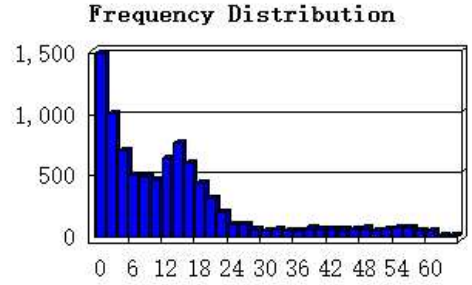
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean | St.d. | Mean | % | St.d. |
| 1500m Buffer | 3.62 | 4.39 | 0.49 | 13.54% | 0.70 |
| 3000m Buffer | 13.15 | 13.62 | 2.07 | 15.74% | 2.09 |



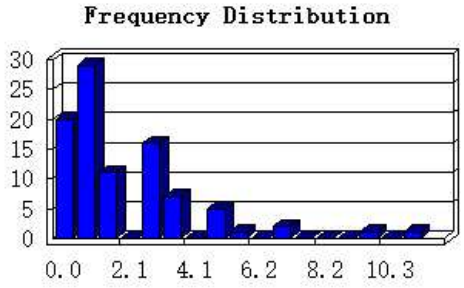

A1. The park availability of all communities in 1500m buffer.




B1. The park availability of shared ownership housing in 1500m buffer.




A2. The park availability of all communities in 3000m buffer.




B2. The park availability of shared ownership housing in 3000m buffer.

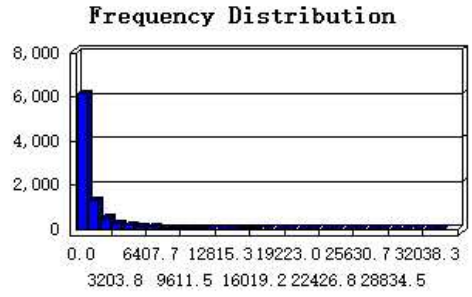
Figure 5.22 The frequency distributions of park availability of all communities and shared ownership housing in 2017

### 5.4.3 Proximity

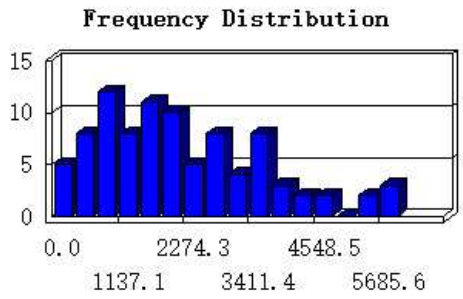
The mean of park proximity is above 1.2 km, both for all communities and shared ownership housing and both in 2010 and 2017 (see Table 5.12). This number reflects a common lack of parks. Moreover, the standard deviation of all communities is greater than that of shared ownership housing, which signals a greater difference in park proximity in all communities than in shared ownership housing.

Table 5.12 The park proximity of all communities and shared ownership housing in 2010 and 2017.

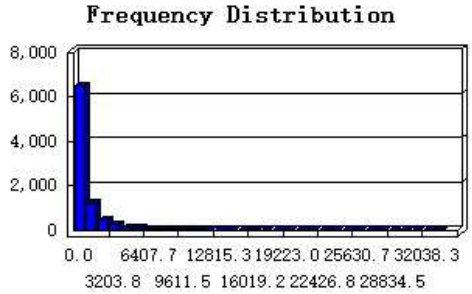
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | % | St.d. |
| The park proximity in 2010 | 1429.60 | 2594.41 | 2223.60 | 155.54% | 1439.90 |
| The park proximity in 2017 | 1203.41 | 2187.53 | 1822.34 | 151.43% | 1144.88 |



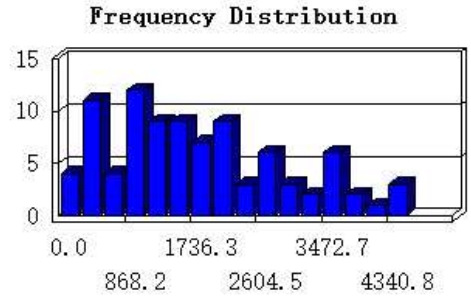

A1. All communities in 2010




B1. Shared ownership housing in 2010




A2. All communities in 2017



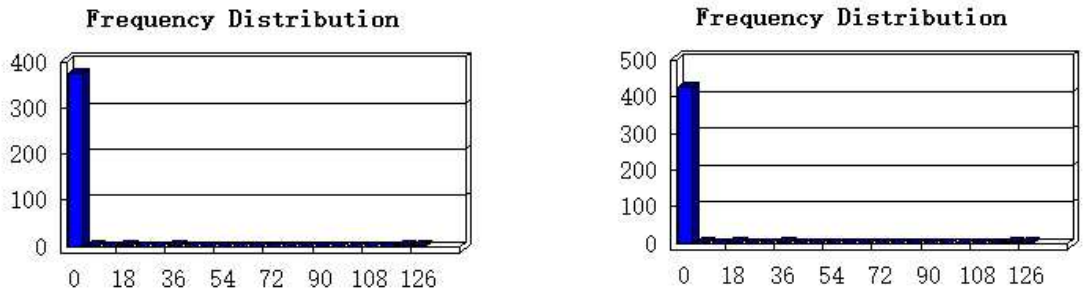

B2. Shared ownership housing in 2017

Figure 5.23 The frequency distributions of park proximity of all communities and shared ownership housing in 2010 and 2017

For the frequency distribution (Figure 5.23), there is a remarkably large number of communities with a small distance to the nearest parks. While the park's proximity to shared ownership housing shows a dispersed pattern. Since there are limited, new parks constructed between 2010 and 2017, the change in park proximity between all communities and shared ownership housing was not obvious.

### 5.4.4 Affordability

Over 90% of Shanghai parks are free of charge. As Figure 5.24 shows, the vertical axis is the number of parks, and the horizontal axis is the park entrance fee. From 2010 to 2017, the number of fee parks increased along with the enlarged total number of parks. Certain specialized parks and private parks, such as Shanghai Wild Animal Park, Disneyland Park, and Shanghai Jinjiang Amusement Park, had no more than 200 RMB as park admission fees. In 2021, three of the large-size public parks began to be free of charge. We can then conclude that the park's affordability of shared ownership housing residents, even for tourists, is high.




A. 2010 Parks B. 2017 Parks

Figure 5.24 The frequency distribution of park fees in 2010 and 2017

## 5.5 Horizontal Comparison: Public Transport

The residents of shared ownership housing tend to have less mobility and rely more on public transport. The service level of public transport is therefore crucial for their daily travel. To reflect the service level of public transport, an indicator “SL” is introduced into the analysis. As Equation 5-1 shows, the total “SL” equals the service level of the subway and that of the bus:

Equation 5-1

$$SL = SL_{subway} + SL_{bus} = w_{i\_sub}A_{i\_sub} + w_{i\_bus}A_{i\_bus}$$

where *SL* refers to the service level of a certain grid; $SL_{subway}$ and $SL_{bus}$ are the service level of subway and bus, which is equal to the sum of the service level weight and the according service area. $w_{i\_sub}$ is the service level weight of the subway, determined by the distance between the grid and the subway station; $A_{i\_sub}$ is the service area covered by the according service level weight of the subway station. $w_{i\_bus}$ is the service weight of the bus, determined by the distance between the grid and the bus station; $A_{i\_bus}$ is the service area covered by the according service level weight of the bus station.

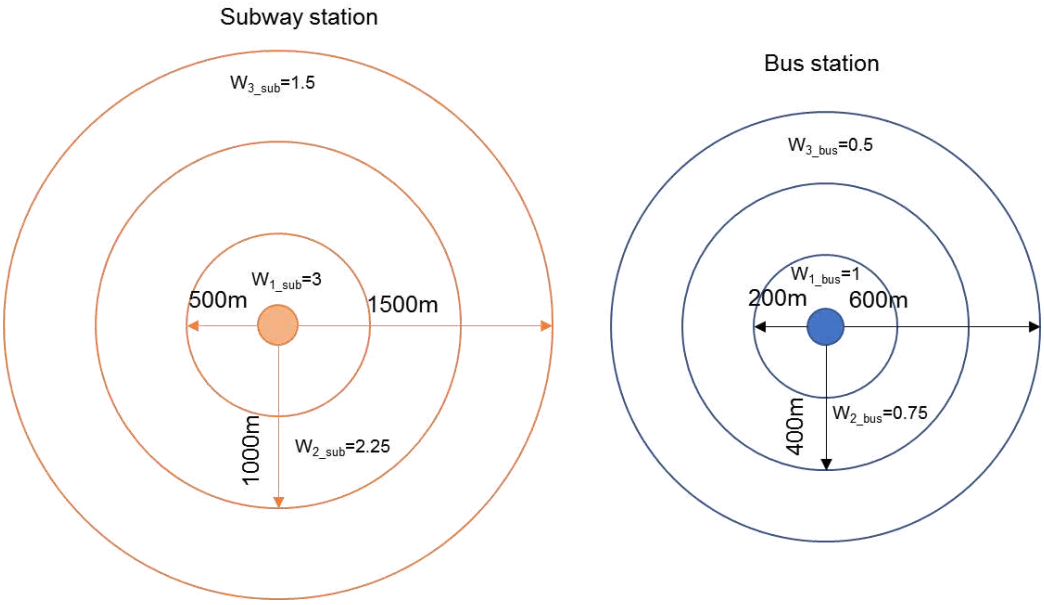



Figure 5.25 The calculation of public transport service level

Figure 5.25 shows the different partitions of the service level weight of subway stations and bus stations. For bus stations, the partitions are divided by 200m, 400m, and 600m with accordingly service level weights (1, 0.75, 0.5). For subway stations, the partitions of their service level weights are divided by their radius distance (500m, 1000m, 1500m) with accordingly service level weights (3, 2.25, 1.5). So that the closer the grid is located to the subway and bus stations, the greater the public transport service lever is. Figure 5.26 is the result of the public transport service level and reflects the area with public transport services. The figure also reflects the road network and the locations of subway and bus stations. As the planning principle for shared ownership housing is to choose the site near the public transport station, we can find a strong relevance between locations of shared ownership housing and public transport stations. Due to the limited number of subway stations, it is problematic to measure the overall accessibility to the subway stations. For the indicator accessibility, availability, and proximity, the spatial object will be the bus stations.

