Three Essays on Housing Affordability in Chinese Cities

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Dedication

This dissertation is dedicated to Xiaomei, Zhenquan, and Yang.

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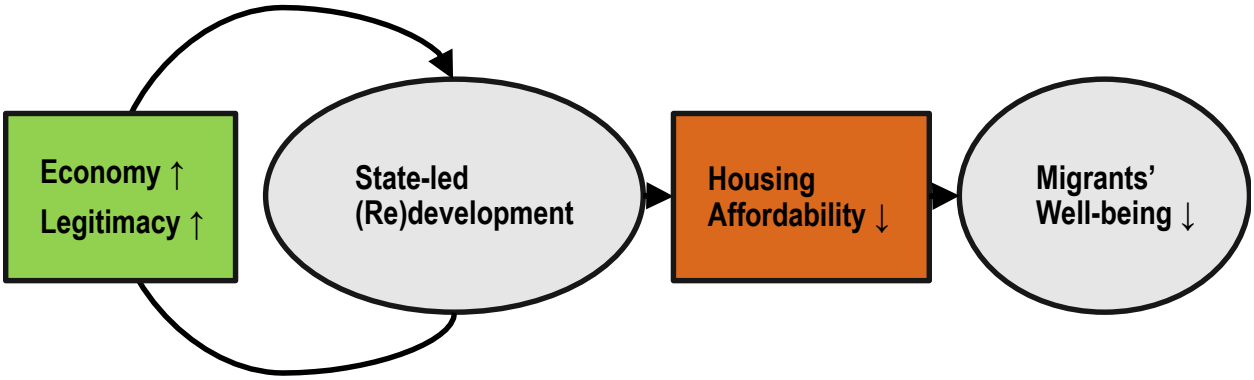
Chapter 1. Introduction

China has gone through rapid urbanization and economic growth in the past two decades. From 2000 to 2020, the percentage of population in China lived in cities increased from 36% to 63%. At the same time, the nationwide gross domestic product (GDP) per capita increased from 2.2 to 11.2 million US dollars[1] (World Bank, 2022a, 2022b). Since the housing reform in the 1990s, Chinese cities have been operating in an authoritarian capitalist system in which surplus values / profits need to be constantly produced and fixed to land through state-led urban development and redevelopment (Wu, 2015, 2016). Constant growth supports economic prosperity. Continuous urban development and redevelopment bring economic growth, which helps to reinforce the political legitimacy of the Chinese state (Wong, 2015). In megacities where immediately developable land in prime locations is scarce, redevelopment becomes the go-to policy instrument of spatial fix that the state uses to sustain growth.

Figure 1-1. Redevelopment, housing affordability, and migrants' wellbeing: a theoretical framework



The rapid urbanization and growing income have substantially increased housing demand in Chinese cities (Yao et al., 2014). As a result of nonstop urban (re)development, market speculation, and a lack of governmental support for low-income housing, property prices in major Chinese cities have skyrocketed, leading to declining housing affordability (Chen and Wen, 2017;

Huang, 2012; Li and Song, 2016; Wu et al., 2012). One study found that the land value in Beijing increased by nearly 800% from 2003 to 2010 (Wu et al., 2012).

Perpetual redevelopment has negatively impacted the housing affordability in Chinese cities (Figure 1-1). The targets of redevelopment are usually dilapidated residential areas—also known as shantytowns—which is the main housing provider of affordable housing for low-income renters in Chinese cities. The removal of shantytowns and the construction of better-quality residential complexes will likely reduce the existing stock of affordable rentals and drive up the housing price in the neighborhood. The redevelopment-induced housing price increase and displacement of migrants have become a pressing issue in recent years (Liu et al., 2017, 2018).

The great housing boom is accompanied by a rise of residential segregation by income in major Chinese cities (Li and Wu, 2008; Wu, 2002). In the 1990s, the Chinese government restructured its previous welfare housing system into a market-oriented one (Lee and Zhu, 2006; Wu, 2015). The public sector gradually retreated from the provision of housing, while the market took over the role as the major housing provider. In a market-oriented economy, people's income directly affects the types of housing they can afford. Clustered 'zones of affluence' and gated communities targeting the rich began to spring up in Beijing (Hu and Kaplan, 2001; Wu, 2005; Wu and Webber, 2004), while urban villages where low-wage migrants concentrated were found in the urban periphery (Gu, 2001; Ma and Xiang, 1998).

As land in prime locations becomes increasingly scarce, the upgrade / redevelopment of existing buildings in those locations becomes attractive to developers. Many central city neighborhoods have been through waves of redevelopment in the past decades (He, 2019; Wu, 2016). The redeveloped housing complexes are often targeting the rich and are out of the price

range for most preexisting residents. The successive waves of redevelopment are likely to contribute to the growth of residential segregation by income.

Declining housing affordability disproportionately affects the migrant workers, who are predominantly low-income renters (Fang et al., 2020; Huang and Tao, 2015). Over 80% of migrant workers in Chinese cities live in rental housing and employer-provided dormitories (Wang, 2023; Zhu et al., 2014), a significantly higher proportion compared to the national average of 25% (National Bureau of Statistics of China, 2022). Due to limited income and the lack of housing assistance, migrants are also less likely to own a home compared to local residents (Wu and Wang, 2014; Zhu et al., 2014). They have also been excluded from high quality housing in prime locations (Wang, 2023; Zhu et al., 2014) and are vulnerable to redevelopment-induced housing price increase.

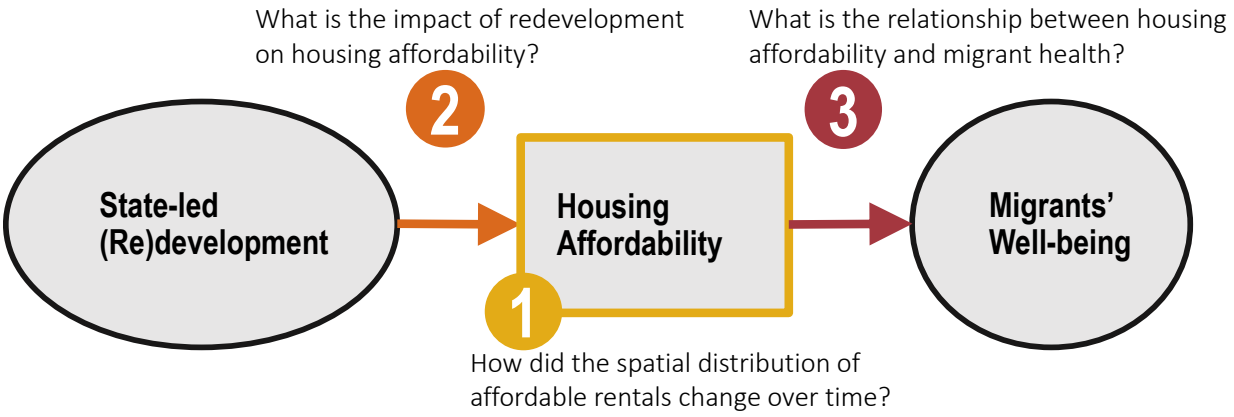
The unequal access to decent housing is a product of the discriminatory *hukou* system. The *hukou* system, established in the late 1950s, assigns each individual a household registration identity, primarily based on place of birth (Song and Smith, 2021). Individual hukou is directly tied to the social welfare that a person can access, which includes but not limited to healthcare, pension benefits, and housing assistance (Chen and Fan, 2016; Song, 2014; Zhou and Cheung, 2017). Without local *hukou*, migrants are excluded from most of the subsidized housing programs in large Chinese cities (Huang and Tao, 2015).

The discriminatory *hukou* system puts the migrant population in a vulnerable position in China's urban redevelopment process. A continued decline in housing affordability may increase the risk of displacement among low-income migrant workers. Migrant workers often live in dilapidated residential areas that are prone to redevelopment. As redevelopment removes the informal rental sector that makes affordable housing possible in central locations, it is hard for

low-income migrant workers to find alternative housing units in the same neighborhood after the redevelopment.

Housing policy and state-led redevelopment programs play central roles in the production of urban inequality in Chinese cities. The current housing system operates in an institutional context[2] where housing is a scarce resource for the poor and such scarcity generates profit for the affluent. Unaffordable housing undermines the well-being of the poor, and wealth generated from homeownership benefits the rich. The state-led redevelopment programs may contribute to the increasing urban inequality by direct and indirect displacement of migrant renters from the redeveloped neighborhood. Despite the potentially adverse impact of state-led urban redevelopment, studies that explore the linkages among redevelopment, housing affordability, and migrants' health have been rare.

Figure 1-2. Research questions



Using data compiled from the Beijing Municipal Government, the real estate brokerage company *Lianjia*, the Census Bureau, and the National Health Commission, I look at different aspects of the housing affordability problem and its impact on the migrant population in Chinese cities. Specifically, I ask the following research questions:

(1) How did the spatial distribution of affordable rentals change over time?

(2) What is the impact of redevelopment on housing affordability?

(3) What is the relationship between housing affordability and migrant health?

Each of these questions will be addressed in separate chapters of this dissertation. Chapter 2 examines the spatial distribution of affordable rentals in the formal market in Beijing between 2015 and 2021. Given the declining stock of affordable rentals in the informal market as a result of the state-initiated redevelopment in the city (Li and Kong, 2019; Liu et al., 2020; Liu and Wong, 2018), the study shifts the focus to Beijing's formal rental market and investigates the spatial configuration of affordable formal rentals in the market.

Chapter 3 digs into the potential impact of shantytown redevelopment in Beijing on rental housing affordability. The study, while acknowledging the economic contribution of state-led redevelopment, investigates the unequal distribution of benefits and burdens between migrant renters and local homeowners in the redevelopment process. By examining the potential spillover effect of shantytown redevelopment, the study sheds light on the potentially disproportionate burden borne by migrant renters in state-led redevelopment.

Chapter 4 examines the phenomenon of migrant health decline in Chinese cities and explores its linkage with financial housing stress. The study asks whether the incorporation of residence duration alters the relationship between financial housing stress and health, that is, whether the relationship between financial stress and health can be at least partially explained by a migrant's duration of stay in the host city. The study positions the unequal access to adequate housing and the stress related to that as an outcome of the discriminatory *hukou* system, escalating the housing affordability problem to the institution that produces it.

Chapter 5 summarizes the findings from Chapters 2-4, discusses their policy implications, and points out directions for future research.

Notes

1. Data are in constant 2015 U.S. dollars.

2. "Institutional context" in this dissertation refers to the 'rules of the game' which are codified by law and activated by policy.

References

Chen C and Fan CC (2016) China's Hukou Puzzle: Why Don't Rural Migrants Want Urban Hukou? *China Review* 16(3). The Chinese University of Hong Kong Press: 9–39.

Chen K and Wen Y (2017) The Great Housing Boom of China. *American Economic Journal: Macroeconomics* 9(2): 73–114. DOI: 10.1257/mac.20140234.

Fang Y, Liu Z and Chen Y (2020) Housing Inequality in Urban China: Theoretical Debates, Empirical Evidences, and Future Directions. *Journal of Planning Literature* 35(1). SAGE Publications Inc: 41–53. DOI: 10.1177/0885412219880898.

Gu C (2001) Social polarization and segregation in Beijing. *Chinese Geographical Science* 11(1): 17–26. DOI: 10.1007/s11769-001-0003-7.

He S (2019) Three Waves of State-led Gentrification in China. *Tijdschrift voor Economische en Sociale Geografie* 110(1): 26–34. DOI: 10.1111/tesg.12334.

Hu X and Kaplan DH (2001) The Emergence Of Affluence In Beijing: Residential Social Stratification In China's Capital City. *Urban Geography* 22(1): 54–77. DOI: 10.2747/0272-3638.22.1.54.

Huang Y (2012) Low-income Housing in Chinese Cities: Policies and Practices*. *The China Quarterly* 212. Cambridge University Press: 941–964. DOI: 10.1017/S0305741012001270.

Huang Y and Tao R (2015) Housing migrants in Chinese cities: current status and policy design. *Environment and Planning C: Government and Policy* 33(3): 640–660. DOI: 10.1068/c12120.

Lee J and Zhu Y (2006) Urban governance, neoliberalism and housing reform in China. *The Pacific Review* 19(1). Routledge: 39–61. DOI: 10.1080/09512740500417657.

Li B and Kong X (2019) The Beijing municipal government will continue to focus on the dispersal of 'non-capital' functions and the fight against "urban diseases" in 2019. Available at: http://m.xinhuanet.com/2019-02/20/c_1124142366.htm (accessed 30 January 2020).

Li P and Song S (2016) What Pushes Up China's Urban Housing Price So High? *The Chinese Economy* 49(2). Routledge: 128–141. DOI: 10.1080/10971475.2016.1143306.

Li Z and Wu F (2008) Tenure-based residential segregation in post-reform Chinese cities: a case study of Shanghai. *Transactions of the Institute of British Geographers* 33(3): 404–419. DOI: 10.1111/j.1475-5661.2008.00304.x.

Liu R and Wong T (2018) Urban village redevelopment in Beijing: The state-dominated formalization of informal housing. *Cities* 72: 160–172. DOI: 10.1016/j.cities.2017.08.008.

Liu R, Li T and Greene R (2020) Migration and inequality in rental housing: Affordability stress in the Chinese cities. *Applied Geography* 115: 102138. DOI: 10.1016/j.apgeog.2019.102138.

Liu Y, Tang S, Geertman S, et al. (2017) The chain effects of property-led redevelopment in Shenzhen: Price-shadowing and indirect displacement. *Cities* 67: 31–42. DOI: 10.1016/j.cities.2017.04.017.

Liu Y, Geertman S, Oort F van, et al. (2018) Making the 'Invisible' Visible: Redevelopment-induced Displacement of Migrants in Shenzhen, China. *International Journal of Urban and Regional Research* 42(3): 483–499. DOI: 10.1111/1468-2427.12646.

Ma LJC and Xiang B (1998) Native Place, Migration and the Emergence of Peasant Enclaves in Beijing. *The China Quarterly* (155). Cambridge University Press: 546–581.

National Bureau of Statistics of China (2022) *China Population Census Yearbook 2020*. China Statistics Press Beijing, China.

Song Q and Smith JP (2021) The citizenship advantage in psychological well-being: An examination of the Hukou system in China. *Demography* 58(1). Duke University Press: 165–189.

Song Y (2014) What should economists know about the current Chinese hukou system? *China Economic Review* 29: 200–212. DOI: 10.1016/j.chieco.2014.04.012.

Wang Y (2023) Housing cost burden, homeownership, and self-rated health among migrant workers in Chinese cities: The confounding effect of residence duration. *Cities* 133: 104128. DOI: 10.1016/j.cities.2022.104128.

Wong SW (2015) Urbanization as A Process of State Building: Local Governance Reforms in China. *International Journal of Urban and Regional Research* 39(5): 912–926. DOI: 10.1111/1468-2427.12250.

World Bank (2022a) GDP per capita (constant 2015 US$) - China. Available at: https://data.worldbank.org/indicator/NY.GDP.PCAP.KD?locations=CN (accessed 15 April 2023).

World Bank (2022b) Urban population (% of total population) - China. Available at: https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=CN (accessed 15 April 2023).

Wu F (2002) Sociospatial Differentiation in Urban China: Evidence from Shanghai's Real Estate Markets. *Environment and Planning A: Economy and Space* 34(9). SAGE Publications Ltd: 1591–1615. DOI: 10.1068/a34196.

Wu F (2005) Rediscovering the 'Gate' Under Market Transition: From Work-unit Compounds to Commodity Housing Enclaves. *Housing Studies* 20(2). Routledge: 235–254. DOI: 10.1080/02673030342000331754.

Wu F (2015) Commodification and housing market cycles in Chinese cities. *International Journal of Housing Policy* 15(1). Routledge: 6–26. DOI: 10.1080/14616718.2014.925255.

Wu F (2016) State Dominance in Urban Redevelopment: Beyond Gentrification in Urban China. *Urban Affairs Review* 52(5). SAGE Publications Inc: 631–658. DOI: 10.1177/1078087415612930.

Wu F and Webber K (2004) The rise of "foreign gated communities" in Beijing: between economic globalization and local institutions. *Cities* 21(3): 203–213. DOI: 10.1016/j.cities.2004.03.002.

Wu J, Gyourko J and Deng Y (2012) Evaluating conditions in major Chinese housing markets. *Regional Science and Urban Economics* 42(3). Special Section on Asian Real Estate Market: 531–543. DOI: 10.1016/j.regsciurbeco.2011.03.003.

Wu W and Wang G (2014) Together but Unequal: Citizenship Rights for Migrants and Locals in Urban China. *Urban Affairs Review* 50(6). SAGE Publications Inc: 781–805. DOI: 10.1177/1078087413518172.

Yao S, Luo D and Wang J (2014) Housing Development and Urbanisation in China. *The World Economy* 37(3): 481–500. DOI: 10.1111/twec.12105.

Zhou S and Cheung M (2017) Hukou system effects on migrant children's education in China: Learning from past disparities. *International Social Work* 60(6). SAGE Publications Ltd: 1327–1342. DOI: 10.1177/0020872817725134.

Zhu Y, Fu Q and Ren Q (2014) Cross-City Variations in Housing Outcomes in Postreform China. *Chinese Sociological Review* 46(3). Routledge: 26–54. DOI: 10.2753/CSA2162-0555460302.

Chapter 2. No Place in the City: The Segregation of Affordable Formal Private Rentals in Beijing

Abstract

Residential segregation by income has become an emerging concern in Chinese cities. Existing literature on residential segregation has mostly focused on informal rental market, and little is known about the formal rental market. Nevertheless, with the continued removal of informal settlements, formal private rentals (FPRs) are likely to play a more pivotal role in the provision of affordable housing in the upcoming years. Using data from online rental listings, this paper examines changes in the spatial distribution of affordable FPRs in Beijing between 2015 and 2021. The study finds that the availability of affordable FPRs decreased drastically in the central city area over the six-year period, and the remaining affordable FPRs in the central-city subdistricts became increasingly segregated from higher-priced FPRs. When compared across FPRs of different price ranges, the affordable FPRs turn out to be the most segregated in both 2015 and 2021, with a city-level dissimilarity index of 0.74 and 0.80 respectively. Policy responses are needed to maintain rental housing affordability in prime locations and prevent further segregation of affordable rentals in the central city.

1 Introduction

Residential segregation by income has become a pressing issue in Chinese cities. The series of economic reforms in the 1980s and '90s not only increased the average income of Chinese families but also widened the wealth gap between rich and poor (Harvey, 2007: 17; Wang, 2016: 168). After the establishment of land and housing markets in the 1990s, wealth inequality started to

manifest itself in the sorting of rich and poor into different neighborhoods (Li and Wu, 2008; Wu, 2002).

The degree of residential segregation in Chinese cities can be greatly affected by the spatial configuration of affordable rental housing. Even though China has one of the highest homeownership rates in the world (Zeng et al., 2020), there are still over one-third of the population living in rental housing in megacities like Beijing and Shanghai (National Bureau of Statistics of China, 2012). The proportion of renters in the lower-income population tends to be higher than the city's average. According to the 2017 China Migrants Dynamic Survey, about 62% of migrants[1] in Beijing----a group that is disproportionately low-income (Park and Wang, 2010; Shi et al., 2017; Wu and Logan, 2016)----lived in rental housing.

Rental units in Chinese cities, as elsewhere, can be characterized as formal or informal based on the legality of the lease. Informal rentals tend to have lower prices than the formal rentals in similar locations because of the insecurity of tenure and the relatively deteriorated living conditions. Formal rentals—both public and private—are usually not the first choice of residence for lower-income renters (Huang and Tao, 2015; Kim, 2016; Kroeber, 2016: 76–79). Lower-income renters often end up living in very small, poor-quality housing in the informal sector, which includes illegal rental units in urban villages[2] (*cheng zhong cun*) (Huang and Tao, 2015; Wang, 2016; Wang et al., 2009; Wu, 2002), group rentals[3] (*qun zu fang*) (Harten and Kim, 2018), and basement rentals (Huang and Yi, 2015; Kim, 2016; Yu and Cai, 2013). Existing evidence suggests that the informal sector plays a vital role in the provision of affordable housing for lower-income people.

Nevertheless, the informal rental stock has been declining due to a series of redevelopment initiatives in recent years (Li and Kong, 2019; Lin et al., 2014; Liu and Wong, 2018). As the

informal rental stock declines, formal private rentals (FPRs) are likely to play a more pivotal role in the provision of affordable housing for the lower-income population. The availability of affordable rentals affects people's health and well-being, and also their employment and educational opportunities (Byrne and Diamond, 2007; Fan et al., 2014). It is therefore important to find out how the spatial distribution of FPRs has changed in recent years.

Existing research on the segregation of affordable rentals in Chinese cities has mostly focused on the informal sector. Few studies have investigated the spatial configuration of the affordable rentals in the formal market and how it has changed over time. This paper fills in the gap by examining spatial distribution of affordable FPRs in Beijing between 2015 and 2018 using data collected from an online real estate brokerage.

The paper begins with a review of the existing literature on the segregation of affordable rentals in Beijing. Next, the study area and data used for this study are described. In the third section, the methods used in the analysis are discussed. Section four presents the findings on the spatial configuration of affordable FPRs. Finally, in the conclusion, the policy implications of the findings are discussed.

2 The segregation of affordable rentals in Beijing

The emergence of residential segregation

Urban residences in Beijing were almost homogeneous before the Chinese economic reform. In the previous planned economy, the central and local governments oversaw housing production and allocation. Urban residents paid a nominal rent to live in the state-allocated public housing (Kroeber, 2016: 76–79; Wang, 2016: 143–144), which was designed and constructed in a uniform way to emphasize egalitarianism and collectivism (Wang, 2016: 148).

In the 1990s, the central government restructured the previous in-kind welfare housing system into a market-oriented one (Lee and Zhu, 2006; Wu, 2015). The state gradually retreated from the direct provision of public housing, and the market started to play a major role in the provision of housing. In a market-oriented economy, people's income directly affects the types of housing they can afford. Clustered 'zones of affluence' and gated communities targeting the rich began to spring up in Beijing (Hu and Kaplan, 2001; Wu, 2005; Wu and Webber, 2004), while urban villages where low-wage migrants concentrated were found in the urban periphery (Gu, 2001; Ma and Xiang, 1998). The residential segregation between rich and poor began to emerge.

Formal and informal rentals

Both formal and informal rental housing exist in Beijing's housing market (Table 2-1). The former has the legal rights of occupancy while the latter do not. The informal rentals--including illegal rentals in urban villages, basement rentals, and group rentals--serve as the major housing source for the lower-income population (Wang, 2016: 170; Zhai et al., 2007). Regardless of their poor living conditions, the informal rentals typically have locational advantages; they enabled lower-income people to live close to jobs and sometimes gain better access to urban amenities (Harten and Kim, 2018; Huang and Yi, 2015; Kim, 2016; Knowles, 2016; Li, 2010; Peng et al., 2010; Wang et al., 2009; Wu, 2002; Yu and Cai, 2013; Zheng et al., 2009). Nevertheless, the lower-income people who live in informal rentals are often found to be physically and/or socially[4] segregated from other urban residents (Oreglia, 2010; Wang et al., 2009; Wu, 2002; Zheng et al., 2009). Dehumanizing names such as "ant tribe" and "mouse tribe" have been used to refer to tenants who live in informal rentals, perpetuating the social stigma associated with the lower-income group (Huang and Yi, 2015).

Table 2-1. Types of formal and informal rentals in Chinese cities

Type	Location	Tenure	Land Type	Living Conditions	Provision
Illegal rentals in urban villages (*cheng zhong cun*)	Primarily urban periphery	Insecure	Rural	Poor-quality, overcrowded; inadequate access to public services and amenities; physically segregated	Declining
Basement rentals	Primarily central city	Insecure	Urban	Poor-quality, overcrowded; socially segregated	Declining
Group rentals (*qun zu fang*)	Primarily central city	Insecure	Urban	Poor-quality, overcrowded; socially segregated	Declining
Dormitories provided by employers	Central city and urban periphery	Mixed	Mixed	Poor-quality, overcrowded	
Public rental housing (*gong zu fang*)	Primarily urban periphery	Secured	Mixed	Design and constructed in compliance with local housing codes; physically segregated	Limited
Formal private rentals (FPRs)	Central city and urban periphery	Secured	Urban	Design and constructed in compliance with local r housing codes	Limited

Formal rentals, which include public and private rentals, are often seen as secondary in providing affordable housing for the low-income population. Public rental housing is designed and constructed in compliance with local housing codes but has been criticized for its limited provision and distant locations from the city center (Kim, 2016; Lin et al., 2014). A recent study suggested that public rental housing also faced the problem of being physically isolated from other commercial housing (Chu et al., 2019). Formal private rentals (FPRs) are rarely the focus of affordable housing research in China due to its limited supply (Huang and Tao, 2015). Few studies have examined the spatial configurations of affordable FPRs in Chinese cities and how they change over time.

The removal of informal settlements

The informal housing sector is seen as a major barrier to economic development and city branding in China (Lai et al., 2014; Tian, 2008; Zhu, 2019). To proclaim Beijing's image as a leading global city, the municipal government has taken a series of actions to improve the built environment and boost economic growth, in which the redevelopment of informal settlements plays a major role (Wong et al., 2018; Wong and Liu, 2017).

The municipal government's effort to redevelop the informal settlement can be traced back to the early 2000s (Hsing, 2012). In 2004, there were 343 identified urban villages in Beijing, of which 171 were torn down between 2005 and 2010 (Mu, 2004; Rao, 2011). In face of the 2008 global financialization crisis, urban redevelopment projects were used by the central government to facilitate capital circulation and help cities to recover from their economic downturns (Chen, 2018; He et al., 2020).

More extensive demolition of the informal rental sector has been carried out by the Beijing municipal government in recent years. In the end of 2017, a fire broke out at an informal apartment building in southern Beijing, which triggered a sweeping inspection of illegal rentals in the city (Liu, 2017; The Economist, 2017). The tragic fire provided a catalyst for the municipal government to enforce stricter regulations on the rental market and speed up the clearance of informal rentals (Gao, 2017).