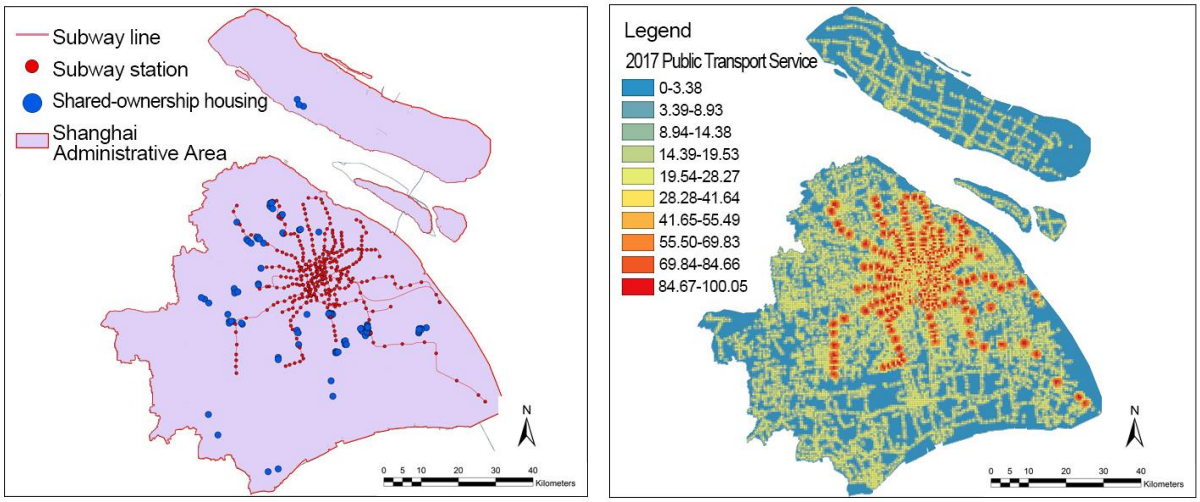



Figure 5.26 The public transport service in Shanghai in 2017

### 5.5.1 Accessibility

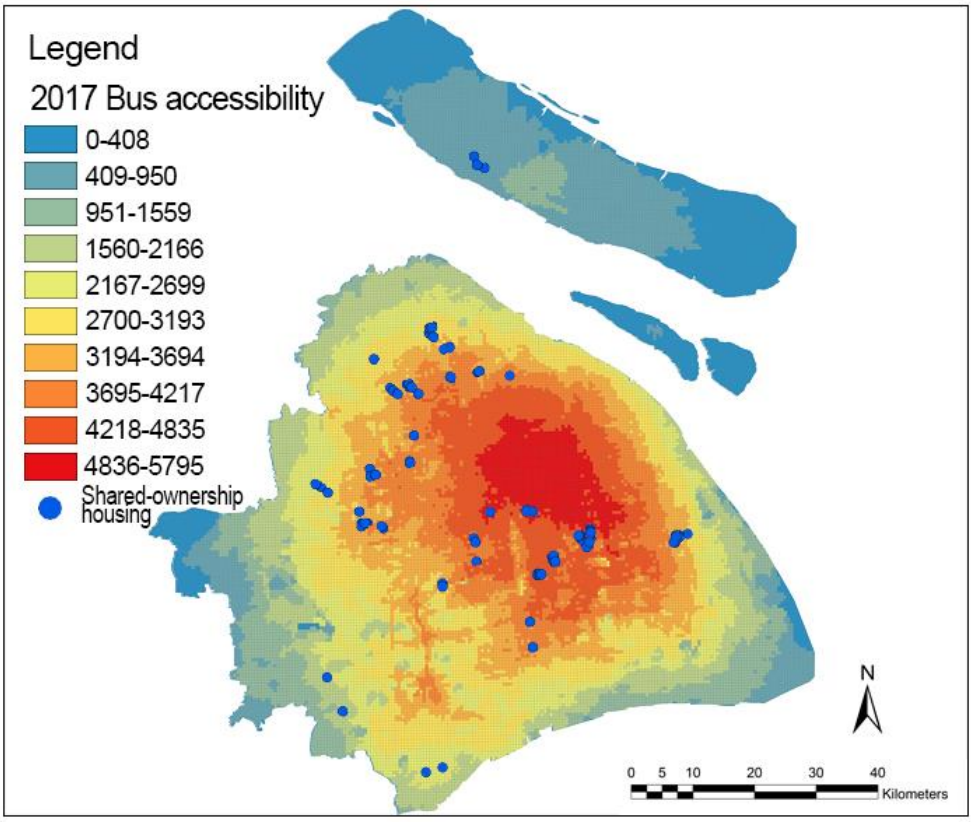



Figure 5.27 The accessibility to bus stations in Shanghai in 2017

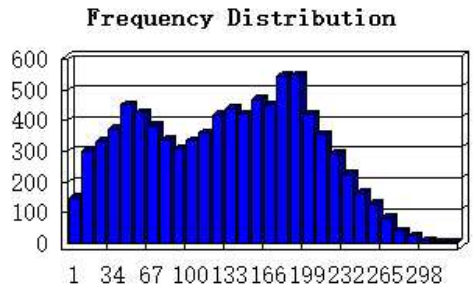
Figure 5.27 shows the accessibility to bus stations in Shanghai in 2017. Although the spatial structure has a center in the inner city, there is an obvious offset between the high accessibility to the southeast area and the accessibility extending according to the road network in the south area. The shared ownership housings fall in the middle-high bus accessibility area. Some of them even reach the highest bus accessibility area (the red color).

### 5.5.2 Availability

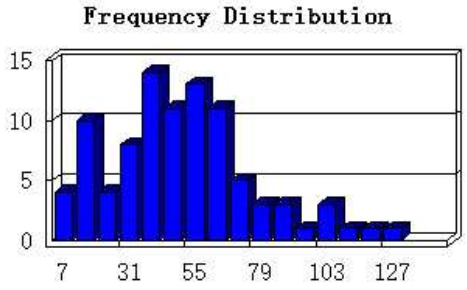
The numbers of available bus stations falling in the 1500m reach high values (Table 5.13): for all communities' 1500m buffer, its mean is around 133, and for shared ownership housing is about 53. In the 3000m buffer, the mean of available bus stations reaches 478 for all communities and the standard deviation is only about 263 for all communities. It reflects the abundant bus resources across the city. For shared ownership housing, the ratios of its according to means divided by that of all communities also reach a high percentage, which is around 40%. The frequency distributions (Figure 5.28) also reveal that less difference between all communities and shared ownership housing than the other resources.

Table 5.13 The bus availability of all communities and shared ownership housing in 2017

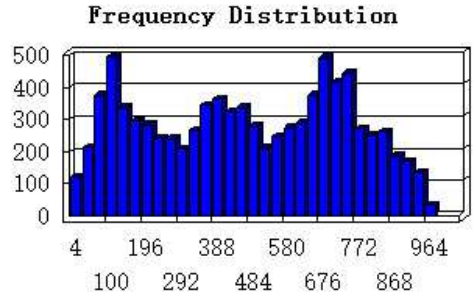
| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean | St.d. | Mean | % | St.d. |
| 1500m Buffer | 133.37 | 70.02 | 52.77 | 39.57% | 26.44 |
| 3000m Buffer | 478.02 | 263.47 | 197.81 | 41.38% | 93.12 |



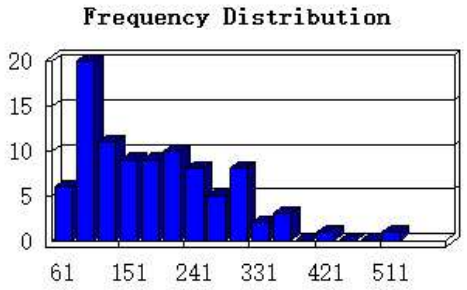

A1. The bus availability of all communities in 1500m buffer.




B1. The bus availability of shared ownership housing in 1500m buffer.




A2. The bus availability of all communities in 3000m buffer.




B2. The bus availability of shared ownership housing in 3000m buffer.

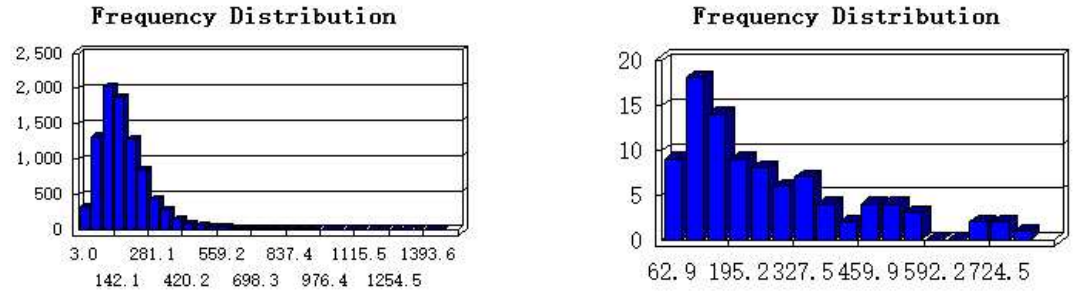
Figure 5.28 The frequency distributions of bus availability of all communities and shared ownership housing in 2017

### 5.5.3 Proximity

Although the number of available bus stations has fewer gaps, the bus proximity of shared ownership housing is about 1.85 times that of all communities (Table 5.14). For general communities, residents have a mean of about 181m to the nearest bus station. While the mean of shared ownership housing is about 276m. Compared to the other resources, the bus proximity has less standard deviation, which indicates the more dispersed distribution of bus stations.

Table 5.14 The bus proximity of all communities and shared ownership housing in 2017

| | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | % | St.d. |
| Proximity of bus station in 2017 | 181.78 | 115.38 | 275.86 | 185.28% | 172.72 |




A. All communities B. Shared ownership housing

Figure 5.29 The frequency distribution of bus proximity of all communities and shared ownership housing in 2017

Figure 5.29 shows that the most significant percentage of shared ownership housings owns bus proximity less than 195m and greater than 63m. This value segment is similar to that of all communities. However, there are more shared ownership housings that have greater than 592m proximity to bus stations. It is possible that in certain suburban areas, the bus stations still remain far away from the shared ownership housing.

### 5.5.4 Affordability

According to the “2018 Shanghai price information guide for citizens”, the basic price of a regular bus was 1 yuan and that of an air-conditioned bus was 2 yuan. The ticket for the metro system starts from 3 yuan, with a 1-yuan increment per 10 km. Table 5.15 shows the detailed ticket prices of the bus and metro system. Moreover, there was two more discount policy: the public transportation within 120 minutes has a 1-yuan discount and a 10% discount for monthly fare expenditures exceeding 70 yuan of public transportation. Compared with the 2017 per capita GDP of 126,634 yuan (Statistics, 2018), the economic affordability of residents for public transportation is relatively high.

Table 5.15 The ticker price of bus and metro system in “2018 Shanghai price information guide”

| Route | Vehicle type | Ticket price |
|---|---|---|
| Urban regular route | air-conditioned bus | ¥ 2 |
| | regular bus (bus routes under 13 kilometers) | ¥ 1 |
| | regular bus (bus routes above13 kilometers) | ¥ 1.5 |
| Urban Express Routes (Multi-tier Fare System) | air-conditioned bus | starting at 2 yuan, with a 1-yuan increment. |
| | regular bus | starting at 1 yuan, with a 1-yuan increment. |
| Suburban Regular Routes (Multi-tier Fare System) | air-conditioned bus | starting at 1 yuan, with a 1-yuan increment. |
| | regular bus | starting at 1 yuan, with a 1-yuan increment. |
| Suburban Express Routes (Multi-tier Fare System) | air-conditioned bus | starting at 2 yuan, with a 1-yuan increment. |
| | regular bus | starting at 1 yuan, with a 1-yuan increment. |
| Metro System | | The first 6 kilometers of the travel cost 3 yuan, and for each subsequent 10 kilometers, there is an additional 1-yuan increment. |

* Transfer Discount: Transfers between surface buses and between surface buses and rail transportation within 120 minutes receive a 1-yuan fare discount.