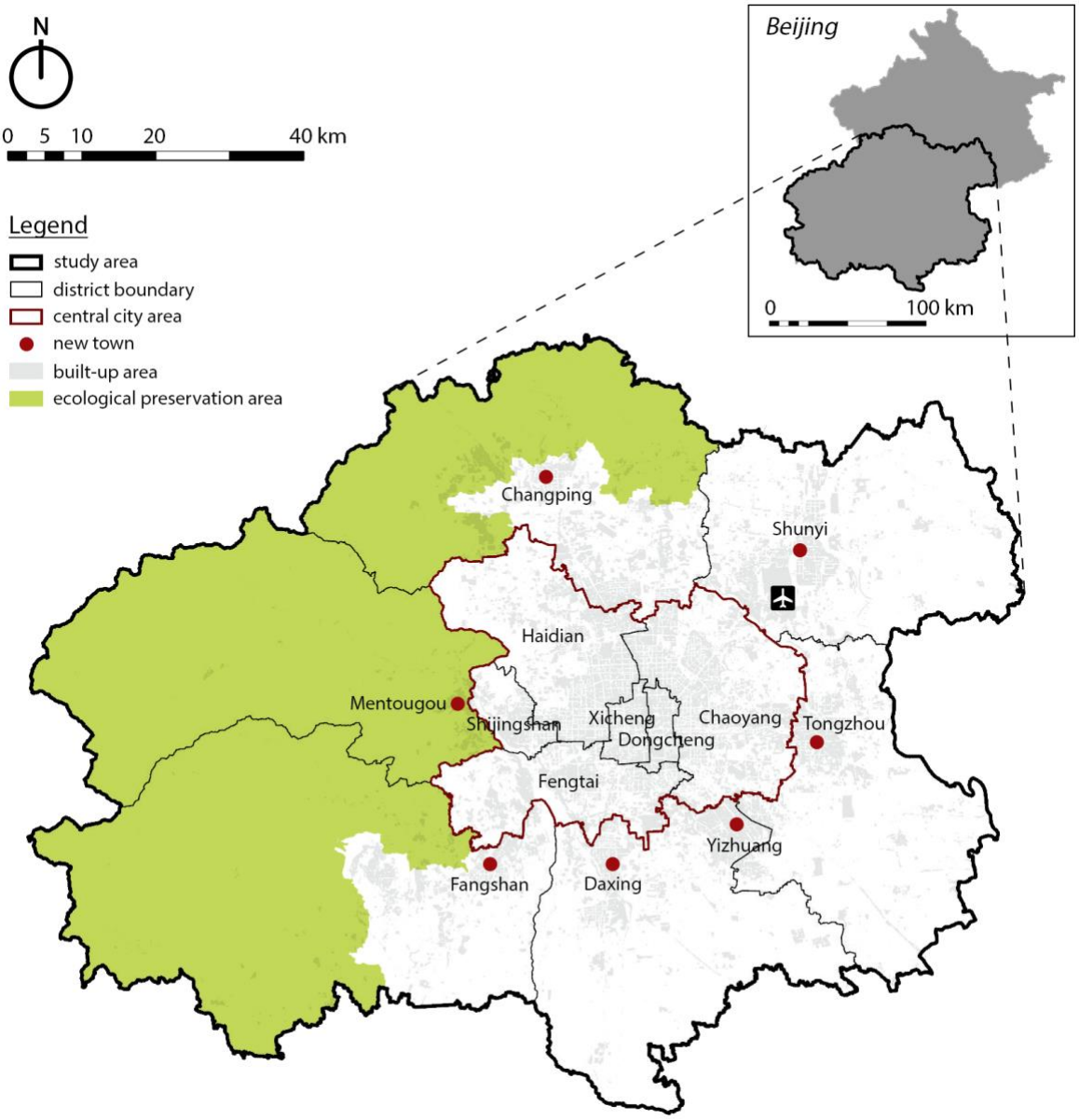
Given the declining informal rental stock (Huang and Yi, 2015; Liu and Wong, 2018; Mohabir et al., 2017; Wong et al., 2018; Wong and Liu, 2017) and the limited provision of formal public rentals (Huang and Tao, 2015), more low-income renters may shift to the formal rental market to look for housing in the coming years. While there are numerous empirical studies on rentals in the informal market (Harten and Kim, 2018; Huang and Yi, 2015; Kim, 2016; Wang et

al., 2009; Wu, 2002; Yu and Cai, 2013; Zheng et al., 2009) and on public rentals provided by the government (Huang and Tao, 2015; Lin et al., 2014), little is known about rentals in the formal market. This paper aims to fill the gap by asking the following questions: Where are the affordable FPRs? To what extent are they segregated from other FPRs? How did the spatial distribution of affordable FPRs change in recent years? I address these questions by examining the changing patterns of affordable FPRs in Beijing between 2015 and 2021.

3 Study area and data

The city of Beijing had a population of 21.7 million and a land area of 16,410 square kilometers as of 2015. The case study area includes twelve districts of the city with a population of 19.9 million, accounting for 93% of the total population (Figure 2-1). The twelve districts administer 257 sub-districts (*jiedao/xiang/zhen*). Subdistricts are the finest geographic level reported in publicly accessible government statistical yearbooks. Six inner districts constitute the central city area--a densely populated area that has remained the focus of urban policy for decades. Seven suburb subdistricts, as derivatives of Beijing's 2020 master plan, function as the economic subcenters surrounding the central city area[5]. The northern and western mountainous part of the city has been designated as the ecological preservation area since 2005, where the preservation of natural resources is set as the priority in local development agendas.

Figure 2-1. The study area



The Beijing municipal government publishes the average per capita disposable incomes for households in the bottom 20%, 20th to 40th percentile, 40th to 60th percentile, and top 20% of the income distribution every year. In this study, I defined the low-income population as households in the bottom 40% of the income distribution. In 2015, the lower-income population

had a larger average household size of 3.1 and a lower per-capita disposable income of 25,656 yuan (approximately 4,136 U.S. dollars in 2015) than the city's average (Table 2-2). The increasing gap between the mean income of the bottom 40 percentile and the overall mean indicates an increase in citywide income inequality in the 6-year period.

Table 2-2. The bottom 40% vs. all households, 2015 and 2021.

	Number of households (million)		Mean household size		Mean per capita disposable income (yuan)	
	2015	2021	2015	2021	2015	2021
The bottom 40%	3.1	3.1	3.1	n/a	25,656	38,641
All households	7.8	7.8	2.8	2.8	51,360	80,046

Source: Beijing Municipal Bureau of Statistics (2016, 2022)

Census surveys in China are conducted every ten years and cannot capture short-term changes in the built environment. In contrast, data from the real estate brokerages can reflect immediate changes in the property market. This study takes advantage of data from the online rental listings to examine the spatial dynamics of Affordable formal rentals in the formal market between 2015 and 2021.

I access the rental listings from Lianjia (http://bj.lianjia.com), which is the major real estate brokerage company in Beijing. In 2014, Lianjia signed a pledge affirming that all their rental units are legal and comply with the municipal regulations (Liu and Zhong, 2014), which, to a great extent, ensures the formality of the rental information they posted online. The rental listing data include information on the unit's geographical location, floor area (in square meters), and monthly rent. From the raw data set, I removed items that were duplicates, items that contained invalid or incomplete information, and items that were not about residential units but storage or commercial spaces. After cleaning, I obtained property information on 133,883 rental units in 2015 and

201,381 rental units in 2021. Point of interest (POI)[6] data from AutoNavi--a Chinese navigation service provider--were also used in this study to compute the rentals' accessibility to public services and amenities.

4 Methods

Affordable rent

Defining the affordable rental price should take the socioeconomic status of urban residents, family size, number of dependent children, and other factors into account. But the limited availability of fine-grained demographic data constrained our ability to calculate a household-tailored affordable rent threshold. Western housing studies often use 30% of income as the upper limit of affordability, suggesting that families or individuals who spend more than 30 percent of their monthly income on housing as financially burdened (Leishman and Rowley, 2012; Schwartz, 2014; Stone, 2006). The 30 percent of income measure has also been adopted by the U.S. Department of Housing and Urban Development as their standard for housing affordability (Schwartz, 2014). While using a fixed ratio to measure housing affordability can be seen as arbitrary, it does provide a mathematically simple indicator that can be "compared across time and space (Stone, 2006: 162)." To make our case comparable to studies in other countries and also feasible given limited data availability, I define rents as affordable if they are lower than 30% of the household disposable income.

I compute the upper limit of the monthly affordable rent per square meters using the formula:

$$r = \frac{0.3c}{a} \tag{1}$$

where *r* represents the upper limit of monthly affordable rent per square meters (yuan/m^2); *c* denotes the mean per capita disposable income of the low-income households; *a* is the minimum housing area standard (m^2 per capita) set by the municipal government in its public rental housing regulations (BMCHURD, 2011).

Based on data from the Beijing statistical yearbook, the monthly disposable income was 2,138 yuan per capita in 2015, and 3,220 yuan per capita in 2021. The minimum housing area is 15 m^2 per capita according to local regulations. Accordingly, the upper limit of the monthly affordable rent per square meters is 42.76 yuan/m^2 for 2015, and 64.40 yuan/m^2 for 2021.

Measures of segregation

I measure the segregation of affordable FPRs from two aspects: the level of *concentration* of Affordable formal rentals and the degree of *unevenness* of the distribution of Affordable formal rentals. The local Moran's I index (*I*) developed by Anselin (1995) is employed to capture the spatial concentration of affordable units. Local Moran's I is one of the Local Indicators of Spatial Association (LISAs) that can help to identify areas where the share of affordable rentals is unusually high/low. The equation for *I* is:

$$I_i = \frac{x_i - \bar{X}}{S_i^2} \sum_{j=1, j\neq i}^{n} w_{i,j}(x_j - \bar{X}) \quad (2)$$

where x_i is the share of affordable rental units in the subdistrict i, $\bar{X}$ is the mean of the affordable unit share in all subdistricts, $w_{i,j}$ is the spatial weight between subdistrict i and j.

$$S_i^2 = \frac{\sum_{j=1, j\neq i}^{n}(x_j - \bar{X})^2}{n-1} \quad (3)$$

with n equating to the total number of subdistricts in a year.

The subdistricts can be divided into four categories according to *I*: high-high (HH), low-low (LL), low-high (LH), and high-low (HL). HH subdistricts are "hot spots" that represent areas where the share of affordable rentals at the subdistrict and its surroundings are higher than average. LL subdistricts are "cold spots" that represent areas where the share of affordable rentals at the subdistrict and its surroundings are lower than average. LH subdistricts are "doughnuts" where the focal subdistrict displays a low value but its surroundings have high values. Conversely, HL subdistricts are "diamonds in the rough" where the focal subdistrict display a high value but its surroundings have low values.

The index of dissimilarity (*D*), the most widely used measure in the study of residential segregation (Allen et al., 2015; Krieger et al., 2017; Li and Wu, 2008; Mulekar et al., 2008), was employed to assess the level of the uneven distribution of affordable FPRs. *D* shows the proportion of affordable FPRs that would have to relocate to achieve an even distribution (Massey and Denton, 1988). *D* ranges between 0 and 1. In our case, a *D* equal to 1 indicates that the affordable FPRs and the non-affordable FPRs are completely isolated from each other, and a *D* equal to 0 indicates that the two groups are intermingled evenly. To calculate *D*, I create a grid with 1 by 1 km horizontal and vertical spacings over the study area and join the rental listing point features to each grid cell. The equation for *D* is:

$$D = \frac{1}{2}\sum_{i=1}^{N}\left|\frac{b_i}{B} - \frac{w_i}{W}\right| \quad (4)$$

where b_i represents the number of affordable FPRs in the grid cell *i*; *B* represents the number of affordable FPRs in the sub-district that the grid cell is in; w_i represents the number of non-affordable FPRs in the grid cell *i*; *W* represents the number of non-affordable FPRs in the sub-district that the grid cell is in.

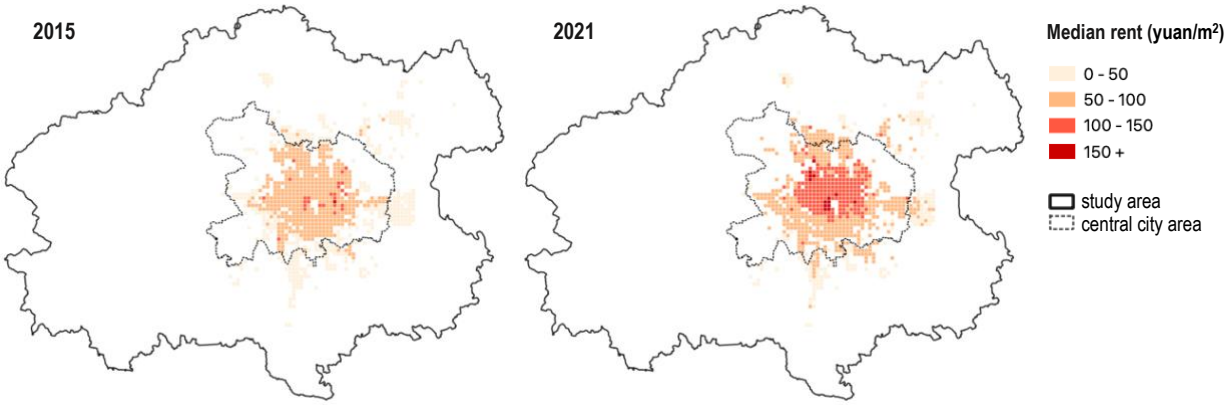
Researchers have come to a consensus after a considerable debate that a *D* under 0.25 indicates little or no segregation, while a *D* greater than 0.60 is interpreted as a high level of segregation (Gregory et al., 2011). Using these criteria, I categorize the sub-districts in our study as having low-, medium-, and high-levels of uneven distribution of affordable FPRs. In a neighborhood with a high-level of uneven distribution of affordable rentals, over 60% percent of affordable FPRs have to move from the grid cell where the group is overrepresented to other cells to eliminate segregation.