** When using the same public transportation card for rail transportation, there is a 10% discount for monthly fare expenditures exceeding 70 yuan.

# 6 Assessing Spatial Justice: Space as Mirror

Chapter 6 aims to analyze the different justice philosophies reflected and implemented in the planning practice of Shanghai shared ownership housing. The analysis of spatial justice consists of two parts. The first part provides a vertical comparison across the five basic resources, including resource comparison (how these five resources distribute), status comparison (what is the resource acquisition of shared ownership housing residents according to their decisions), and the relationship between justice and social sustainability. The second part tries to reveal the different reflections of justice philosophies in the planning practice.

## 6.1 Vertical Comparison: Resource and Status Comparison

### 6.1.1 Resource Comparison

The spatial equity of five resources verifies the urban-rural duality of resource allocation in Shanghai. The accessibility maps of the five social goods, i.e., medical and education resource, job opportunities, parks, and public transportation, all show up a mono-centric spatial structure with minor differences. Significant spatial boundaries between the urban and rural areas of the resource provision reflect the distinct welfare levels of urban and rural residents. Because of the *Hukou* system, urban and rural residents share different forms of welfare. Urban residents, as substantive citizens, receive systematic benefits which are provided by the municipal government, including retirement pension, education, and health care. On the contrary, rural residents, as members of the village collectives, hold the ownership of land and enjoy benefits provided by their own villages. Despite the wide variation in collective rural benefits, in general, rural residents have fewer social benefits than urban residents. The spatiality of this urban-rural duality is the concentration of social goods, such as elementary schools, primary hospitals, and parks, in the central city and the lack of social goods in the rural areas.

Due to the socialist institutional legacy, there are different levels of marketization of the five social goods. Based on the data from the Statistic Year Book 2018 (Statistics, 2018), Table 6.1 shows the number of resources owned by the public section and private section. The level of marketization is calculated as the number of social goods owned by the private section divided by the total amount of the social goods. Of primary schools, 80% were public primary schools, and high-quality education resources concentrated at public schools. For medical resources, the marketization level differs according to the level of medical resources. For main hospitals, which are greater than 2 levels, were half private-owned. Moreover, public hospitals tended to have larger facility sizes. Average public hospitals have 530 beds, while average private hospitals have 114 beds. For all medical facilities, it is possible that a higher level of marketization exited, since there might be more private medica facilities, such as private dental clinics. When it comes to parks, over 90% of the urban parks in Shanghai were stated-owned, except for several private parks for profit.

Table 6.1 The marketization levels of the five social goods

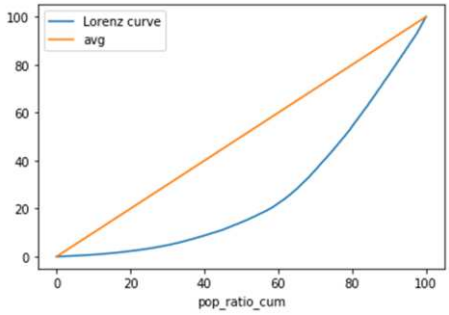
| Resource | The number of facilities in accessibility measures | Shanghai Statistic Yearbook 2018 | | | |
|---|---|---|---|---|---|
| | | The facilities number | Public ownership | Private ownership | Level of marketization |
| Primary schools | 828 | 741 | 602 | 139 | 18.76% |
| Main hospitals | 4,632 | 5,144 | - | - | >50% |
| Parks | 432 | 243 | 239 | 4 | 1.65% |
| Bus stations | 30,031 | Bus routes 1,496 | 1,496 | 0 (100%) | 0 (100%) |
| Job opportunities | 203,439 | GDP (Billion RMB) 30,633 | 14,878 | 15,755 | 51.4% |

The marketization process of bus routes was a special case in the five basic social goods. From 1996 to 2009, there is a deep marketization of Shanghai's public transportation system. In 2003, the last state-owned public transportation firm was reformed to private and 52 private transportation companies ran 951 bus lines. Later, the top four companies in the scale of business were listed on the Shanghai and Shenzhen stock exchanges. However, there were growing criticisms of Shanghai's public transportation industry for its over-marketization and neglect of public welfare. Private operators are not willing to run bus lines in remote areas because of the limited profits. In 2009, the Shanghai municipal announced the launch of a new round of public transport reform, and the city's public transport industry returned to state-owned holding. Until 2021, there were still eight public transportation companies listed on the stock exchanges with state ownership.

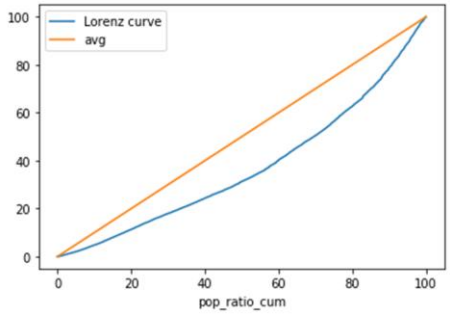
For job opportunities, it has the highest level of marketization among the five social goods. Although the difference between the GDP created by public and private creation is not significant, state-owned companies are still involved in market-based competition. And there is the limited influence of governance in the locations of companies. According to the calculation methods in Chapter 4, Figure 6.1 shows the Lorenz curves of the accessibilities to the five social goods in 2017. Table 6.2 shows the according Gini coefficients and the average accessibilities of all communities and shared ownership housing. We could find that a relevance the Gini coefficient values of the resource accessibilities and the ratios of shared ownership housings accessibility of all communities. It seems that the higher ratios of the shared ownership housing accessibility divided by all communities, the smaller the according Gini coefficient of the resource

distribution. Another finding is the relationship between the Gini coefficient and the marketization level of social goods. Except for the park accessibility, it seems that the higher level of marketization in resource allocation leads to a smaller Gini coefficient, as well as a lower possibility of inequality in resource accessibility.

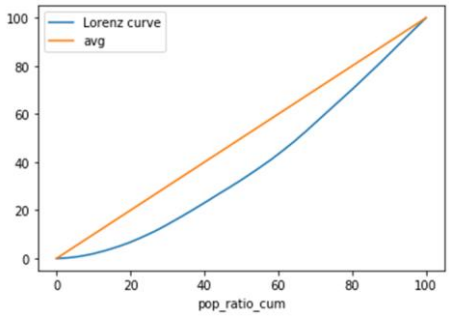
Table 6.3 and Table 6.4 are the summaries of availabilities and proximities of the five resources in 2017. The availabilities of shared ownership housing, which are the available numbers of resources, have a mean of around 10-20% of all communities except for bus stations. The percentages of the mean availability of shared ownership housing of all communities are slightly enlarged in the 3000m buffer than the 1500m buffer. The proximities of the five social goods of the shared ownership housing have a mean of 1.5-1.8 that of all communities. The results show that bus stations have an ambulant provision among the five social goods. And the shared ownership housings are generally farther away from the five social goods than the other communities.



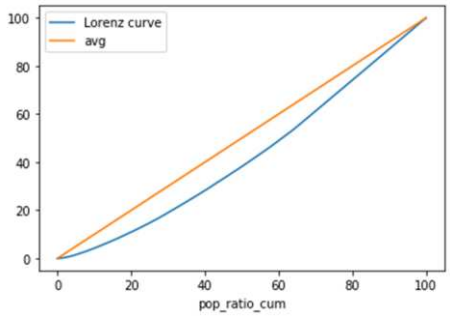

A. Primary schools



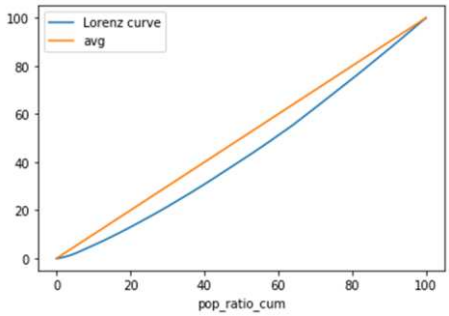

B. Main hospitals




C. Parks




D. Job opportunities




E. Bus stations

Figure 6.1 The Lorenz curves of the accessibilities to the five social goods in 2017

Table 6.2 The accessibilities of all communities and shared ownership housing in 2017

| | | All communities (AC) | Shared ownership housing (SH) | Rate (SH/AC) | Gini |
|---|---|---|---|---|---|
| Average population | | 4456.98 | 973.09 | 21.83% | - |
| The mean of accessibility | Primary schools | 357.17 | 114.38 | 32.02% | 0.47 |
| | Main hospitals | 129.34 | 85.32 | 65.97% | 0.34 |
| | Parks | 70.99 | 53.05 | 74.74% | 0.24 |
| | Job opportunities | 167.18 | 140.33 | 83.94% | 0.16 |
| | Bus stations | 400.32 | 372.28 | 93.00% | 0.12 |

Table 6.3 The availabilities of all communities and shared ownership housing in 2017

| Availability | | All communities | | Shared ownership housing | | |
|---|---|---|---|---|---|---|
| | | Mean | St.d. | Mean | Rate (%) | St.d. |
| 1500m Buffer | Main hospitals | 3.15 | 4.09 | 0.34 | 10.79% | 0.75 |
| | Primary schools | 5.48 | 4.14 | 1.3 | 23.72% | 1.18 |
| | Job opportunities | 1227.28 | 1257.4 | 180.46 | 14.70% | 144.93 |
| | Parks | 3.62 | 4.39 | 0.49 | 13.54% | 0.7 |
| | Bus stations | 133.37 | 70.02 | 52.77 | 39.57% | 26.44 |
| 3000m Buffer | Main hospitals | 11.23 | 13.62 | 1.3 | 11.57% | 1.33 |
| | Primary schools | 19.13 | 14.24 | 5.22 | 27.29% | 4.48 |
| | Job opportunities | 4734.3 | 4415.5 | 907.69 | 19.17% | 482.74 |
| | Parks | 13.15 | 13.62 | 2.07 | 15.74% | 2.09 |
| | Bus stations | 478.02 | 263.47 | 197.81 | 41.38% | 93.12 |

Table 6.4 The proximities of all communities and shared ownership housing in 2017

| The proximities (distance to the nearest resource) | All Communities | | Shared ownership housing | | |
|---|---|---|---|---|---|
| | Mean (m) | St.d. | Mean (m) | Proportion | St.d. |
| Main hospitals | 1449.06 | 1491.42 | 2418.61 | 1.67 | 1240.71 |
| Primary schools | 519.87 | 324.81 | 784.22 | 1.51 | 389.12 |
| Job opportunities | 113.43 | 98.14 | 210.16 | 1.85 | 146.77 |
| Parks | 1203.41 | 2187.53 | 1822.34 | 1.51 | 1144.88 |
| Bus stations | 181.78 | 115.38 | 275.86 | 1.52 | 172.72 |

### 6.1.2 Status Comparison

The status comparison refers to the three indicators of the five resource distributions (accessibility, availability, and proximity) in four statuses of shared ownership housing residents. The four statuses are according to the shared ownership housing residents' possible decisions. Status A and B are their realized situations: before the shared ownership housing planning and after moving to the shared ownership housing. Status C and D are fictional states: if they stayed in the inner-city and if they moved to other suburban areas. As the shared ownership housing residents are the research subject, their realized situation in 2017 is the only status that has a spatial agglomeration. The community referred to below is, therefore, the spatial entities in which shared ownership housing residents are the main focus.