5 The segregation of affordable rentals in the formal market

Declining affordable FPRs stock in central city

The share of affordable FPRs in the central city area declined between 2015 and 2021. I identified 9,132 affordable FPRs from the central city area in 2015 and 7,221 affordable FPRs from the central city area in 2021, accounting for 9% and 5% of the total central-city FPRs in each year. The shrinking share of affordable FPRs indicates a greater difficulty for lower-income renters to find housing in the central city without causing affordability problems.

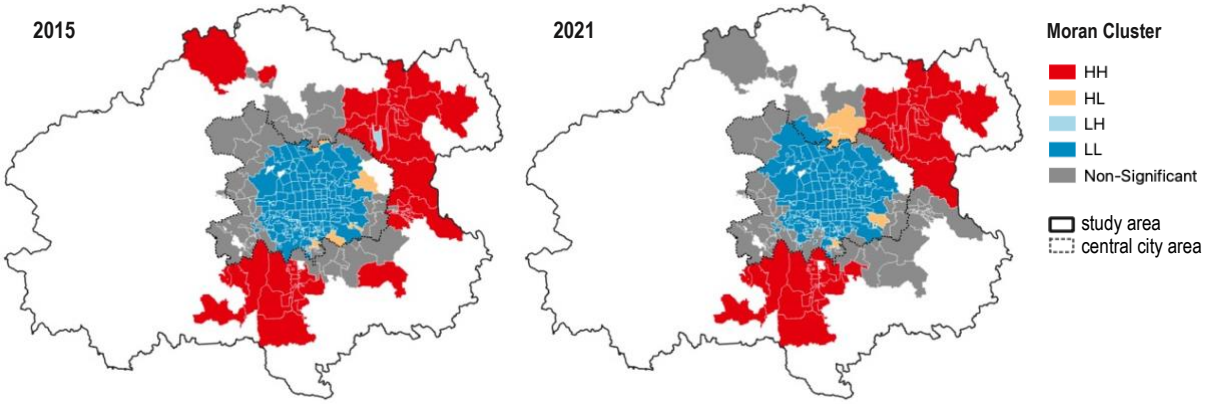
Figure 2-2. Median rent of FPRs (yuan/m^2), by grid cell



Notes: Only cells with at least 10 rental units in both years are included. Rents in 2021 are adjusted for inflation using the annual city-level CPIs for rental housing in 2015 yuan. Source: Lianjia.

Rental prices in the central city area increased drastically in the six-year period (Figure 2-2). The percentage of grid cells with median rent no less than 100 yuan/m^2 grew from 4% to 27% between 2015 and 2021. The stock of affordable FPRs also decreased in the central city area between 2015 and 2021. In 2015, 26% of the affordable FPRs were in the central city area. The proportion dropped down to 13% in 2021. The housing affordability decline may be related to the redevelopment of informal settlements in the central city area. The removal of informal settlements reduces the existing affordable rental stock, and the decline in affordable rental stock is likely to drive up rents in the central city area.

Figure 2-3. The concentration of affordable FPRs, by subdistrict (N=188)



Notes: Only subdistricts with at least 10 FPRs in both years are included. Threshold for statistical significance: $p<0.05$. Source: Lianjia.

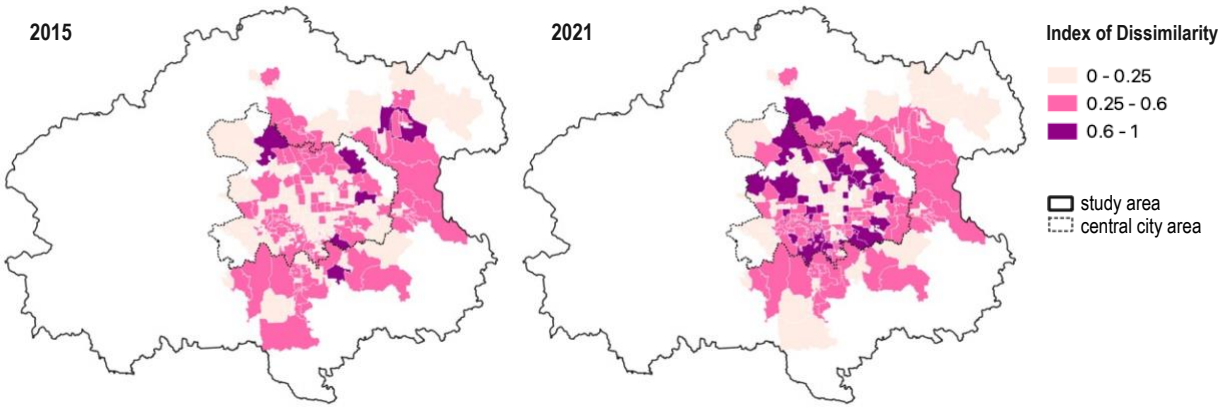
Clusters of affordable FPRs in the study area have been disappearing over the years (Figure 2-3). In 2015, there were clusters of subdistricts with HH categorization in the northwest and southeast side of the study area, indicating spatial concentrations of subdistricts with high shares of affordable FPRs. These two affordable rental hot spots disappeared in 2021. The number of subdistricts with a statistically significant HH categorization (affordable housing hot spots) decreased from 40 to 34 from 2015 to 2021. At the same time, subdistricts with a statistically significant LL categorization (affordable housing cold spots) increased from 102 to 106.

Accompanied by the removal of informal rentals in the central city area, the declining share of affordable FPRs implies greater risks of displacement among the lower-income renters. The potential migration of lower-income tenants from central city to bedroom suburb may result in longer commuting times and a heavier burden on the transit system.

Uneven distribution of affordable FPRs

As the number of affordable FPRs in the central city area decreased from 2015 to 2021, the remaining affordable FPRs in the area had become more unevenly distributed (Figure 2-4). Subdistricts with a relatively even distribution of affordable FPRs ($D < 0.25$) decreased from 75 to 57 in the central city area, while subdistricts with a highly uneven distribution of affordable FPRs ($D > 0.6$) increased from 4 to 28 in the same area. This suggests an increasing spatial isolation of affordable FPRs from the higher priced FPRs in prime locations. To put it in another way, no matter where the low-income renters end up living in the central city, their residences tend to be distanced from higher priced rentals. The spatial isolation of affordable FPRs is likely to reinforce the physical and social segregation of the low-income population, just as the informal settlements.

Figure 2-4. The uneven distribution of affordable FPRs, by subdistrict (N=179)



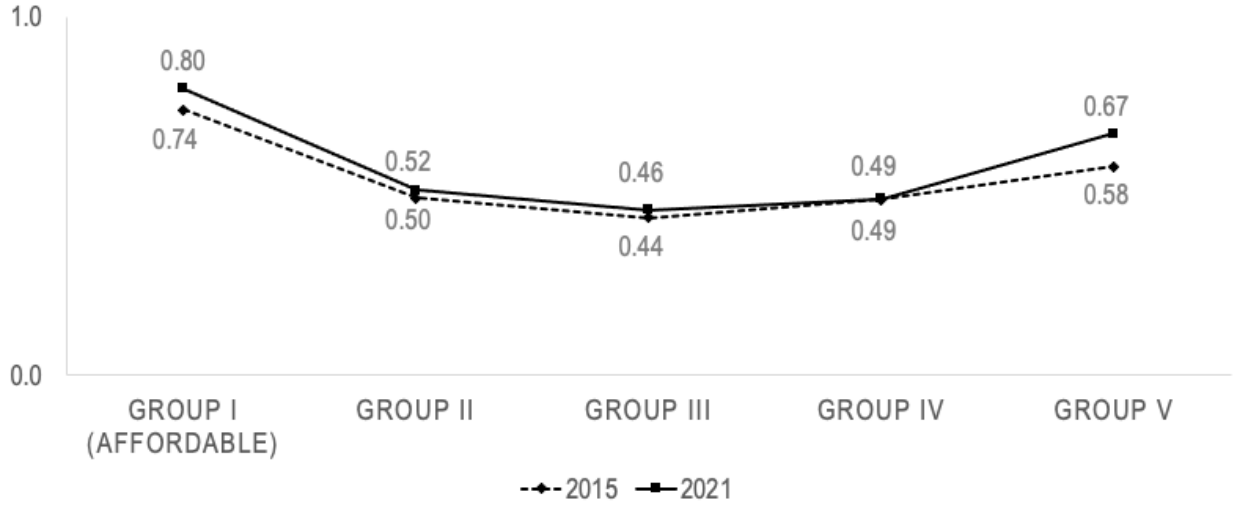
Note: Only cells with at least 10 FPRs in both years are included. Source: Lianjia.

Most segregated FPRs

The intensified segregation of private rentals is not occurring across all price points in the market. I break down the sample into 5 groups based on the rental price: Group I corresponds to the affordable FPRs; Group II to V were created by splitting the rest of the sample into four groups according to quartile range of rents (per square meters). City-level *D* for each of these groups is computed and compared between 2015 and 2021.

As shown in Figure 2-5, the affordable FPRs are the most segregated compared to groups of higher-priced FPRs. The affordable rentals became more unevenly distributed from 2015 to 2021 as its *D* increased from 0.74 to 0.80. The results suggest that, on a city level, there is a consistent pattern of segregation of affordable FPRs and the integration of medium-priced FPRs. FPRs of other price ranges, even the ones of the highest price range, have *D*s lower than 0.70 in both years. Both affordable (Group I) and luxury FPRs (Group V) became more isolated in the six-year period, indicating the spatial segregation of FPRs on both ends of the rent spectrum.

Figure 2-5. City-level Index of Dissimilarity (*D*)



Note: Only subdistricts with at least 10 FPRs in both years are included. Source: Lianjia.

Poor access to public services and amenities

Proximity to public transit and other public services are essential to lower-income households due to their lack of car ownership (Li et al., 2010). However, abundant research in the western world indicates that public services and amenities are capitalized into the price of land and the housing atop of it, making the housing in proximity to those services and amenities relatively less affordable (Dawkins and Moeckel, 2016; Heyman and Sommervoll, 2019; Rosen, 1974). In China, there is also strong evidence showing that variations in housing prices can be explained by variations in the housing units' physical and locational attributes (Hu et al., 2014; Zheng and Kahn, 2013; Zou and Chau, 2015). Our analysis demonstrates a pattern consistent with previous studies: the affordable FPRs have poor access to public services and amenities compared to higher-priced FPRs (Table 2-3).

I use the POI data in 2014 to compute distances to the nearest subway station and the nearest top elementary school, and numbers of restaurants and healthcare facilities within a one-kilometer radius (10-minute walking distance) for the five rental groups in 2015. Among these groups, the affordable FPRs, on average, have the longest distances to the nearest subway stop and top elementary school, the lowest numbers of restaurants and healthcare facilities within a one-kilometer radius.

For low-income renters who are taking on or looking for entry-level jobs, proximity to public transit can increase the number of accessible jobs and reduce their daily commuting time. Before the massive city-wide crackdown on informal rentals, low-income workers can gain access to public transportation and urban amenities by renting from the informal market. However, the regulation of the informal sector and the redevelopment of informal settlements have made informal rentals less an option for the low-income workers. If the municipal government continues

to uproot the informal sector without complementary strategies to maintain housing affordability, the lower-income tenants are likely to end up in more isolated neighborhoods with poor public services.

Table 2-3. Access to public services and amenities, by rental group

	Group I	Group II	Group III	Group IV	Group V
Distance to subway station (m)	1,857 (1,634)	1,221 (970)	951 (719)	785 (536)	732 (540)
Distance to top elementary school (m)	2,522 (2,382)	1,642 (1,383)	1,253 (1,054)	882 (834)	812 (738)
Number of restaurants within a 1 km radius	77 (72)	110 (82)	181 (117)	267 (146)	337 (195)
Number of healthcare facilities within a 1 km radius	4.4 (3.4)	4.7 (3.4)	6.2 (4.0)	7.6 (4.4)	8.2 (6.0)
N	34,476	24,860	24,859	24,854	24,834

Note: standard deviation in the bracket. The numbers are calculated using 2014 POI data and 2015 FPR data.

6 Discussion and Conclusion

With the continued removal of informal settlements, FPRs are going to play a more important role in the provision of affordable housing for lower-income population. This paper examines the changing spatial distribution of affordable FPRs in Beijing between 2015 and 2021, using data collected from online rental listings. I measure the segregation of affordable FPRs by the extent to which they are concentrated and unevenly distributed within the city. I also compare the dissimilarity index of affordable FPRs with the ones of higher-priced FPRs. Our study finds that: (1) the affordable FPRs became less available and more isolated from higher-priced FPRs in the central city area in the six-year period; (2) when compared across different price ranges, the affordable FPRs ended up being the most segregated in both 2015 and 2021, with a city-level index of dissimilarity of 0.74 and 0.80 respectively; (3) consistent with the existing literature, the

affordable FPRs tend to locate in places with poor access to public services and amenities. Overall, it has become increasingly difficult for low-income households to find a place to live in the city.