Table 6.5 is the results of the status comparison, including population, accessibility, availability, and proximity. Each main indicator has its mean, standard deviation (St. D.), and value as a percentage of Status A. The living area per capita of shared ownership housing residents increases from less than 15 $m^2$ (the application limitation) to an average of 22 $m^2$ (as the public information of shared ownership housing), which is still less than the average of suburban residents 28 $m^2$ (Statistics, 2018). The population refers to the number of residents in each 250*250m grid unit. The lowest population in Status B is consistent with shared ownership housing residents moving from densely populated areas to suburbs.

Three indicators of resource provision show that shared ownership housing residents have the least resources in the four statuses. Accessibility can be regarded as every resident's opportunity to the five resources, whose mean and standard deviation are both the lowest. It reveals that shared ownership housing has very limited resource compared to the population demand and there is not much difference between those affordable communities. Similarly, availability in Status B also ranks lowest, which equals the number of resources within the 3000m buffer of the community. Proximity is the distance from communities to the nearest primary schools. The shared ownership housing residents have the longest distance, more than twice as their original position. The largest standard deviation of proximity in Status B implies possible variations between the shared ownership housing communities.

Another issue is whether the lowest rank can evaluate the shared ownership housing planning as unjust. Despite the other amenities utilization left vacant, the improvement of living area per capita for shared ownership housing residents is definite. There is a variety of individual preferences for the wights of living space and amenities convenience in the personal well-being formula. Regarding the aims of the shared ownership housing policy, the implementation enlarged the living area of low- and middle-income families and achieved one of the policy objectives. From this perspective, the results deduce that the planning still improved social justice.

Table 6.5 The five-resource provision for shared ownership housing residents in four statuses

| Status | | A | | B | | | C | | | D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Decision | | Original Position | | Moving to shared ownership housing | | | If stayed in the inner-city | | | If moved to other suburban | | |
| Spatial-temporal status | | 2010 inner city | | 2017 shared ownership housing | | | 2017 inner city | | | 2017 suburban | | |
| Per capita living area (m2/person) | | 15 | | 22 | | | 15 | | | 28 | | |
| Statistic Indicators | | Avg. | St.d. | Avg. | St.d. | % | Avg. | St.d. | % | Avg. | St.d. | % |
| Population | | 8582 | 4056.61 | 1051 | 655.37 | 12.00% | 8656 | 3673.5 | 101.00% | 5027 | 4078.06 | 59.00% |
| Main hospitals | Accessibility | 3764.392 | 3118.36 | 158.23 | 103.92 | 4.20% | 3440.21 | 2536.72 | 91.39% | 2485.1 | 2529.62 | 66.02% |
| | Availability | 17.75 | 14.2 | 1.3 | 1.32 | 7.32% | 18.3 | 14.21 | 103.10% | 12.17 | 13.86 | 68.56% |
| | Proximity | - | - | 599.11 | 272.99 | - | 563.59 | 424.87 | - | 1213.82 | 1307.03 | - |
| Primary schools | Accessibility | 684.44 | 219.55 | 123.79 | 150.31 | 18.00% | 671.82 | 199.23 | 98.00% | 407.11 | 310.32 | 59.00% |
| | Availability | 8.68 | 3.32 | 1.39 | 1.29 | 16.00% | 6 | 4.13 | 100.00% | 8.77 | 3.24 | 69.00% |
| | Proximity | 413.12 | 253.47 | 1006.73 | 605.21 | 244.00% | 623.02 | 249.44 | 99.00% | 409.11 | 559.97 | 151.00% |
| Job opportunities | Accessibility | - | - | 140.33 | 46.49 | - | 205.59 | 7.62 | - | 182.21 | 35.28 | - |
| | Availability | - | - | 907.68 | 482.74 | - | 7348.9 | 4165.89 | - | 5130.57 | 4409.95 | - |
| | Proximity | - | - | 210.167 | 146.78 | - | 23.49 | 39.41 | - | 32.06 | 56.51 | - |
| Parks | Accessibility | 98.5 | 4.92 | 53.05 | 26.83 | 53.86% | 98.46 | 5.02 | 99.96% | 79.29 | 26.2 | 80.50% |
| | Availability | 19.2 | 13.47 | 2.07 | 2.09 | 10.78% | 20.27 | 13.88 | 105.57% | 1.73 | 3.01 | 9.01% |
| | Proximity | - | - | 930.93 | 264.4 | - | 544.1 | 354.63 | - | 915.12 | 1041.30 | - |
| Bus stations | Accessibility | - | - | 372.27 | 90.17 | - | 491.65 | 33.77 | - | 432.97 | 71.01 | - |
| | Availability | - | - | 197.81 | 93.11 | - | 661.35 | 165.9 | - | 507.39 | 253.15 | - |
| | Proximity | - | - | 275.86 | 172.72 | - | 81.78 | 76.45 | - | 79.44 | 95.98 | - |

### 6.1.3 Justice and Social Sustainability

Another issue is the relationship between justice and social sustainability. The planning practice of Shanghai shared ownership housing provides empirical evidence that promoting justice is not necessarily equate to promoting social sustainability, which constitutes the non-linear relationship between justice and social sustainability.

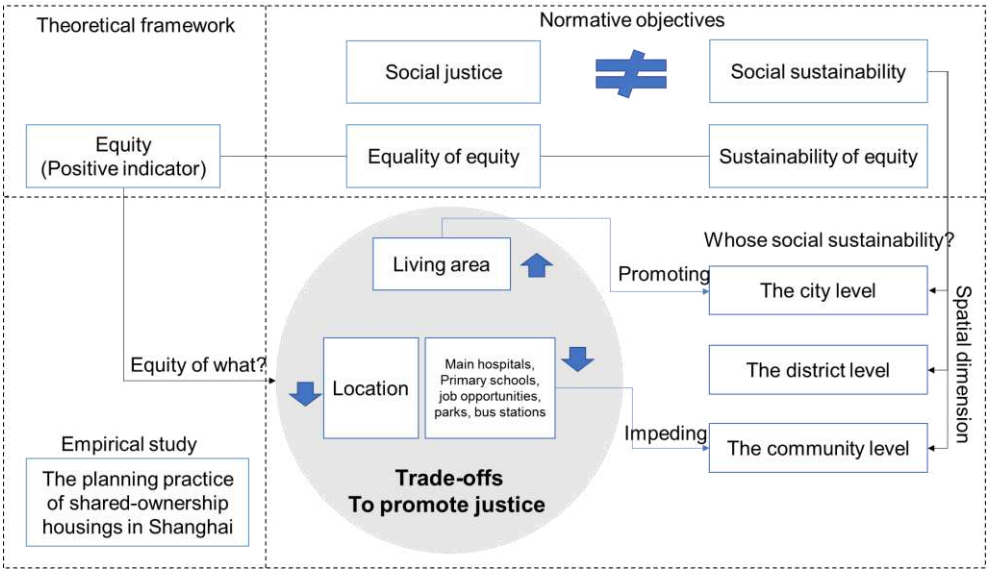



Figure 6.2 A conceptual model of the relationship between social justice and social sustainability

Figure 6.2 reflects the gap between the theoretical framework and empirical study of the relationship between justice and social sustainability. At the theoretical level, social justice and social sustainability share the same positive indicator "equity" with distinct normative standards: the equality of equity for the former and the sustainability of equity for the latter. Social justice aims at the quality of equity, while social sustainability focuses on the equity's ability to be sustained. In the empirical case, Shanghai's shared ownership housing planning took priority of equality of living area over the other resources and made the trade-offs between location, living area, and primary school resources, to promote social justice. While the sustainability of equity requires diverse needs based on development stages in different spatial entities.

Although the spatial scale and dynamic development process have not gained enough attention in social sustainability (Buck et al., 2021; Orenstein & Shach-Pinsley, 2017; Pitarch-Garrido, 2018; Zuindeau, 2006), this study reveals their importance in planning practice. The Shanghai shared ownership housing planning provided the low-income with enlarged living areas at the cost of decreased public resources, including main hospitals, primary schools, job opportunities, parks, and bus stations. At the city level, the shared ownership housing planning policy improved the social sustainability of the entire Shanghai city. As the low-income relocated from the inner city to the suburbs, the downtown area attracted younger and richer people and avoided the “hollowing out” of the inner city. Simultaneously, the relocation of the low-income accelerated the urbanization development of the suburban area. Conversely, the shared ownership housing itself can hardly be described as socially sustainable. Bossel (2002) reveals that it is imperative for each domain in a system to be able to reproduce itself so as to be sustainable (Ngui & Apparicio, 2011). Lacking equivalent access to social goods, the shared ownership housing in Shanghai can hardly attract the population and continue the urban sprawl. We can observe in Figure 5.5 that only a small amount of shared ownership housing has significant population growth. This trade-off between

enlarged living areas and declined social goods, promotes the city level's sustainable development, and hinders the community level.

The spatial dimension questions at what spatial level social sustainability aims and what are the spatial subject of social sustainability. Zuindeau (2006) proposes that not every part of a territory can and/or need to be achieved sustainability and takes equity as one theme to arrange the spatial dimension of sustainability. However, this study asks whether social sustainability at larger spatial scales can prioritize that of smaller ones. If we regard collective welfare cannot take precedence over individual welfare, then it will not be reasonable for regional/city/district social sustainability to prioritize that of communities.

Furthermore, this section revealed one pitfall of the framework approach to social sustainability: broad scope and lack of logic. A long list of concepts and indicators prevail in the various frameworks of social sustainability (Hajirasouli & Kumarasuriyar, 2016; Missimer et al., 2017; Omann & Spangenberg, 2002; Weingaertner & Moberg, 2014). Some have certain hierarchy/structure of concepts, such as triad, quaternity, or quintuplet (Boström, 2012; Cuthill, 2010; Eizenberg & Jabareen, 2017; Murphy, 2012; Shirazi & Keivani, 2019). While multiple structures reflect the absence of certain rational logic. The framework approach takes the concept of social sustainability as a fruit basket, which lacks the logical structure of sustainable development (Langhelle, 1999). The frameworks deconstruct the elements of social sustainability without causal inference. As Davidson (2010) has argued, a dissected sustainability risks losing the pivotal ethos (Evans et al., 2009) of sustainable development.

## 6.2 Space as Mirror: The Reflection of Justice Theories

The overall process of the planning practice of Shanghai shared ownership housing reflects a mixture of justice philosophy schools. The space records the great variety of justice philosophy schools. While some of the reflection is intended, the other might be an unconscious practiced impacted by contextual and culture background. To clarify, the analysis follows the major justice philosophy schools.

### 6.2.1 The implemented Justice Theories

The vertical comparison conducted a utilitarian analysis of allocating of the five social goods. It left the question of which justice theories have been implemented in the case of Shanghai's shared ownership housing. This section compares the corresponding reflection of different justice theories in planning with the empirical planning practice. By analyzing the planning objective, principle, design, standard, and process, this section tries to figure out the underlying justice philosophies implemented in the planning practice of shared ownership housing.

Table 6.6 The implemented justice theories in the planning practice of shared ownership housing in Shanghai

| Philosophy of justice | The corresponding reflection in planning | Shanghai shared ownership housing |
|---|---|---|
| Classic utilitarianism | Spatial equity: the maximum of average/overall utility as planning objectives; planning principles; resource allocation | Planning objective, principles, and design |
| Classic intuitionism | Spatial equity: Equal distribution of resources as planning objectives; planning principles; resource allocation | Planning objective, principles, and design |
| Sen's Capability Approach | Maximum of Individual capability as planning objective | None |
| Rawls's egalitarian liberalism | Substantive justice: Enlarging the benefits of the least advantages as planning objectives; planning principles; resource allocation | Planning objective, principles, and design |
| Nozick's entitlement theory | Procedural justice: The entitlement judgment in planning process | Production mode |
| Walzer's spheres of justice | Each social good applies its distribution norms of justice; planning principles; resource allocation | Planning standard |
| David Harvey | The circulation of surplus (re)production in planning outcome and process | Contextual background |
| Habermas's Discourse Ethics | Hermeneutic analysis: Equal access to communication in the planning process | Planning process |
| Iris Marion Young's recognition justice | Whether the five types of oppression (exploitation, marginalization, powerlessness, culture imperialism, and violence) exist in planning process | Planning process |
| Nancy Fraser's recognition justice | Equal share of economic redistribution, equal respect of cultural recognition, and equal say of political representation | Planning process |

Table 6.6 shows the matched content of the planning practice of Shanghai shared ownership housing with different justice theories. We could see the planning objects, principles, and design are matched with classic utilitarianism and intuitionism. As the planning objective is to provide basic housing security for low- and middle-income families, which promotes the benefits and utilities for the disadvantaged and falls in the framework of classic utilitarianism, intuitionism, and Rawls's egalitarian liberalism. The planning principle contains the pursuit for overall comprehensive development of the entire city and the planning design aims to provide the basic living conditions and to build mature urban areas in the suburbs, which contains certain degrees of utilitarian and intuition thoughts. However, the planning practice did not provide advocates for individual capabilities as it follows a top-down approach. The production mode of shared ownership housing, which contains a marketization process and allowed a certain degree of economic interests of the developer, that follows Nozick's entitlement theory. The planning standard for shared ownership housing specifies different housing conditions for different family structures, which follows the divergent distribution

norms of justice in Walzer's sphere of justice. The contextual background of Shanghai meets the analysis of the circulation of surplus (re)production in David Harvey's theory. The degree of public participation in the planning process then falls in the area of discourse ethics and recognition justice, which emphasize the fairness in planning process. The following section analyzes the reflection of specific justice theories in the planning practice of shared ownership housing in Shanghai. For brevity, there are four sections of the reflection based on the planning content and the scope of justice theories: utilitarianism and intuitionism, liberalism, Marxism and (neu) socialism, and discourse ethics and recognition justice.

### 6.2.2 The Reflection of Justice Theories in the Planning

#### 6.2.2.1 Reflection of Utilitarianism and Intuitionism: Overall Utility

The planning practices of shared ownership housing are based on the construction of large-scale residential communities. The planning principles of site selection of the large-scale residential community reflect the utilitarian claims in the planning practice. The first four principles "focusing on the new towns, prioritizing public transportation, highlighting (spatial) functions, integrating industry and city" put emphasis on the overall development of suburban communities. The principle of prioritizing public transportation ensures the mobility of the residents and builds up transport relations between the suburban communities and the city center. The principle of highlighting spatial function ensures the proper allocation of necessary social goods, such as infrastructure and amenities. The principle of integrating industry and city tries to provide enough job opportunities for the residents and sustainable development of the district. These three principles support the first principle "focusing on the new town", which takes the overall utility of the entire city as a priority. These planning principles reflect a utilitarianism advocate for justice, which takes the maximum of overall utility as a planning objective.

This utilitarianism advocated in the planning practice weighs the overall utility over the average utility. Even though the planning of shared ownership housing had the purpose of improving the low- and middle-income residents' living conditions, the planning practice did not prioritize the interests of particular social groups to the maximum extent. Instead, the tradeoff between enlarged living areas and worsen social goods acquisition benefits the overall development of the city. The planning practices of shared ownership housing promoted social sustainability at the city level. The new towns, as well as new large-scale residential communities, promoted urban development in the way of providing sufficient resident population for urban sprawl and the vacant space in the central city for newcomers. These outcomes of the planning practices were conducted by the planning principles and reflected the priority of the overall utility of the entire urban residents.

We could also see the impact of intuitionism in the change from "For Sale Only" to "For Rent Only". As shared ownership housing plays an important role in the system of affordable housing in Shanghai, its aim at promoting the ownership of housing for low- and middle-income families shows the intuitive influence of socialist thoughts. The

socialist thoughts advocated everyone's equal ownership of housing with equal living conditions, which made the ownership of housing important in affordable housing. While in the following development of affordable housing, it is revealed that the ownership of housing and the right of residency are not the same issue. It is the right of residency secured in low-renting housing and public rental housing. The idea of "For Sale Only" then reflected an intuitive consideration in the affordable housing system, which was impacted by the cultural and contextual background, discussed later.

#### 6.2.2.2 Reflection of Liberalism: Marketization

The above analysis reflects the dislocation and inconsistencies between the planning objective and the planning principles. The planning objective aimed to improve the living condition of low- and middle-income families, while the planning principles weighed the overall development of urban areas. As a result, the planning practice promoted the process of urban sprawl, namely the residential communities' development in the suburbs. The issues that can help develop the sustainability of the shared ownership housing itself, such as introduce of primary schools and parks, were difficult to prioritize.

If the planning objective can be regarded as pursuing equal basic liberty in Rawls's theory, it then can hardly be committed that the planning practice of shared ownership housing reached the greatest benefits of the least advantaged. On one side, the shared ownership housing residents received the least among the four statuses (see Table 6.5) regarding the five basic social goods, in terms of accessibility, availability, proximity, and affordability. On the other side, the position of the least advantaged was limited to the local *Hukou* residents. Before 2019, the migrants without Shanghai *Hukou* cannot apply for shared ownership housing. Although after 2019, the application for shared ownership housing was open to the migrants with certain living area in Shanghai, the migrants were still left behind by the local *Hukou* residents.

However, there are many reflections of Nozick's libertarian-oriented approach in the planning practice. The libertarian-oriented spatial planning focus on avoiding market failures, aiming for resource efficiency, and allowing as many freedoms as possible (Hartmann, 2018). The planning practice of shared ownership housing has three significant aspects of libertarian orients: the planning principle of "easy to initiate", the marketization of its construction, and the possible transfer from shared ownership housing to commercial housing.

First is the planning principle of "easy to initiate", which reflects the operation of the market and reflects the economics of land use. The land use type of most shared ownership housing is "agreement transfer", which means no fee is paid to the local government. For other shared ownership housing in the community of commercial housing, there is also a possible way to transfer part of the housing ownership from private property developers to local government. The principle of "easy to initiate" is to improve the market efficiency of the construction of shared ownership housing.

The public-private-partnership (PPP) in the construction of shared ownership housing promotes its marketization process. A variety of development bodies for shared

ownership housing. Through public bidding, domestic property developers, including both private and stated-own enterprises, can obtain the opportunity to develop shared ownership housing. However, the profit of shared ownership housing is limited to less than 10% (Wang, 2009). For the government, the PPP mode reduced the pressure on the government's financial payment. For the development bodies, the PPP mode ensured the reliability of the investment project. For the development bodies, the marketization instruments, including ABS and SPVs, transfer the investment cost and guarantee market-oriented returns. For the shared ownership housing residents, the PPP promoted their ownership of housing assets and guaranteed the consumption and investment attributes of affordable housing (Zhu, 2018). Shared ownership housing, albeit part of the housing ownership, ensured their basic housing condition in the background of the soaring house prices under the process of urbanization.

The possible transfer from shared ownership housing into commercial housing guarantees investment value in the real estate market. As long as the residents have obtained the shared ownership for five years, then the residents can purchase the government's share of property rights and turn it into commercial housing. In this way, the family property increases at a certain proportion (50-80% of the total ownership) with the average commercial housing prices. This possible transfer kept the basic affordability and investment attributes of shared ownership housing.

#### 6.2.2.3 Reflection of Marxism and Socialism: Shared Ownership

The shared ownership housing reflects the influence of the previous socialist system. Before the socialist market-oriented reform, the welfare housing allocation system theoretically guaranteed the housing ownership of each employee in *Danwei*. In the beginning, shared ownership housing played a role as a variant of socialist welfare housing. The housing ownership of low- and middle-income residents seems to be a policy continuation. The housing property rights policy has indeed stimulated the housing consumption of Chinese urban residents and promoted the rapid development of the real estate market. The egalitarianism of Marxism and socialism further promoted the government’s policy of supporting low- and middle-income families to purchase housing. There is also an emphasis on housing ownership in traditional Chinese culture. Therefore, the post-socialist system of social goods and cultural background together suggest the housing ownership of low- and middle-income families. The entry mechanism of basic educational resources was banded with the local *Hukou*, and local *Hukou* is accessible with the ownership of local housing. Even there is collective *Hukou*, which is a specific type of *Hukou* under the account of certain *Danwei*, which might also be confronted with institutional thresholds in certain schools. A general case is that financial compensation is required for social goods in the lack of local *Hukou*.

However, housing ownership is not a necessity for the lowest-income family. The lowest-income family may suffer from economic poverty and housing difficulties at the same time and can hardly afford shared ownership housing. In 2010, the Chinese central government launched public rental housing, gradually diluting the shared

ownership housing policy. To solve the problem of public goods, especially educational and medical resources, certain local governments introduced the "same rights for rent and ownership" policy. In the case of Shanghai, public rental housing was also promoted, and the entry threshold of basic public goods was allowed for non-*Hukou* migrants.

The socialist pursuit for justice was reflected in the planning standard for shared ownership housing, especially in its flat set mode. As Table 4.4 shows, the planning standard specially defined the number and combination of bedrooms, living rooms, and dining rooms according to family structure. The distribution norms of public facilities are based on the size of the residential community and the attribute of the public facilities. These distribution norms of social goods are matched with Walzer's spheres of justice, as each social good has different allocation norms of justice.