Decreasing housing affordability has long been a challenge for the low-income renters in Beijing (Gu, 2001; Huang and Yi, 2015; Zheng et al., 2009). As the national capital, Beijing has gone through rapid population growth in the past three decades. Between 1990 and 2021, Beijing's population increased from 10.9 million to 21.9 million[7]. The land and housing reforms in the 1990s, followed by a booming demand for housing, greatly drove up housing prices in the city. While the municipal government implemented a series of affordable housing policies and programs, most of the benefits went to middle-to-high-income households and homeowners (Hsing, 2012; Huang, 2012). Between 2012 and 2018, the accumulated government investment in public rental housing was 64 billion yuan—only one-sixth of the amount of money that the municipal government had put in the resettlement housing for displaced homeowners (BMCHURD, 2019). By uprooting the informal sector without considering low-income people's housing needs, the municipal government is implicitly depriving their rights to live in the central city area.

The informal sector exists for a reason. Even with poor living conditions, an informal rental close to public transit or workplace can be of great use value to a low-income worker. It is the low-income people's demand for affordable housing at central locations that created the informal sector in the first place. Researchers from different countries have demonstrated that the interconnection between the formal and informal sectors exists in the labor markets, financial markets, and housing markets (Ayyagari et al., 2010; Burgers, 1998; Roy, 2005; Williams, 2008). The demolition of the informal settlement without sufficient provision of affordable housing sacrifices the livelihood of the poor tenants for the city's pursuit of economic growth.

There is a clear need for policies that focus on providing affordable housing for the lower-income population, especially in central locations. There are currently two affordable housing programs in Beijing that aim to address the housing needs of low-income renters. One is the underfunded public rental housing program mentioned above, and the other is a rental subsidy program initiated in 2015 (BMCHURD, 2015). The latter provides qualified households with monthly subsidies to rent housing on the formal market. While the program makes it possible for the lower-income population to rent market-rate housing with better access to public transit and employment, it is only open to individuals with local household registration (*hukou*). Yet, a well-designed rental subsidy program should consider the housing needs of residents regardless of their household registration status. To maintain housing affordability of the low-income renters, increased investment in public rental housing and wider coverage of the rental subsidy program are both essential.

It is important to note some limitations of this research. First, while the real estate brokerage company promised to make sure that all its rental units are legal, there is still a possibility of imperfect implementation where informal units get into the online listings. Second, the rentals in our dataset were still on the market on the collection date, which means that they had not yet been rented. Thus, the data demonstrate a near-future residential pattern instead of an existing one. Third, the data used in this study only represents rental units listed through the real estate brokerage website, and it misses out units that are never publicly advertised and are instead rented through personal networks. More analysis is thus valuable to move beyond the online listings and explore FPRs rented through other channels. Nevertheless, our analysis sheds light on the increasing segregation of affordable FPRs in Chinese cities.

Notes

1. Migrants refer to people without local household registration (*hukou*) in the city where they live.

2. The distinction between formal and informal is a contractual one and not a structure-type one. The formal/informal divide can and does occur within urban villages.

3. Group rentals (*qun zu fang*) are private rental units that have been illegally converted to overcrowded dormitories.

4. Huang & Yi (2015) found that tenants who lived in basement rentals are socially segregated from the residents who live above ground. Oreglia (2009) found that low-income migrant women who lived in urban neighborhoods rarely interact with their urban neighbors.

5. The seven new towns, except Yizhuang, are pre-existing seats of the district governments. Yizhuang is a state-level economic and technological development zone that was established in 1992.

6. A point of interest (POI for short) is commonly used in cartography to represent a particular feature using an icon that occupies a particular geographical point (e.g. a restaurant, a shopping mall, or a hospital).

7. Beijing's population decreased between 2016 and 2018 due to the municipal government's efforts to control population growth, especially in the central city area. See Wong et al. (2018) for details.

References

Allen R, Burgess S, Davidson R, et al. (2015) More reliable inference for the dissimilarity index of segregation. *The Econometrics Journal* 18(1). Oxford Academic: 40–66. DOI: 10.1111/ectj.12039.

Anselin L (1995) Local Indicators of Spatial Association—LISA. *Geographical Analysis* 27(2): 93–115. DOI: 10.1111/j.1538-4632.1995.tb00338.x.

Ayyagari M, Demirgüç-Kunt A and Maksimovic V (2010) Formal versus Informal Finance: Evidence from China. *The Review of Financial Studies* 23(8). [Oxford University Press, Society for Financial Studies]: 3048–3097.

Beijing Municipal Bureau of Statistics (2016) *Beijing Statistical Yearbook 2016*. Beijing, China: China Statistical Press. Available at: https://nj.tjj.beijing.gov.cn/nj/main/2016-tjnj/zk/indexch.htm.

Beijing Municipal Bureau of Statistics (2022) *Beijing Statistical Yearbook 2022*. Beijing, China: China Statistical Press. Available at: https://nj.tjj.beijing.gov.cn/nj/main/2022-tjnj/zk/indexch.htm.

BMCHURD (2011) Guidance on the application, review, and allocation of public rental housing in Beijing. Available at: http://zjw.beijing.gov.cn/bjjs/xxgk/qtwj/fwglltz/353852/index.shtml (accessed 30 January 2020).

BMCHURD (2015) The Beijing municipal government launched a new rental subsidy program. Available at: http://zjw.beijing.gov.cn/bjjs/xxgk/xwfb/317882/index.shtml (accessed 24 June 2020).

BMCHURD (2019) White Paper for Urban and Rural Development in Beijing 2019. Available at: http://zjw.beijing.gov.cn/bjjs/xxgk/zwdt/53599902/index.shtml (accessed 8 September 2020).

Burgers J (1998) Formal determinants of informal arrangements: housing and undocumented immigrants in Rotterdam. *Journal of Ethnic and Migration Studies* 24(2): 295–312. DOI: 10.1080/1369183X.1998.9976634.

Byrne JP and Diamond M (2007) Affordable Housing, Land Tenure, and Urban Policy: The Matrix Revealed. *Fordham Urban Law Journal* 34: 527.

Chen Y (2018) China ploughs $144 billion into shantytown redevelopment so far in 2018. *Reuters*, 16 August. Available at: https://www.reuters.com/article/us-china-economy-property-idUSKBN1L10WC (accessed 27 April 2020).

Chu C, Nomura R and Mori S (2019) Actual Conditions of Mixed Public–Private Planning for Housing Complexes in Beijing. *Sustainability* 11(8): 2409. DOI: 10.3390/su11082409.

Dawkins C and Moeckel R (2016) Transit-Induced Gentrification: Who Will Stay, and Who Will Go? *Housing Policy Debate* 26(4–5). Routledge: 801–818. DOI: 10.1080/10511482.2016.1138986.

Fan Y, Allen R and Sun T (2014) Spatial mismatch in Beijing, China: Implications of job accessibility for Chinese low-wage workers. *Habitat International* 44: 202–210. DOI: 10.1016/j.habitatint.2014.06.002.

Gao C (2017) Beijing: How Does a Tragic Fire Turn Into the Mass Eviction of Migrant Workers? *The Diplomat*, 27 November. Available at: https://thediplomat.com/2017/11/beijing-how-does-a-tragic-fire-turn-into-the-mass-eviction-of-migrant-workers/ (accessed 9 March 2020).

Gregory D, Johnston R, Pratt G, et al. (2011) *The Dictionary of Human Geography*. Hoboken, NJ: John Wiley & Sons.

Gu C (2001) Social polarization and segregation in Beijing. *Chinese Geographical Science* 11(1): 17–26. DOI: 10.1007/s11769-001-0003-7.

Harten JG and Kim AM (2018) The Price of Crowding: Modeling the Rental Market for Overcrowded Housing in Shanghai. *USC Lusk Center for Real Estate Research Brief*. Available at: https://lusk.usc.edu/sites/default/files/research_briefs/The%20Price%20of%20Crowding.pdf.

Harvey D (2007) *A Brief History of Neoliberalism*. Oxford University Press.

He S, Zhang M and Wei Z (2020) The state project of crisis management: China's Shantytown Redevelopment Schemes under state-led financialization. *Environment and Planning A: Economy and Space* 52(3). SAGE Publications Ltd: 632–653. DOI: 10.1177/0308518X19882427.

Heyman AV and Sommervoll DE (2019) House prices and relative location. *Cities* 95: 102373. DOI: 10.1016/j.cities.2019.06.004.

Hsing Y (2012) *The Great Urban Transformation: Politics of Land and Property in China*. 1st edition. Oxford: Oxford University Press. DOI: 10.1093/acprof:oso/9780199568048.001.0001.

Hu H, Geertman S and Hooimeijer P (2014) Amenity value in post-industrial Chinese cities: the case of Nanjing. *Urban Geography* 35(3). Routledge: 420–439. DOI: 10.1080/02723638.2014.886419.

Hu X and Kaplan DH (2001) The Emergence Of Affluence In Beijing: Residential Social Stratification In China's Capital City. *Urban Geography* 22(1): 54–77. DOI: 10.2747/0272-3638.22.1.54.

Huang Y (2012) Low-income Housing in Chinese Cities: Policies and Practices*. *The China Quarterly* 212. Cambridge University Press: 941–964. DOI: 10.1017/S0305741012001270.

Huang Y and Tao R (2015) Housing migrants in Chinese cities: current status and policy design. *Environment and Planning C: Government and Policy* 33(3): 640–660. DOI: 10.1068/c12120.

Huang Y and Yi C (2015) Invisible migrant enclaves in Chinese cities: Underground living in Beijing, China. *Urban Studies* 52(15). SAGE Publications Ltd: 2948–2973. DOI: 10.1177/0042098014564535.

Kim AM (2016) The extreme primacy of location: Beijing's underground rental housing market. *Cities* 52: 148–158. DOI: 10.1016/j.cities.2015.11.027.

Knowles G (2016) Life for China's migrant workers: dorm that looks like prison. *South China Morning Post (SCMP)*, 27 May. Available at: https://www.scmp.com/magazines/post-magazine/article/1955023/life-chinas-migrant-workers-dorm-looks-prison.

Krieger N, Feldman JM, Waterman PD, et al. (2017) Local Residential Segregation Matters: Stronger Association of Census Tract Compared to Conventional City-Level Measures with Fatal and Non-Fatal Assaults (Total and Firearm Related), Using the Index of Concentration at the Extremes (ICE) for Racial, Economic, and Racialized Economic Segregation, Massachusetts (US), 1995–2010. *Journal of Urban Health : Bulletin of the New York Academy of Medicine* 94(2): 244–258. DOI: 10.1007/s11524-016-0116-z.

Kroeber AR (2016) *China's Economy: What Everyone Needs to Know*®. Oxford University Press.

Lai Y, Peng Y, Li B, et al. (2014) Industrial land development in urban villages in China: A property rights perspective. *Habitat International* 41: 185–194. DOI: 10.1016/j.habitatint.2013.08.004.

Lee J and Zhu Y (2006) Urban governance, neoliberalism and housing reform in China. *The Pacific Review* 19(1). Routledge: 39–61. DOI: 10.1080/09512740500417657.

Leishman C and Rowley S (2012) Affordable housing. In: *The Sage Handbook of Housing Studies*. SAGE Publications Ltd, pp. 379–96.

Li B and Kong X (2019) The Beijing municipal government will continue to focus on the dispersal of 'non-capital' functions and the fight against "urban diseases" in 2019. Available at: http://m.xinhuanet.com/2019-02/20/c_1124142366.htm (accessed 30 January 2020).

Li J, Walker JL, Srinivasan S, et al. (2010) Modeling Private Car Ownership in China: Investigation of Urban Form Impact Across Megacities. *Transportation Research Record* 2193(1). SAGE Publications Inc: 76–84. DOI: 10.3141/2193-10.

Li Z (2010) Housing Conditions and Housing Determinants of New Migrants in Chinese Cities. *Chinese Sociology & Anthropology* 43(2). Routledge: 70–89. DOI: 10.2753/CSA0009-4625430204.

Li Z and Wu F (2008) Tenure-based residential segregation in post-reform Chinese cities: a case study of Shanghai. *Transactions of the Institute of British Geographers* 33(3): 404–419. DOI: 10.1111/j.1475-5661.2008.00304.x.

Lin Y, De Meulder B, Cai X, et al. (2014) Linking social housing provision for rural migrants with the redevelopment of 'villages in the city': A case study of Beijing. *Cities* 40: 111–119. DOI: 10.1016/j.cities.2014.03.011.

Liu R and Wong T (2018) Urban village redevelopment in Beijing: The state-dominated formalization of informal housing. *Cities* 72: 160–172. DOI: 10.1016/j.cities.2017.08.008.

Liu Y and Zhong Z (2014) Qianshu guifan fangwu zulin fuwu shixiang chengnuo: beijing muqian yi mopai 3.7 wanhu weifa qunzufang [Signing a pledge of conformity with market rental regulations: The Beijing municipal government has investigated 37,000 illegal group rentals]. *The Beijing News*, 23 April. Available at: http://epaper.bjnews.com.cn/html/2014-04/23/content_508088.htm?div=-1#fina (accessed 30 January 2020).

Liu Z (2017) 19 killed as fire sweeps through Beijing housing block. *South China Morning Post*, 19 November. Hong Kong. Available at: https://www.scmp.com/news/china/society/article/2120558/19-killed-fire-sweeps-through-beijing-accommodation-block (accessed 9 March 2020).

Ma LJC and Xiang B (1998) Native Place, Migration and the Emergence of Peasant Enclaves in Beijing. *The China Quarterly* (155). Cambridge University Press: 546–581.