Furthermore, certain social goods are restricted by social institutions, which also reflects the influence of (post) socialism. For example, the student places in public primary schools are restricted by the local *Hukou*, while the student places in private primary schools can be bought without local *Hukou*. Certain economic benefits compensated for the limitation of social institutions. It could be a possible reason for the negative relationship between the marketization level of resource allocation and the Gini coefficient. The higher level of marketization in resource allocation, the less possibility of inequality in resource accessibility. This contextual background of the allocation of social goods reflected the possible pursuit of building up a circulation of surplus (re)production, which has been mentioned in David Harvey's theory. Another reflection of the socialist institutional legacy was the typical "top-down" approach in the planning process, which will be discussed in the following section.

#### 6.2.2.4 Reflection of Discourse Ethics and Recognition Justice

The planning process of shared ownership housing was dominated by the government, which followed a typical "top-down" approach. The planning process (see Figure 4.8), including the project establishment, the site location, land preparation, and management approval, were carried out by the local government. The development bodies played a supportive role in the planning process. Due to the limited public participation, the planning practice of shared ownership housing lacked individual-level discourse ethics and followed a post-socialist redistribution of recognition justice. The performance of discourse ethics showed up outside the process of planning and took the form of policy updates, such as the enlarged entre conditions of the applicants. The top-down approach of the planning practice limited the discourse ethics within the institutional level. For example, the proportion of shared ownership housing differed from 50% to 80%, which was the game result between the government and different development bodies. If we apply Habermas's discourse ethics to the planning process of shared ownership housing in Shanghai, there is unequal access to communication. Local governments had a strong voice, followed by the development bodies, and the residents of shared ownership housing had the least voice. If we examine the five types

of oppression in Iris Marion Young's recognition justice, then there is a certain degree of powerlessness and marginalization of the residents in the planning process. However, the residents expressed their opinion in the way of voting with their feet. Certain shared ownership housing in certain areas was rarely chosen by the residents because of its relatively poor conditions.

The social group aimed by the shared ownership housing was low- and middle-income families. The recognition of this group has a clear boundary of social status, including income and living conditions. The planning practice has taken family status instead of group differentiation into account. The group differentiation, such as local *Hukou* residents and non-*Hukou* residents, was involved in the afterward application process of shared ownership housing. It then can be seen that discourse ethics and recognition justice were relatively neglected in the planning practice.

### 6.2.3 The Judgment Condition of Spatial Justice

The above analysis identified which justice theories were practiced or implicitly practiced and their corresponding reflections. This section discusses which judgement condition should be applied in the Shanghai case. The three judgment conditions, namely the strict condition, the tolerant condition, and the custom condition should be applied in the planning practice of shared ownership housing in Shanghai.

The inconsistency between the planning objective, the planning principles, and the contextual background makes it impossible to apply the strict condition and the tolerant condition. The planning objective followed intuitive utilitarianism, which pursued the improved living conditions and property ownership of low- and middle-income households. In the meantime, the planning principles prioritized the overall utility and took the planning practice of shared ownership housing as a means of promoting the development of suburbanization. Certain social goods' allocations had relatively strict institutional limitations, such as the ownership of *Hukou*. This contextual background is a production of the post-socialist system. Situations satisfying all three theoretical claims simultaneously should not be possible. Therefore, the strict condition cannot be applied. For the tolerant condition, as long as one theoretical claim has been achieved, the planning practice could be regarded as realizing spatial justice. It then overemphasizes certain theories of justice and neglects others that have been practiced, which is unacceptable in the Shanghai case.

The custom condition should be applied in the Shanghai case. Across the entire planning practice of shared ownership housing, there is an obvious theoretical preference. Utilitarianism advocates for the maximum overall utility that has been prioritized. Liberalism justice showed up in the marketization of housing construction. Communication in the planning process, promoted by discourse ethics and recognition justice, has been neglected. From this, we can draw a simple conclusion that the planning practice of shared ownership housing in Shanghai has realized spatial justice in terms of utilitarian justice based on a post-socialist background, carried out partial liberal justice, and lacked that of discourse ethics and recognition justice.

# 7 Summary and Prospects

The motivation for this work originated from a simple question: Can we evaluate a spatial planning practice as (un)just? Answering this simple question is not easy. The first difficulty lies in the understanding of justice. There are multiple justice philosophy schools, and each has its own specific claim and complex relationships with the others. Understanding one justice philosophy requires endeavor, and understanding multiple ones and their relationships requires an enormous amount of effort. The second difficulty lies in the proper measurement of resource distribution. The GIS methods for assessing resource allocation require the examination of models and realized utilization. The third difficulty is the outcome of planning practice. The outcome consists of two parts: what type of reproduction of space is brought about by the planning practice and how to measure whether the resource allocation is balanced, especially regarding the relationship between resource provision and population demand. This chapter begins with the major findings regarding the first difficulty.

## 7.1 Summary of Findings

### 7.1.1 Different Philosophies of Justice: Different Roles in Spatial Justice

The first major finding is that the concept of “spatial justice” can act as the bridge over the gaps between justice philosophy and spatial planning. Spatial justice can solve three critical gaps: 1) the complexity of justice philosophy impedes its spatial turn (Philippopoulos-Mihalopoulos, 2011), 2) why spatiality plays an important role in justice philosophy; 3) how to fulfill the connotation of spatial justice.

The complexity of justice philosophy consists of the contradictions between the schools of philosophy and the divergence within those schools. Complicated relationships exist among the five listed philosophical schools of justice, that is, utilitarianism and intuitionism, liberalism, Marxism and (neo) socialism, discourse ethics, and recognition justice. There has been a long history of disputes between the normative approach and the cognitive approach, as well as between the distributive paradigm and the cognitive paradigm. As Figure 3.3 shows, certain schools may have shared the same ideology while developing distinct theories of justice, such as discourse ethnicity and recognition justice, which developed the Hegelian ideology into their own theories of justice.

More differences than commonalities are shared by the schools of philosophy. Even in justice theories within the same schools of philosophy, the theoretical approaches and claims vary greatly. For example, Rawls’s “Justice and Fairness” and Nozick’s entitlement theory both support the liberal view of justice, although the liberal views advocated by the two are quite different. Sometimes different theories within the same school generate many critiques and contradictions, such as the argument of recognition justice between Nancy Frasers and Iris Marion Young. The diversity and conflicts within and between those philosophical schools of justice make it difficult to support a clear approach to its spatial turn.

However, spatiality is an inherent element of justice philosophies, and among the multiple justice theories, the spatial dimension is inherent and essential. From one side, the primordiality of space builds the necessity of space in justice theories. The spatial system, consisting of physical space as a foundation, social space as a mixture of reflection, and mental spaces as a tool of consciousness, enables the understanding of justice theories. Spatial concepts, such as Rawls's Original Position and the orientation and symmetry of metal space, play a basic role in forming justice philosophies. The primordiality of space leads to the primary spatial dimension of justice philosophies. Secondly, space plays an external representation of justice philosophies. Space is an important reflection of historical (in)justice, which records the reproduction of capital, social relations, and institutions. Space then records and reflects the various claims and implements of justice schools. The spatial dimension can record and reflect the massive advocations and contradictions in various justice theories.

The study has introduced the concept of "space as mirror" as a possible theoretical framework for bridging the philosophy of justice and spatial planning. Rather than choosing the only right justice theory, this work has argued that the key question is what kind of justice philology has been pursued, adopted, and implemented in the planning. The possible analytical framework for spatial justice in certain planning practices contains three steps. The first step is to identify the possible justice theories to be implemented in the planning practice, regarding the planning objective, principle, and process. The second step is to analyze what kind of reflection of each justice theory in the planning practice. The reflection could be in the planning design or the planning process. The third step is to determine the judgment conditions of those implemented justice theories, including the strict, tolerant, and custom conditions. The third step deals with the relationship between the implemented justice theories as well as their importance and priority in the planning practice.

Moreover, it is possible that different justice theories have different roles in spatial justice. For example, discourse ethics emphasizes equal access to communication in the planning process, while utilitarian justice focuses on utility in terms of equal distribution of social goods or the maximum overall or average utility. Rawls's justice might be applied at the level of social institution (Moroni, 2023). Nozick's theory places emphasis on property rights. The role of justice theories in spatial justice seems to be independent of its philosophical schools; instead, the core claims of a theory of justice have a major effect on its role in spatial justice. We cannot apply the principles of discourse ethics, which emphasize the communication of the planning process, to substantive planning results. It is argued that substantive justice is different from procedural justice, and each of them can only be achieved in its own way. We also cannot realize procedural justice in the advocation of substantive justice or achieve substantive justice by optimizing the planning process. When it comes to the analysis of spatial justice of empirical studies, the difficulties lie in what types of justice theories have been implemented and to what kind of reflections they have produced in planning practices. The different roles of various justice theories in spatial planning require further exploration.

### 7.1.2 Assessing Spatial Equity: User Behavior

The second major finding pertains to the proper measurement of resource distribution in terms of spatial equity. This work adopted four indicators (accessibility, availability, proximity, and affordability) to measure the distribution of five social goods (health resources, educational resources, job opportunities, parks, and public transport). Accessibility refers to the geographical supply-and-demand relationship of the resources. Availability refers to the number of facilities and opportunities in a certain living area of a residential community. This case study has adopted the 1500- and 3000-meter buffers as the living area. Proximity refers to the distance from a residential community to the nearest facility. Affordability refers to whether residents can afford to use the resources, including the price and social institutions of facility utilization. These four indicators contributed to a comprehensive analysis of the allocation of the five social goods, which further led to horizontal comparison (aimed at one social good) and vertical comparison (between the five social goods) in the empirical study.

The proper measurement of accessibility presents a difficulty in assessing spatial equity. There were three phases in figuring out its proper measurement. In the first phase, this work identified the influence of different factors in assessing spatial equity, including the surface type, parameter value, and model formula. It then evaluated the dominance of the model formula and the influence hierarchy of the determinants in assessing accessibility. The second phase was to analyze the use of geographical weights in various FCA methods of accessibility. The different applications of geographical weights can change the results greatly and could produce potentially problematic results. It then raised the question of which accessibility methods could be regarded as proper and accurate. The third phase studied the evaluation criteria for accessibility methods. Four types of the existing evaluation criteria for accessibility methods were analyzed, including pattern analysis, statistical analysis, relationship analysis, and realized analysis. This study then established a triple performance based on the mechanism of space reproduction, consisting of the performances of physical space, temporal changes, and spatial utilization to be the evaluation criteria for accessibility methods. Accessibility to different facilities could be different due to divergent facility utilization. It was then concluded that the simulation of user behaviour is crucial to a proper assessment of accessibility.

### 7.1.3 The Empirical Study of Shared Ownership Housing in Shanghai

The third major finding is based on the spatial justice analysis of the empirical study of the planning practice of Shanghai shared ownership housing, including the overall investigation, the assessment of spatial equity, and the analysis of spatial justice. The overall investigation included the historical development, the production mode, the planning process, and the planning standard and design of Shanghai shared ownership housing. The planning of large-scale residential areas carried out the construction of shared ownership housing. The development body of shared ownership housing involved various domestic enterprises and used a combination of government funds,

enterprise funds, and financial credit. The land acquisition type was predominately in the form of an agreement transfer. The five planning principles for site selection included “focusing on the new towns, prioritizing public transportation, highlighting functions, integrating industry and city, and easy to initiate”. The planning process consisted of project bidding, land preparation, and management approval. The planning standard stipulated the flat-set mode of shared ownership housing by family structure.