Massey DS and Denton NA (1988) The Dimensions of Residential Segregation. *Social Forces* 67: 281.

Mohabir N, Jiang Y and Ma J (2017) Chinese floating migrants: Rural-urban migrant labourers' intentions to stay or return. *Habitat International* 60: 101–110. DOI: 10.1016/j.habitatint.2016.12.008.

Mu Z (2004) Beijing tackles enclaves of poverty. *China Daily*, 30 September. Available at: http://www.chinadaily.com.cn/english/cndy/2004-09/30/content_378880.htm (accessed 30 January 2020).

Mulekar MS, Knutson JC and Champanerkar JA (2008) How useful are approximations to mean and variance of the index of dissimilarity? *Computational Statistics & Data Analysis* 52(4): 2098–2109. DOI: 10.1016/j.csda.2007.07.007.

National Bureau of Statistics of China (2012) *Tabulation on the 2010 Population Census of the People's Republic of China*. China Statistics Press Beijing, China.

Oreglia E (2010) Creating Community, Rejecting Community: Migrant Women in Beijing. *The Journal of Community Informatics*. DOI: 10.15353/joci.vi.2430.

Park A and Wang D (2010) Migration and urban poverty and inequality in China. *China Economic Journal* 3(1). Routledge: 49–67. DOI: 10.1080/17538963.2010.487351.

Peng Y, Chang W, Zhou H, et al. (2010) Factors associated with health-seeking behavior among migrant workers in Beijing, China. *BMC Health Services Research* 10(1): 69. DOI: 10.1186/1472-6963-10-69.

Rao P (2011) Beijing 2015 nian qian ni xiaomie "Chengzhongcun"; Muqian haiyou baiyu ge [Beijing Plans to Eradicate All the 'urban villages' before 2015; Till Now There Remains One Hundred Villages Untouched]. *The Beijing News*, 5 November. Available at: https://house.qq.com/a/20111105/000006.htm.

Rosen S (1974) Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy* 82(1). The University of Chicago Press: 34–55. DOI: 10.1086/260169.

Roy A (2005) Urban Informality: Toward an Epistemology of Planning. *Journal of the American Planning Association* 71(2). Routledge: 147–158. DOI: 10.1080/01944360508976689.

Schwartz AF (2014) *Housing Policy in the United States*. 3rd edition. New York: Routledge.

Shi Q, Liu T, Musterd S, et al. (2017) How social structure changes in Chinese global cities: Synthesizing globalization, migration and institutional factors in Beijing. *Cities* 60: 156–165. DOI: 10.1016/j.cities.2016.09.001.

Stone ME (2006) What is housing affordability? The case for the residual income approach. *Housing Policy Debate* 17(1). Routledge: 151–184. DOI: 10.1080/10511482.2006.9521564.

The Economist (2017) In Beijing, the rich and poor are shocked. *The Economist*, 30 November. Available at: https://www.economist.com/china/2017/11/30/in-beijing-the-rich-and-poor-are-shocked (accessed 21 June 2020).

Tian L (2008) The Chengzhongcun Land Market in China: Boon or Bane? — A Perspective on Property Rights. *International Journal of Urban and Regional Research* 32(2): 282–304. DOI: 10.1111/j.1468-2427.2008.00787.x.

Wang Y (2016) *A Century of Change: Beijing's Urban Structure in the 20th Century*. Springer. Available at: https://link.springer.com/content/pdf/10.1007%2F978-3-319-39633-0.pdf.

Wang YP, Wang Y and Wu J (2009) Urbanization and Informal Development in China: Urban Villages in Shenzhen. *International Journal of Urban and Regional Research* 33(4): 957–973. DOI: 10.1111/j.1468-2427.2009.00891.x.

Williams CC (2008) A critical evaluation of competing representations of the relationship between formal and informal work. *Community, Work & Family* 11(1). Routledge: 105–124. DOI: 10.1080/13668800701785353.

Wong C, Qiao M and Zheng W (2018) 'Dispersing, regulating and upgrading' urban villages in suburban Beijing. *Town Planning Review* 89(6): 597–621. DOI: 10.3828/tpr.2018.41.

Wong T and Liu R (2017) Developmental Urbanism, City Image Branding and the "Right to the City" in Transitional China. *Urban Policy and Research* 35(2). Routledge: 210–223. DOI: 10.1080/08111146.2015.1122587.

Wu F (2002) Sociospatial Differentiation in Urban China: Evidence from Shanghai's Real Estate Markets. *Environment and Planning A: Economy and Space* 34(9). SAGE Publications Ltd: 1591–1615. DOI: 10.1068/a34196.

Wu F (2005) Rediscovering the 'Gate' Under Market Transition: From Work-unit Compounds to Commodity Housing Enclaves. *Housing Studies* 20(2). Routledge: 235–254. DOI: 10.1080/02673030342000331754.

Wu F (2015) Commodification and housing market cycles in Chinese cities. *International Journal of Housing Policy* 15(1). Routledge: 6–26. DOI: 10.1080/14616718.2014.925255.

Wu F and Logan J (2016) Do rural migrants 'float' in urban China? Neighbouring and neighbourhood sentiment in Beijing. *Urban Studies* 53(14). SAGE Publications Ltd: 2973–2990. DOI: 10.1177/0042098015598745.

Wu F and Webber K (2004) The rise of "foreign gated communities" in Beijing: between economic globalization and local institutions. *Cities* 21(3): 203–213. DOI: 10.1016/j.cities.2004.03.002.

Yu L and Cai H (2013) Challenges for housing rural-to-urban migrants in Beijing. *Habitat International* 40: 268–277. DOI: 10.1016/j.habitatint.2013.05.006.

Zeng T, Yang M, Li Y, et al. (2020) Export expansion and homeownership in China: Evidence from the China Household Finance Survey. *Cities* 104: 102765. DOI: 10.1016/j.cities.2020.102765.

Zhai Z, Duan C and Bi Q (2007) The floating population in Beijing: an update. *Population Research* 31(2): 30–40.

Zheng S and Kahn ME (2013) Does Government Investment in Local Public Goods Spur Gentrification? Evidence from Beijing. *Real Estate Economics* 41(1): 1–28. DOI: 10.1111/j.1540-6229.2012.00339.x.

Zheng S, Long F, Fan CC, et al. (2009) Urban Villages in China: A 2008 Survey of Migrant Settlements in Beijing. *Eurasian Geography and Economics* 50(4). Routledge: 425–446. DOI: 10.2747/1539-7216.50.4.425.

Zhu J (2019) *Urban Development in China under the Institution of Land Rights*. Routledge.

Zou GL and Chau KW (2015) Determinants and Sustainability of House Prices: The Case of Shanghai, China. *Sustainability* 7(4): 4524–4548. DOI: 10.3390/su7044524.

Chapter 3. Development for Whom? The Impact of State-led Redevelopment on Rental Housing Affordability in Beijing

Abstract

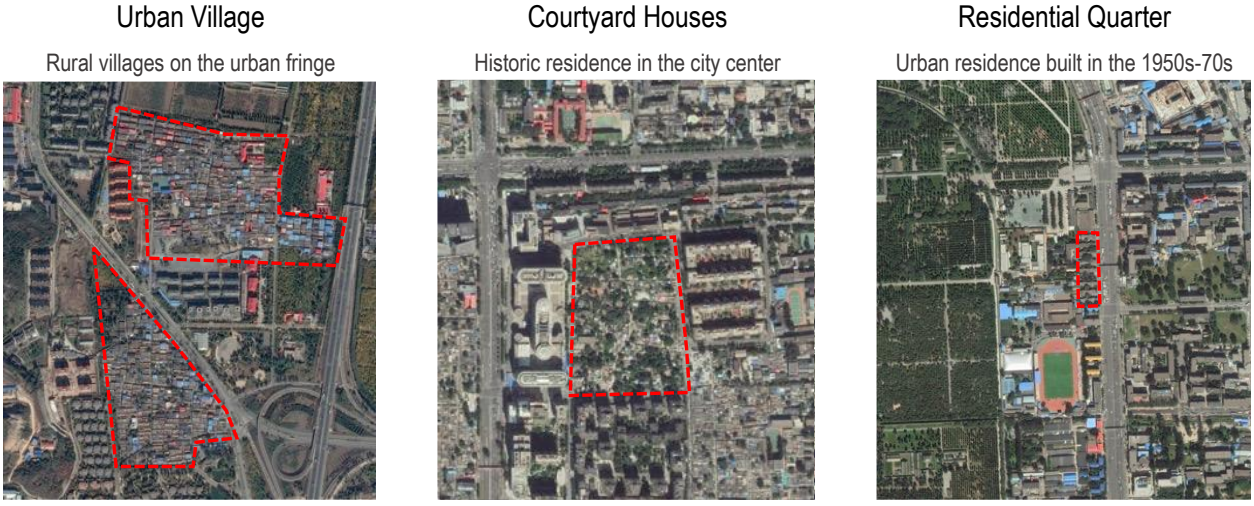
Since 2013, Shantytown Redevelopment Projects (SRPs) have been implemented city-wide in Beijing as an instrument to stimulate economic growth and improve the built environment. The SRPs, while being promoted as state-led welfare programs that improve people's living conditions, could also lead to the direct and indirect displacement of migrant renters. Using a unique data set compiled from the Beijing municipal government, the Chinese Census, and a real estate brokerage company, this study investigates the spatial-temporal patterns and outcomes of SRPs from 2013 to 2020. Logistic regression is used to examine the association between shantytown redevelopment and migrant share change. Difference-in-Differences (DID) regression is used to examine the impact of SRPs on housing affordability in neighboring areas. The results show that: (1) SRPs are associated with declines in the share of migrants, who are predominantly renters and are not eligible for compensation when the shantytown is redeveloped; (2) most shantytown homeowners have the option to resettle in the same subdistrict and are thus able to benefit from SRPs, while migrant renters face the risk of permanent displacement; (3) small- to medium-size SRPs increase the rent in the surrounding area by 3.6%, further reducing housing affordability for migrant renters. The findings shed light on the consequences of SRPs and suggest the necessity for complementing strategies to maintain rental housing affordability in neighborhoods that are undergoing shantytown redevelopment.

1 Introduction

On the evening of November 18th, 2017, a fire broke out in a two-story building in southern Beijing occupied by low-income migrant renters (The Economist, 2017). Nineteen people died, including seven children (Liu, 2017). The building was illegally constructed in an urban village to house migrant workers, violating local housing regulations. The Beijing municipal government soon started a 40-day cleanup operation of illegal rental units, which resulted in large-scale demolition of illegal building structures and displacement of migrant renters across the city (Gao, 2017). The cleanup operation is part of the Shantytown Redevelopment Projects (SRPs) that have continued for years in the city. The tragic fire provides the municipal government a strong motive to expand the demolition of urban villages and facilitate the implementation of SRPs.

Initiated in 2008 by the central government at the beginning of the global financial crisis (Li et al., 2018), the state government expects SRPs to help cities recover from economic downturns and improve people's living conditions (He et al., 2020). SRPs target "shantytowns" (*penghuqu*), a catch-all term that includes (1) urban villages, (2) dilapidated courtyard houses, and (3) aging residential quarters (Figure 3-1). Although shantytowns suffer from overcrowding, poor quality housing, and illegal construction, they serve as the major providers of affordable rental housing for low-income migrants in Chinese cities (Hao et al., 2011; Huang and Tao, 2015; Jin et al., 2021; Lin et al., 2014; Liu and Wong, 2018; Wong et al., 2018; Wu, 2016; Wu and He, 2005). Being the major providers of affordable housing in Chinese cities, shantytowns usually have more migrant population than local residents (ibid.). The population of migrant renters in a shantytown is usually 9-17 times greater than that of the local residents in the shantytown (Jin et al., 2021; Lin et al., 2014).

Figure 3-1. Three types of shantytowns



Source:
Google Earth 7.3, (2012) Shuangxin Village 39°57’25.96"N, 116°12’22.72”E, elevation 0ft. [Online] Available at: http://www.google.com/earth/index.html [Accessed 24 Feb 2023].
Google Earth 7.3, (2012) Xuanwai Dongli 39°53’ 45.95"N, 116°22’18.10”E, elevation 0ft. [Online] Available at: http://www.google.com/earth/index.html [Accessed 24 Feb 2023].
Google Earth 7.3, (2012) Tiantan Dongli 39°52’49.16"N, 116°24’51.15”E, elevation 0ft. [Online] Available at: http://www.google.com/earth/index.html [Accessed 24 Feb 2023].

At first glance, the state-led redevelopment program appears to have been a success: SRPs played vital roles in China’s economic revival and helped about 100 million people to move to better housing in the first decade of implementation (Zhao, 2018). Yet despite the success, the tactics of the state-initiated program raise questions about who actually benefit from SRPs. While shantytown residents are predominantly migrant renters (Wang, 2016; Ye and Wen, 2017), they are not eligible for compensation when the shantytown is redeveloped. The program improves the living conditions of shantytown homeowners through in-kind and monetary compensation, but it also poses the threat of displacement to shantytown renters who are excluded from the compensation process (BMCHURD, 2013; Wu, 2016). As a result, the current shantytown redevelopment policy creates an unequal distribution of benefits and burdens between homeowners and renters.