The assessment of spatial equity involved a horizontal comparison of each social good, namely, health resources, educational resources, job opportunities, parks, and public transport. The distributions of social goods were examined according to the four indicators, accessibility, availability, proximity, and affordability. The spatial structures of the accessibilities to the five social goods show different levels of monocentricity. The availability and proximity of shared ownership housing demonstrated different levels of inferiority to the common communities. Among the five social goods, primary schools presented relatively high barriers to acquisition, and the institutional restrictions of public primary schools could be compensated by paying fees at private primary schools. The affordability of health resources depended on the types of health insurance of the patients, while the affordability of job opportunities, parks, and public transport remained high. Furthermore, the accessibility results showed that the spatial structure of resource distribution, along with the dominance and concentration in the inner city, was difficult to change even with certain reallocation policies. Compensation for historical injustice seems hardly to have been realized in the spatial dimension.

The analysis of spatial justice consisted of vertical comparison across the five social goods and the reflection of justice theories. The vertical comparison revealed a possible negative relationship between the marketization level of social goods and the Gini coefficient of their accessibility. It appears that the more marketization that has occurred in the allocation of social goods, the higher the possibility of a fair distribution of social goods. However, this inference may require further examination involving more social goods. The study also compared the four statuses of the shared ownership housing residents according to four possible decisions, namely, maintaining their original position, moving to shared ownership housing, staying in the inner city, and moving to other suburbs. The result shows that shared-ownership housing residents had the least resource acquisition among the four statuses. The relocation of the shared-ownership housing residents accelerated the urbanization process in the suburbs, provided space in the downtown area for the new migrants, and avoided the “hollowing out” of the inner city. This analysis has revealed that shared ownership housing has promoted social sustainability at the city level while impeding local social sustainability at the community level, and that a conceptual gap exists between social justice and social sustainability.

The reflection of justice theories in the planning practice of shared ownership housing reveals the complexities of reality. The first step in analysis of the reflection identified which justice theories had been reflected in which parts of the planning practice. The second step analyzed to what extent these justice theories had been reflected in

planning practice. Inconsistency and a mixture of spatial justice were present in the planning practice. The planning practice used the maximum of overall utility as the planning principle, followed liberalist justice to construct the shared ownership housing, based on post-socialist justice of the institutions, and lacked emphasis on equal access to communication in the planning process. Therefore, the third step had to apply the custom condition as the judgment condition of spatial justice, which shows a preference for utilitarian and liberal justice. In this way, the planning practice realized both the affordable attribute and the investment attribute of the shared ownership housing at the same time.

## 7.2 Conclusion

Justice has many faces, including its spatial reflections. Rather than asking how to define spatial (in)justice, this study has posited that the question of which justice theory the planning practice has pursued and oriented (even in an underlying way) is the more crucial consideration. Taking the planning practice of Shanghai shared ownership housing as an example, this work has provided a possible analytical framework for spatial justice, linking justice theory and spatial planning.

This dissertation work involved two parts: study of the theoretical framework for spatial justice and empirical research regarding the Shanghai case. The first part analyzed five related mainstream justice theories (i.e., utilitarianism and intuitionism, liberalism, Marxism and (neo) socialism, discourse ethics, and recognition justice), pointing out that spatiality is an inherent element of justice theories, and that space is an external representation of justice philosophy. Taking space as a mirror, the theoretical framework for spatial justice attempts to reveal the differential spatial reflections of justice theories in planning practice.

The second part was based on the spatial equity of five basic social goods (health resources, education resources, job opportunities, parks, and public transport). The assessment of spatial equity involved a horizontal comparison of a particular social good, including its accessibility, availability, proximity, and affordability. Three key findings emerged regarding the assessment methods for accessibility: 1) The model formula plays a dominant role, which determines the geographical patterns of accessibility maps; 2) the use of geographical weights can change the accessibility results to a great extent, which can also lead to problematic outcomes; and 3) the evaluation criteria for the accessibility method should be in line with the space reproduction mechanism, including physical space, temporal changes, and user behaviors. The analysis also involved a comparison of the spatial equity of the five social goods in 2010 and 2017 to examine the influence of the planning practice. However, the results showed that shared ownership housing was inferior to the average of all communities in terms of the acquisition of the five social goods. The accessibility maps of the five social goods showed different patterns of the monocentric structure.

The result of spatial equity leads to the spatial justice of the planning practice. The vertical comparison across the five social goods strengthened the inferiority of shared

ownership housing relative to all residential communities. The status comparison of shared ownership housing residents further revealed the trade-offs between living conditions and the acquisition of social goods. The relocation of the residents promoted the space reproduction of urbanization at the city level, as it accelerated the development of new towns in the suburbs, provided space in the inner city for the new migrants, and avoided the “hollowing out” of the downtown area. This empirical case has provided evidence for the gap between justice and social sustainability. The social sustainability of different spatial entities represents different interests. The subsequent analysis of spatial justice revealed the inconsistency and mixture of justice theories in the planning practice. Although the planning objective was to improve the living conditions of low- and middle-income families, the planning principles of site selection prioritized the overall utility, specifically the overall development of the city, to realize utilitarian and intuitive justice. The production mode of shared ownership housing rather follows a liberal approach to justice. The post-socialist background has produced certain impacts on the allocation of social goods in an underlying way. The planning practice has also reflected an overlooking of discourse ethics and recognition justice.

This study has thus concluded the following: 1) Spatial planning is an important reflection of historical (in)justice, which records the reproduction of capital, social relations, and institutions; 2) a pluralist analysis of spatial justice of planning practices is required in the examination of planning practice in that space can only be judged as (in)justice under the precondition of confirmed justice philosophies, which is highly impacted by socioeconomic and cultural factors; and 3) one question that is more important than t whether the planning practice is (un)just is which justice philosophy the planning practice has pursued. The concept of spatial justice can contribute to further developments in planning theory and practice.

## 7.3 Discussion and Limitation

Several problems remain open to discussion in this study. The theoretical framework for spatial justice, namely “space as mirror”, reflects a pluralist analysis of justice philosophies in the spatial dimension. The case of shared ownership housing in Shanghai has provided one possible combination of the roles of justice theories in planning practice. This study applied a deconstructive approach to analysis, assessing the planning outcomes, principles, and processes of shared ownership housing in Shanghai. The benchmarks of spatial justice were based on planning practice and contextual background. In this regard, whether the planning practice was just or not depends on whether it achieved the spatial justice it defined. It is possible that, within different contextual backgrounds, spatial justice has different definitions, and justice theories could play different roles in spatial planning. How to approach the complexity of justice theories along with the complexity of planning practice remains to be discussed.

Secondly, the monocentric structure of accessibility to the five social goods might indicate that historical injustice is difficult to compensate for in the spatial dimension. The spatial structure of resource distribution could be a stabilizing factor. Areas with

historical disadvantages and a lack of social resources are difficult to improved. In the case of Shanghai, the reallocation policy of high-quality hospitals has achieved limited improvements in medical resources in the suburbs from the perspective of their overall spatial structure. The spatial structures of all five social goods distributions show great similarity in Shanghai. It seems that spatial compensation for historical injustice can only improve the situation of the disadvantaged to a tolerable level. This suggests that the planning practices aimed at compensation for historical injustice might not improve the relative situation of the disadvantaged or narrow the gap between the rich and poor but rather might improve the objective situation of the disadvantaged regardless of the situation of the advantaged.

Thirdly, this empirical case study was based on a typical utilitarian approach to justice. The second part of this research examined the spatial equity of five basic social goods in terms of four indicators, and the analysis of spatial equity reflected an emphasis on substantive justice. This tendency toward utilitarianism and substantive justice might raise critiques of cognitive approach to justice and procedural justice. However, this tendency was determined by the planning practice and the contextual background. The planning practice of shared ownership housing in Shanghai has followed a typical “top-down” model and has focused on the spatial outcome. Then, it also raises the question of whether we can judge a planning practice as just or unjust according to its own pursuit of justice. If a planning project has specifically pursued procedural justice and has produced an enlarged gap between the rich and the poor, judgments based on both procedural justice and substantive justice seem insufficient in this case. In the case of Shanghai, this study has interpreted substantive justice as the basic level of spatial justice. The achievement of improved acquisition of social goods for the disadvantaged should be a prerequisite for achieving spatial justice.

Fourthly, the question of what type of justice theories the planning has pursued is crucial in the analysis of spatial justice. Such pursuit can be either explicit or invisible, such as equal access to communication in the planning process or underlying cultural influence in land use planning. For a planning project aimed at spatial compensation for historical injustice, it is therefore important to determine which justice theories it should follow and in which aspects this pursuit can be applied. Furthermore, the effectiveness of compensation also needs to be assessed.

Finally, the development mode of shared ownership housing in Shanghai appears problematic in terms of sustainability. As stated above, the shared ownership of housing has promoted the urban sprawl in the suburbs and the induction of new migrants in the center city. However, urban resources and populations are limited, and cities cannot forever be in a state of expansion; the process of urbanization is not unlimited. If there is no driving force for continuous urban growth, how to develop such planning practices aimed at compensating for historical injustice remains unclear.

There are three basic limitations of this work. The first is the limitation of data sources. The POIs were limited to the five social goods based on available data sources. Regarding the time dimension, this study also lacked the POIs of job opportunities and

bus stations in 2010. The analysis could become more comprehensive with using more social goods to determine the overall acquisition by shared ownership housing residents. The evaluation of planning practice could be better conducted using a temporal comparison before and during the planning practice of shared ownership housing.

Secondly, due to the impact of the COVID-19 pandemic, this study lacked empirical interviews in terms of gathering a number of stakeholder interviews and insights from planning practitioners. Consequently, this research relied on existing literature, encompassing aspects such as the production mode, planning principles, design, and process of Shanghai shared ownership housing. It is possible that certain biases might developed based on this literature-based approach.

Thirdly, the utilization of social goods lacked the realized use behavior, such as the actual use behavior of patients in certain hospitals. The stimulation of usage behaviors employed various existing reports as a reference. The relationship between resource provision and population demand can be better measured with more detailed investigations of usage behaviors. Because the large-scale residential area planning in Shanghai involved typical blueprints and provided visions of mature urban areas for the suburbs, a gap existed between the planning design and the realized construction, especially regarding public facilities and social goods. In assessing spatial equity, this research tended to focus on the overall structure of social goods distribution rather than the detailed differences in each shared ownership housing. These limitations are unlikely to have affected the major conclusions of this study, such as the inconsistency of spatial justice in the planning practice.

## 7.4 Suggestions for Future Studies

Regarding future studies, this work has only unveiled a glimpse into the field of spatial justice. At the microlevel, the assessment of resource distribution could be further improved by real-time analysis of usage behaviors. With the advancement of information technology, I believe this goal will be realized in the near future. Such real-time analysis could further improve the balance between the demand and supply of the resource.