In Beijing, SRPs are used for a special purpose: dispersing 'non-capital functions.' The term 'non-capital functions' was first used by President Xi Jinping in 2014 to describe sectors that contradict the official vision of the capital city, which include but not limited to low-tech manufacturing, wholesale market, and informal businesses (PGBM, 2017b; Wong et al., 2018; Xinhua, 2015). These 'non-capital sectors' are usually located in shantytowns and provide jobs for migrant workers. About 4,000 low-tech manufacturing facilities, regional wholesale markets, and logistic centers were shut down between 2014 and 2022 (Yu, 2022). During this period, Beijing's central city population in is reduced by 15.1% (ibid.). While not explicitly stated in the official document, it is heavily implied that SRPs were used by the state to facilitate the dispersal of not only the 'non-capital' sectors, but also the migrant population who live in shantytowns and work in those sectors.

SRPs may also drive up the rent in the vicinity, making it harder for displaced renters to find affordable units in nearby neighborhoods. There are multiple ways in which SRPs can increase nearby rents. First, displaced low-income renters usually look for housing in nearby neighborhoods (Xu and Lin, 2019), which increases the demand for rental units in the vicinity. Second, the demolition of shantytowns reduces the local supply of rental units. The increasing demand and shrinking supply of rental housing may lead to an overall rent increase in the neighborhoods surrounding the SRP sites. Third, people tend to have an expectation of better residential environments and improvements in amenities in their neighborhood because of the initiation of a redevelopment (Ki and Jayantha, 2010; Peng and Tian, 2022). The expectation of neighborhood improvement is likely to be considered in the pricing of rental units. As a result of these processes, shantytown redevelopment and the related rent increase may force migrant renters to move out of their current neighborhoods, dispersing them to places that are further away from the city center.

Despite the potentially adverse impact of shantytown redevelopment, studies of the SRPs' impact on housing price using a quasi-experimental design have been rare. Existing studies are mostly descriptive and very few have examined the causal relationship between urban redevelopment and rental housing affordability. Prior research has looked at the interplay between stakeholders regarding project financing and compensation to homeowners (He et al., 2020; Li et al., 2018), the spatiotemporal patterns of SRPs (Yuan and Song, 2020), and the association between SRP funding and average housing price in third-tier cities[1] (Liu, 2019). Little attention has been paid to the impact of SRPs on rental housing affordability at the neighborhood level.

Using a unique data set compiled from the Beijing municipal government, the Chinese census, and a real-estate brokerage company (Lianjia), this study investigates the spatial-temporal patterns of SRPs from 2013 to 2020 and examines the impact of SRPs on nearby rental housing price with a Difference-in-Differences (DID) design. As a case study focusing on the capital city of China, this paper has implications for redevelopment policies in large metropolitan areas worldwide. Specifically, I ask two interrelated research questions:

(**Q1**) Is there an association between SRPs and the dispersal of the migrant population?

(**Q2**) Do SRPs drive up rent in the vicinity? If so, to what extent?

I begin the article by probing into the background, funding scheme, process, and potential impacts of shantytown redevelopment in Chinese cities. Following the literature review is an overview of data sources and methods used to answer the research questions. I then present four major findings from the analysis. I conclude with a discussion on policy implications and future research directions.

2 Literature Review

The Rationale Behind Shantytown Redevelopment

The SRPs were initiated as a part of the 4-trillion-yuan stimulus plan that the Chinese central government adopted in 2008 to mitigate the impact of the Global Financial Crisis (Liu, 2019). About 12.6 million shantytown households moved into better housing through SRPs between 2008 and 2012 (State Council, 2013). In 2013, the central government set up a new goal to redevelop 10 million shantytown housing units in the next five years (Shao, 2013; State Council, 2013). From 2013 to 2018, the total investment in SRPs exceeded 2.2 trillion USD (State Council, 2018), signaling the important role SRPs play in sustaining the nation's economic growth.

Besides its role as an economic stimulator, shantytown redevelopment also serves the goal of improving the built environment. Shantytowns usually lack adequate infrastructure to ensure residents' safe access to water, electricity, gas, and heat (Beijing Youth Daily, 2013; Zhang, 2017). Due to local government's lack of supervision and migrant workers' housing demand, many shantytown homeowners constructed informal housing units and rented them out for profit (Beijing Youth Daily, 2013; Liu and Wong, 2018; Qin, 2017; Wang, 2016; Ye and Wen, 2017; Yu and Hou, 2019). These informal rental units often did not meet local housing codes and were usually overcrowded. The poor-quality housing and overcrowded living conditions create fire hazards and lead to adverse health outcomes among tenants. SRPs provided local governments an opportunity to regulate and formalize the rental market, upgrade the physical infrastructure, and improve neighborhood environmental conditions.

In Beijing, shantytown redevelopment is used for a special purpose: dispersing 'non-capital functions.' The term 'non-capital functions' was first used by President Xi Jinping at a meeting

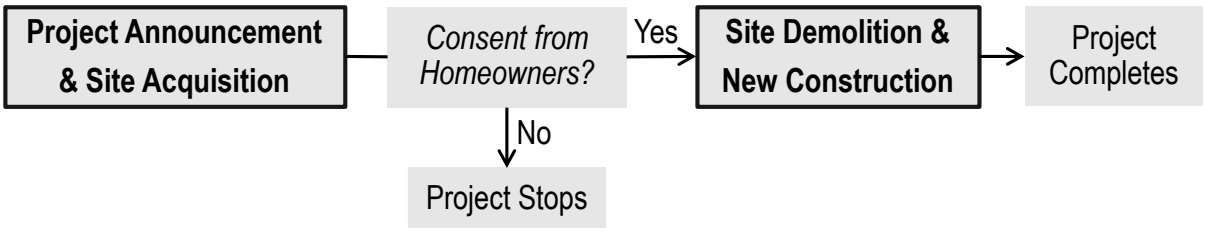
in 2014 to describe sectors that contradict the official vision of the capital city such as low-tech manufacturing, wholesale markets, and informal businesses (PGBM, 2017b; Wong et al., 2018; Xinhua, 2015). In his speech, Xi stressed the importance of "dispersing Beijing's 'non-capital' functions, reducing its population, and promoting economic and social development commensurate with its population and resources (Xinhua, 2017)." The key message is that Beijing was overpopulated, and the state wanted to keep its capital city's population under control by relocating unfavorable industries (and people who work in those industries) further away from the city center. The question is who and what to disperse. In 2017, the Beijing municipal government released its official plan for the dispersal of 'non-capital' functions, in which the relocation of factories and wholesale markets, the regulation of informal economies, and the redevelopment of shantytowns were the areas of focus (PGBM, 2017b). An SRP in Haidian district, for example, shut down 14 low-end wholesale markets and dispersed 100,000 migrants between 2016 and 2017 (Ye and Wen, 2017). While not explicitly stated in the official document, it is heavily implied that SRPs were used by the state to facilitate the dispersal of not only the 'non-capital' sectors, but also migrant workers employed in these sectors.

Funding Scheme

The Beijing municipal government issues bonds to finance SRPs (Ministry of Finance and Ministry of Housing and Urban-Rural Development, 2018; PGBM, 2017a). The bond money has been used in shantytown demolition, resettlement housing construction, and monetary compensation/incentives to shantytown homeowners[2] (CDPGBM, 2019, 2022, 2023). In most cases, the local government has to provide both monetary compensation and resettlement housing to shantytown homeowners (Wen and Nie, 2014) but not to migrant workers. The demolition and

monetary compensation cost per household is about 2 to 3 million yuan for central city SRPs (Li, 2014), which constitutes a huge monetary transfer from the government to the shantytown homeowners. The floor area of the resettlement housing unit is usually 1.5 to 5 times the area of the original housing unit (ibid.). After the shantytown demolition, setting aside the land for resettlement housing and public use, the remaining land will be sold on the land market and the revenue is used to pay back the bonds (Shao, 2013).

Figure 3-2. Process of shantytown redevelopment



Redevelopment Process

The process of an SRP can be divided into two major stages: (1) project announcement and site acquisition; (2) site demolition and new construction (Figure 3-2). I put project announcement and site acquisition together as stage one because they are often intertwined with each other. In some cases, the acquisition precedes the project's official announcement. In other cases, the announcement comes first. An SRP makes its first appearance in the municipal government's annual shantytown redevelopment plan. After the project's announcement, the local government will send a taskforce to conduct housing surveys, make draft compensation plans, and then conduct public hearings to gather feedback on the plans (BMCHURD, 2013). Every SRP needs to obtain consent from a minimum share of homeowners (*shengxiao bili*) within a 6-month period to move on to the next phase (ibid). The minimum share ranges from 70% to 100%, with 85% being the most common. It is worth noting that the process of consent seeking does not involve the migrant

renters who live in the shantytowns. Shantytown demolition not only involves the removal of existing buildings, but also the cleanup of land, installation of utilities, and road improvements. Depending on the site area, new construction can begin when all or part of the site is ready.

The impact of redevelopment on housing affordability

Most studies in China and elsewhere on the redevelopment impact on housing affordability suggest that redevelopment reduces housing affordability both on-site and near-site (Table 3-1). Using site survey and interview data in 4 urban villages, Liu and Wong (2018) found that few migrant renters returned after redevelopment because there were no longer affordable units on site. Other studies in China (Jin et al., 2021; Li et al., 2018; Lin et al., 2014) show similar patterns where rent on site increased drastically post-redevelopment and prior migrant renters were forced to find affordable housing in nearby neighborhoods. Looking at the impact of redevelopment on housing affordability in the vicinity, Liu, et al. (2017) found that proximity to the redevelopment site is associated with higher housing sales price. Similar results have been found in studies conducted in other countries. A study in London indicates that public housing redevelopment causes increases in rents within 400 meters of the redevelopment site (Blanco and Neri, 2023). Studies on public housing redevelopment in the United States consistently showed that the program led to massive displacement of original residents and resulted in significant declines in housing affordability on site (Goetz, 2010; Goetz and Chapple, 2010; Gress et al., 2019; Manzo et al., 2008). There have been limited cases where redevelopment led to increased affordability. In Los Angeles, in a "specific niche situation," a community land trust worked together with an experienced local affordable housing developer to transform Section 8 housing into sustainably affordable housing (Kim and Eisenlohr, 2022).

There are many mechanisms through which redevelopment can affect the price of housing. Literature suggests three ways that redevelopment may contribute to declining housing affordability. First, many redevelopment projects are profit-driven (Hsu and Hsu, 2013; Liu et al., 2017; Lukens, 2021), and the main purpose of redevelopment is to take affordable housing off the market and replace it with higher-priced housing so that the state, developers, and property owners can benefit. Second, displaced residents often look for housing in nearby neighborhoods (Liu et al., 2018), driving up the affordable housing demand in the vicinity and putting upward pressure on rents. Third, urban redevelopment generates a price premium in nearby housing through improved environmental amenities such as parks and trails (Immergluck and Balan, 2018). The increase in property value can occur well before project completion by raising the expectation of investors (Ki and Jayantha, 2010; Liu et al., 2017; Peng and Tian, 2022). Evidence suggests that potential improvements in environment and amenities after redevelopment are considered in the pricing of properties during the demolition and construction phase (ibid.).

Alternatively, redevelopment can also decrease housing prices through negative externalities such as noises and air pollution produced during demolition and construction (Ki and Jayantha, 2010). The negative spillover effect during the redevelopment process can vary by project size. Large scale redevelopment may result in greater adverse impact on nearby housing values because more noise and air pollution are produced during the demolition and construction phase. Some land uses after redevelopment may also have negative impacts on nearby housing prices. For example, some shantytowns are being redeveloped into railroads and waste transfer stations, which are more likely to negatively affect housing price in the vicinity (Zhang et al., 2018).

Most studies on the relationship between redevelopment and housing affordability use a non-quasi-experimental research design due to the lack of panel data. Some studies have looked at a single redevelopment project using in-depth interviews, participant observation, and archival research (Kim and Eisenlohr, 2022; Manzo et al., 2008; Shin, 2008, 2009), other studies have examined the association between proximity to the redevelopment site and housing price using the traditional hedonic pricing model (Immergluck and Balan, 2018; Liu et al., 2017). The traditional hedonic pricing model expresses housing price as a function of characteristics of the property itself as well as characteristics of the neighborhood within which the property is located. The conventional association studies, while incorporating detailed information on housing and neighborhood characteristics, are likely to suffer from omitted variable bias, as unobserved neighborhood characteristics tend to be correlated with both the housing prices and the redevelopment (Huang et al., 2020; Ossokina and Verweij, 2015). A quasi-experimental study has the advantage of avoiding this problem by controlling for potential unmeasured and omitted confounders. Few studies have investigated the redevelopment impact on housing affordability using a quasi-experimental design, which aims to establish a causal relationship between redevelopment and housing affordability in a statistically rigorous way. This paper contributes to the existing literature by not only providing rich descriptions of spatial-temporal patterns of SRPs, but also using a quasi-experiment approach to produce new and improved evidence on the redevelopment impact on housing affordability.