At the analytical level, resource distribution might not be necessary if the planning does not follow a utilitarian approach to justice. This study required a distributive analysis, as the planning practice reflected a dominance of utilitarianism justice. It required detailed and comprehensive analysis to determine which justice philosophy the planning had pursued. Furthermore, the influence mechanisms of various socioeconomic and cultural backgrounds on spatial justice could exhibit great variety across the world. I would expect further case studies in different geographical contexts to answer the question of which justice philosophy has been pursued in planning.

At the theoretical level, there are other possible theoretical frameworks of spatial justice to transfer the philosophical meaning of justice to spatial planning. The role of justice philosophy in planning (Moroni, 2023) might differ according to various factors and is obviously a difficult and meaningful topic. How to achieve spatial justice and

what kind of spatial justice should be pursued are remain matters of exploration. The concept of spatial justice could contribute to further initiatives and developments in spatial planning.

To end this work, I would like to mention the Chinese idiom “heading south by driving the chariot northward (南辕北辙)” which has a wide range of applications. For example, planning practice has seemed to increase the benefits of the disadvantaged, while it indeed also has pursued an overall maximum utility at the cost of the disadvantaged. However, sometimes we cannot realize that our goal is to the south until we have arrived at the north, which may properly be the journey to spatial justice.

# 8 Appendix

## 8.1 Appendix A: Equations in Key Factors in Assessing Accessibility

The gravity model of accessibility to health facilities adapted by Weibull (1976) takes the competition for services among residents into account:

Equation 8-1

$$A_i^G = \sum_{j=1}^{n} \frac{S_j d_{ij}^{-\beta}}{V_j} = \sum_{j=1}^{n} \frac{S_j d_{ij}^{-\beta}}{\sum_{k=1}^{m} P_k d_{kj}^{-\beta}}$$

$A_i^G$ is the gravity-based index of accessibility, $S_j$ is the supply capacity of the facility j, $d_{ij}$ is the distance between the unit i to facility j, and β is the distance decay coefficient, $V_j$ is the population demand, $P_k$ is the population of unit k, where n and m are the total numbers of facility and geographic unit.

The two-step floating catchment area method (2SFCA) tries to solve the border-crossing problems by calculating both catchment area (service area) based on health facility and residential units (Luo & Wang, 2003). The first step of the 2SFCA method is to compute the supply-demand ratio based on each supply facility within the catchment area:

Equation 8-2

$$R_j = \frac{S_j}{\sum_{k \in \{d_{kj} \le d_0\}} P_k}$$

Where $R_j$ is the supply-demand ratio of facility j, $P_k$ is the population of geographic unit k which falls in the catchment of facility j (that is, $d_{kj} \le d_0$), $S_j$ is the supply capacity of facility j, and $d_{kj}$ is the distance between k and j. The second step is to calculate the accessibility of geographic unit i, which equals the sum of supple-demand ratio of facility j ($R_j$) where facility j locates within the catchment ($d_{kj} \le d_0$):

Equation 8-3

$$A_i^F = \sum_{j \in \{d_{ij} \le d_0\}} R_j = \sum_{j \in \{d_{ij} \le d_0\}} \frac{S_j}{\sum_{k \in \{d_{kj} \le d_0\}} P_k}$$

$A_i^F$ represents the accessibility at unit i based on the 2SFCA method, $R_j$ is the supply-demand ratio at facility j which falls in the catchment centered at unit i (that is, $d_{ij} \le d_0$), and the other variables are the same as in the previous equation.

## 8.2 Appendix B: The parameter combinations in key factors of accessibility

Table 8.1 The eighteen tested parameter combinations in Key Factors in Assessing Accessibility

| Nr. | Model formula | Distance type | Supply Capacity | Catchment | Unit aggregation | Distance decay coefficient (β) |
|---|---|---|---|---|---|---|
| 1* | the general gravity model | Euclidean | S1 | - | census block | 1 |
| 2 | the general gravity model | Euclidean | S1 | - | census block | 2 |
| 3 | the general gravity model | network | S1 | - | census block | 1 |
| 4* | the general gravity model | network | S2 | - | census block | 1 |
| 5 | the general gravity model | network | S2 | - | census block | 2 |
| 6 | the general gravity model | network | S2 | - | 1km*1km grid | 1 |
| 7* | the general gravity model | network | S2 | - | 500m*500m grid | 1 |
| 8 | the general gravity model | network | S2 | - | 500m*500m grid | 2 |
| 9 | the general gravity model | network | S3 | - | 500m*500m grid | 1 |
| 10* | the general gravity model | network | S3 | - | 500m*500m grid | 2 |
| 11 | the general gravity model | network | S3 | - | census block | 1 |
| 12 | the 2SFCA method | network | S1 | 20km | census block | 1 |
| 13 | the 2SFCA method | network | S2 | 20km | census block | 1 |
| 14 | the 2SFCA method | network | S2 | 20km | census block | 2 |
| 15* | the 2SFCA method | network | S2 | 20km | 500m*500m grid | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16* | the 2SFCA method | network | S3 | 20km | census block | 1 |
| 17 | the 2SFCA method | network | S3 | 20km | census block | 2 |
| 18* | the KDE method** | - | - | - | - | - |

* The selected parameter combinations, showing in Table 4.6 and applied in Figure 4.14.

** The Kernel Density Estimation (KDE) Method is tested in adaptive and fixed bandwidth (150m, 250m, and 400m). The results showed in the A7 maps of Figure 4.14 are in the bandwidth of 250m, which generate the most reasonable results.

## 8.3 Appendix C: The literature list of the evaluation criteria for accessibility method

Table 8.2 The literature list of the evaluation criteria for accessibility method

| No. | Reference | Accessibility Methods/ Parameters | Evaluation Method | Evaluation Criteria |
|---|---|---|---|---|
| 1 | Talen and Anselin (1998) | Container;<br>Gravity model;<br>Travel cost;<br>Minimum distance | Moran's I test<br>Pattern analysis | Spatial autocorrelation;<br>relationship with population and housing value patterns |
| 2 | Kwan (1998) | Gravity model;<br>Cumulative-opportunity;<br>Space-time measures | Correlation analysis<br>Pattern analysis<br>Factor analysis | Individual accessibility description |
| 3 | Talen (2001) | Access<br>(Miles per block) | Lorenz curve<br>Correlation analysis<br>Pattern analysis<br>Regression simulation | Equality of access;<br>relationship with socio-economic status (SES) patterns |
| 4 | Luo and Wang (2003) | Gravity model;<br>The two-step floating catchment area method (2SFCA) | Standard deviation<br>Relative value<br>Pattern analysis | Spatial variability |
| 5 | Guagliardo (2004) & Guagliardo et al. (2004) | Kernel density estimation (KDE);<br>Space-time measures | Pattern analysis | Solving the border-crossing problem |
| 6 | Smoyer-Tomic et al. (2004) | Minimum-distance;<br>coverage approach (Based on physical distance) | Spearman rank correlation<br>Local indicators of spatial association (LISA) | No direct standard;<br>Social groups' needs as an indirect standard |
| 7 | Omer (2006) | Minimum distance;<br>coverage (both at house level and neighborhood level) | Pattern analysis<br>LISA | Spatial variance as accuracy |
| 8 | Yang et al. (2006) | 2SFCA;<br>KDE | Pattern analysis<br>Accessibility score and ratios | Pattern continuousness;<br>Provision and demand distribution;<br>City structure |

| | | | | |
|---|---|---|---|---|
| 9 | Apparicio et al. (2008) | Aggregation methods with four distance types and three spatial units | Pearson correlation<br>Spearman correlation | Aggregation errors (relative correlation and absolute difference) |
| 10 | Luo and Qi (2009) | 2SFCA<br>Enhanced 2SFCA (E2SFCA) | Pattern analysis<br>Shortage area statistics<br>Accessibility score | Shortage area published by the US Department of Health and Human Services |
| 11 | Schuurman et al. (2010) | KDE;<br>The gravity model | Pattern analysis<br>The logic of the models | Regional structure<br>Facility utilization (e.g., two-hours driving time as the maximum commuting distance; KDE assumes people cannot cross geographic borders) |
| 12 | Luo and Whippo (2012) | Variable catchments in 2SFCA | Pattern analysis<br>Statistical comparison<br>Parameter sensitivity | - |
| 13 | McGrail (2012) | Three decay functions and two catchment functions in 2SFCA | Pattern analysis<br>Accessibility by population | Five-level population size/spatial scale |
| 14 | Wan, Zou, et al. (2012) | Two models: E2SFCA, 3SFCA<br>Two indexes: spatial access index (SPAI), spatial access ratio (SPAR) | Pattern analysis<br>Parameter sensitivity | Pattern stability<br>Spatial structure |
| 15 | Bunel and Tovar (2013) | Distance-based models;<br>Time-based models;<br>Job competition model;<br>Frontier effect model | Pattern analysis<br>Pearson correlation between access score and urban zone, unemployment rate, and social status | Accessibility model as benchmark |
| 16 | Delamater (2013) | E2SFCA<br>M2SFCA<br>3SFCA | Pattern analysis<br>Statistical analysis<br>Model cases | Model logic (dynamic change) |
| 17 | Dewulf et al. (2013) | Ten models, including: two physician-to-population ratio (PPR) models, three distance models, two cumulative opportunity models, and three FCA methods | Statistical analysis<br>Pattern analysis (shortage area and financial assisted area) | The official Impulseo I (PPR) method as benchmark<br>Pattern heterogeneity |
| 18 | Mao and Nekorchuk (2013) | Multi traffic modes<br>2SFCA | Pattern analysis<br>Statistical analysis<br>LISA | Spatial variance as accuracy |
| 19 | Fransen et al. (2015) | The commuter-based 2SFCA | Pattern analysis<br>Statistical analysis<br>Person correlation | Spatial structure |
| 20 | Bauer and Groneberg (2016) | Integrated-FCA with variable distance decay functions.<br>M2SFCA<br>2SFCA<br>E2SFCA | Pattern analysis<br>Statistical analysis<br>Two selected locations | Travel behaviors |

| | | | | |
|---|---|---|---|---|
| 21 | Tang et al. (2017) | the flow-based 2SFCA (F2SFCA)<br>and other three 2SFCA methods | Pattern analysis<br>Statistical analysis<br>Relationship between accessibility and the proportion of the elderly population | Spatial access probability of specific individual |
| 22 | Pan et al. (2018) | The 2SFCA with an integrated catchment area | Pattern analysis<br>Statistical analysis | Taxi GPS trajectories |
| 23 | Delamater et al. (2019) | E2SFCA<br>M2SFCA<br>3SFCA<br>Huff-modified 3SFCA | Statistical analysis<br>Pattern analysis | Observed utilization patterns |
| 24 | Ni et al. (2019) | Multiple transportation within 2SFCA | Pattern analysis<br>Statistical analysis | City structure |
| 25 | Paez et al. (2019) | Standardized weights in FCA methods | Case study of models | Theoretical derivation of model logic |
| 26 | Du and Zhao (2022) | Variable catchment in FCA methods | Statistical analysis<br>Spatial autocorrelation LISA | Official supply-demand ratios<br>Catchment size is determined by the average serviced population (9934 persons) |

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