Table 3-1. Literature on the impact of redevelopment on housing affordability

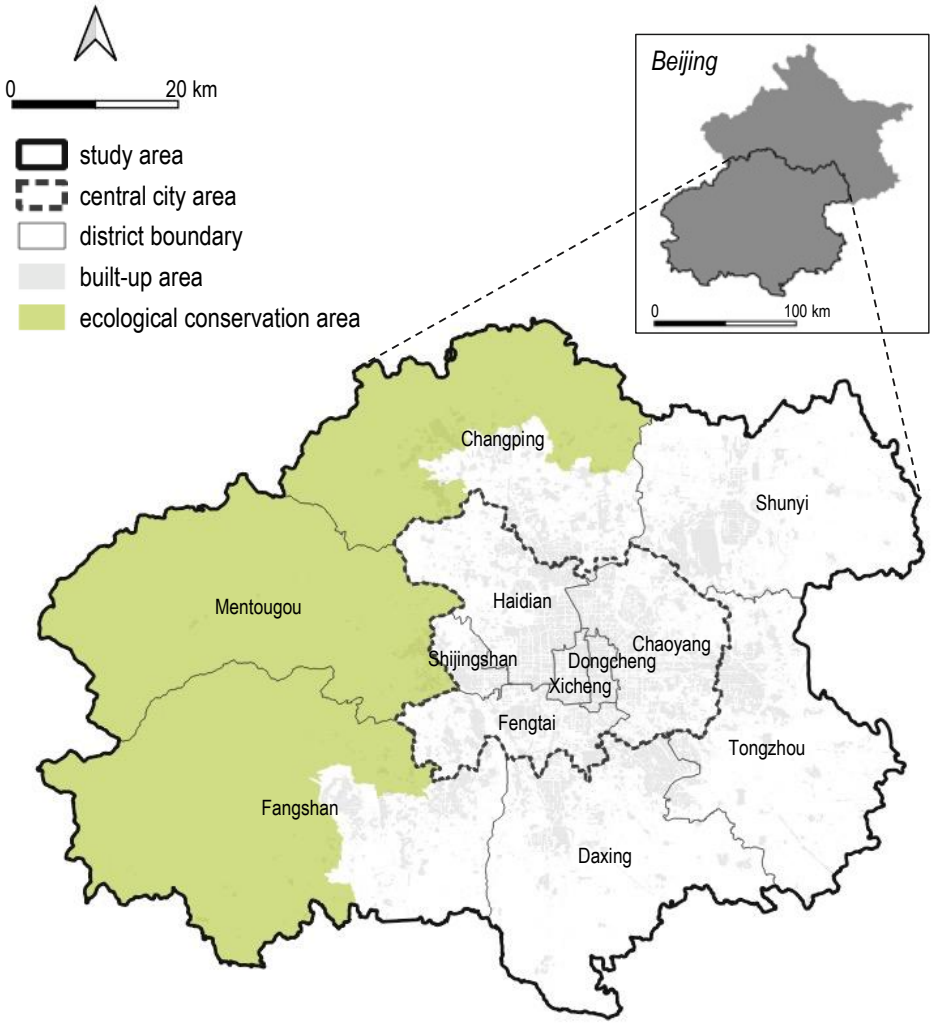
Article	City	Period	Redevelopment of	Led by ^	# of projects	Quasi-experimental design	Impact on housing affordability †	
							On site	In the vicinity
(Liu and Wong, 2018)	Beijing, China	2011-2016	urban village	G	4	No	negative	
(Lin et al., 2014)	Beijing, China	2010-2013	urban village	G	1	No	negative	
(Peng and Tian, 2022)	Hangzhou, China	2015-2018	urban village	G	139	Yes		negative (T: 0-500m; C: rest of the city)
(Jin et al., 2021)	Hangzhou, China	2017	urban village	G	5	No	negative	
(Li et al., 2018)	Shenyang, China	2015	shantytown	G	8	No	negative	
(Liu et al., 2017)	Shenzhen, China	2014	urban village	G	3	No		negative (T: distance to the nearest redevelopment, within 2km)
(Hao et al., 2011)	Shenzhen, China	2006-2009	urban village	G	46	No	negative	
(Ki and Jayantha, 2010)	Hong Kong, China	1998-2010	neighborhood	G	1	No		negative (T: multiple 150m rings; C: 600-750m)
(Lukens, 2021)	Seoul, South Korea	2014	informal settlement	G		No	negative	negative
(Shin, 2008, 2009)	Seoul, South Korea	2001-2003	informal settlement	G	1	No	negative	
(Blanco and Neri, 2023)	London, UK	2004-2018	public housing	G	130	Yes		mixed (T: multiple 100m rings; C: 800-1,000m)
(Davidson, 2008)	London, UK	2004	neighborhood	G	3	No	negative	
(Kim and Eisenlohr, 2022)	Los Angeles, CA, USA	2011-2019	section 8 housing complex	C	1	No	positive	
(Gress et al., 2019)	USA	1993-2014	public housing	G	259	No	negative	
(Manzo et al., 2008)	Pacific Northwest, USA	2003-2004	public housing	G	1	No	no change	
(Immergluck and Balan, 2018)	Atlanta, GA, USA	2011-2015	old rail line	G	1	No		negative (T: 0-0.5mi; C: rest of the city)
(Pearsall, 2010)	New York City, NY, USA	1990-2008	brownfield	G	36	No		-

Notes: ^ G = Government, C = Community-based organization. † T = Treatment, C = Control.

3 Data and Methods

The city of Beijing had a population of 21.9 million and a land area of 16,410 km^2 in 2020. This study is confined to the 12 districts in Beijing (Figure 3-3), which accounted for 92% of the city's total population and 56% of the city's land area in 2020. The twelve districts administer 257 subdistricts (*jiedao/xiang/zhen*). Subdistricts are the most granular geographic level available in the public census data. The six inner districts constitute the central city area—the densely populated urban core where over half of the city's population resides.

Figure 3-3. Study area.



While shantytown redevelopment programs were first devised in 2008, they were first implemented in Beijing in 2009 with three pilot projects in Mentougou, Fengtai, and Tongzhou districts, and then expanded to be city-wide in 2013 (BMCHURD, 2020; Wang, 2013). This study investigates SRP projects in Beijing between 2013 and 2020, the first eight years of the program's city-wide implementation (Table 3-2). The data on SRPs are collected from the municipal government website, where the annual SRP plan was posted on a yearly basis. The annual SRP plans provide information on project name, type, location, and the year of project announcement. Google Earth satellite images, in combination with government documents and newspaper articles, are used to identify the year of demolition and the year of project completion. Information on proposed land use(s) after redevelopment is obtained from the Beijing 2035 master plan and detailed district plans. Government documents and newspaper articles are used to identify the location of resettlement housing for each SRP. The SRP data are linked to the Chinese census data in 2010 and 2020 at the subdistrict level. I confine my analysis to the 157 SRPs that started demolition between 2013 and 2020 (Figure 3-4 & Table 3-3) because only after the completion of land acquisition and the start of demolition can people have a reliable expectation of future improvement in the built environment (Peng and Tian, 2022).

Table 3-2. Shantytown Redevelopment Projects in Beijing, 2013-2020.

Year	First announced	Began demolition	Completed
2013	89	9	0
2014	90	17	1
2015	20	14	2
2016	41	22	4
2017	17	33	2
2018	28	34	2
2019	8	18	5
2020	5	10	7
Total	298	157	23

Figure 3-4. Shantytown redevelopment in Beijing, 2013-2020.

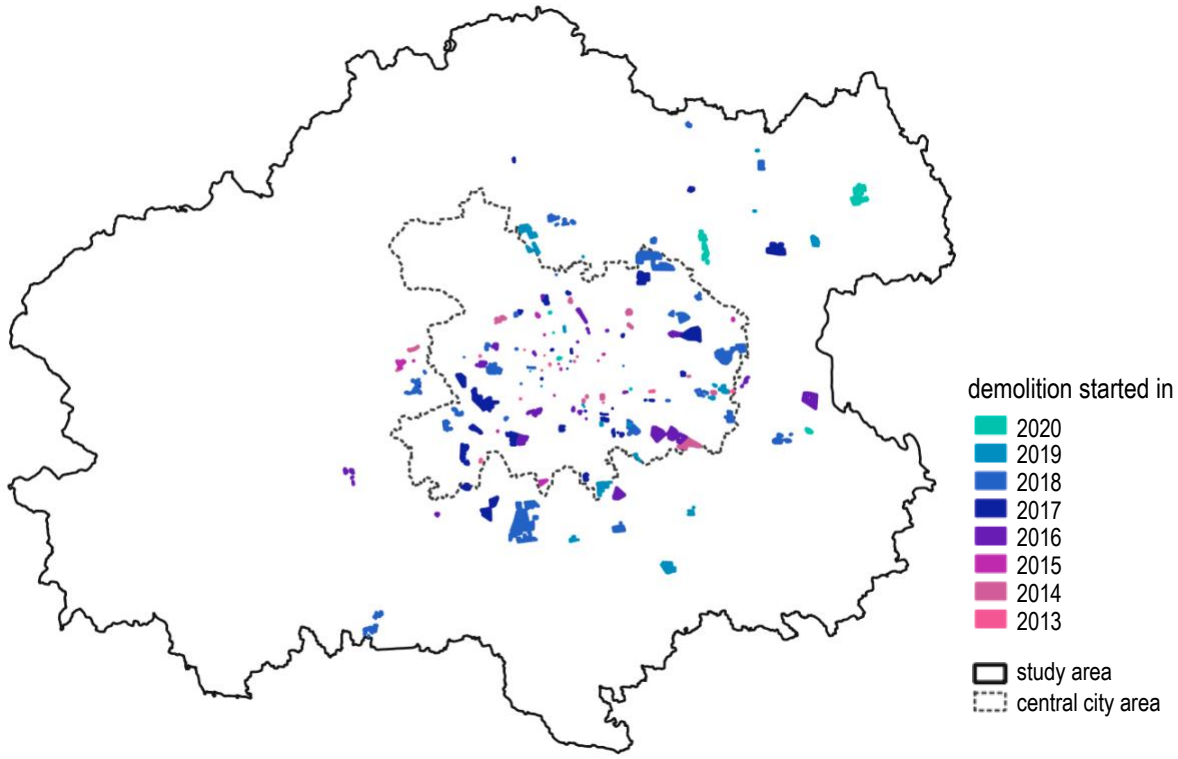


Table 3-3. Descriptive statistics on SRPs (N=157)

		Count	Percentage
Land area	<= 1 km^2	127	81%
	> 1 km^2	30	19%
Location	Central city	111	71%
	Outside central city	46	29%
Shantytown Type	Urban village	117	74%
	Courtyard houses	6	4%
	Residential quarter	34	22%
Proposed land use	Residential / park / commercial	136	87%
	Other	21	13%

Rental listing data in 2015 and 2021 are collected from Lianjia.com to capture the impact of redevelopment projects on the rental market. Lianjia is a housing brokerage company that dominates the rental housing market in Beijing. The rental listings include information on the rental unit's price, floor area, number of bedrooms, year built, and location. Information on

locational amenities (CBD, subway stops, and top elementary school) was collected from Amap.com.

To answer **Q1**, I use descriptive mapping and logit regression to investigate the association between shantytown redevelopment and the decline in migrant share. The logistic regression model has the following general specification:

$$Logit(D_i) = \beta_0 + \beta_1 SRPland_i + \beta_2 SubdPop_i + \beta_3 SubdLand_i \quad (1)$$

D_i is a binary variable that equals to 1 if the share of migrants declined between 2010 and 2020 in subdistrict i. $SRPland_i$ is the total land area of demolished shantytowns in subdistrict i between 2013 and 2020. $SubdPop_i$ is the population of subdistrict i in 2010. $SubdLand_i$ is the land area of subdistrict i.

To address **Q2**, I use a difference-in-differences (DID) approach that compares housing units within a 400m-wide ring around an SRP site (treatment group) to units within 400-800m of the same site (control group) before and after SRPs[3]. The 400m ring is designated as the treatment zone because 400m is considered a reasonable walking distance for people (Rattan et al., 2012; Untermann, 1984) and housing units within the 400m buffer are the most likely to benefit from the redevelopment. I choose housing units in the 400-800m ring as the control group because they are close to units in the treatment zone and are likely to be affected by similar non-SRP factors over time to the treated units. I also test the model using a categorical treatment variable (0-200m, 200-400m, 400-600m, 600-800m) to ensure the results are robust (see Appendix, Table A3-1).

The DID specification expresses the natural log of inflation-adjusted rent (Y) as a function of housing characteristics ($\boldsymbol{H}$ = floor area, number of bedrooms, year built), locational amenities ($\boldsymbol{L}$ = distance to CBD, subway stop, elementary school), a binary variable indicating whether the unit is located within the treatment zone (T), a binary variable indicating whether the unit is listed

post-treatment (P), and an interactive variable that captures the impact of SRPs on rent ($T \times P$). I control for subdistrict-level fixed effects to remove unobserved heterogeneity across subdistricts. I cluster errors at the subdistrict level to account for situations where observations within each subdistrict are not independently and identically distributed.

$$Y = f(\boldsymbol{H},\ \boldsymbol{L}, T, P, T \times P) \tag{2}$$

I choose shantytown demolition as the treatment point in the DID analysis. The reasons are threefold. First, nearly half of the SRPs listed in the annual plans in the study period had not entered the demolition phase as of 2021. Second, only after the completion of the land acquisition can potential homebuyers and renters have a reliable expectation of the shantytown removal and environmental improvements (Peng and Tian, 2022). Some of them were postponed indefinitely, some were still in the acquisition/negotiation stage. Third, most projects are still ongoing in 2021 and it is not feasible to use project completion as the intervention point[4].

The DID analysis is confined to SRPs (1) whose proposed land use(s) include any of the following: residential, park (green space), and commercial; and (2) have no less than 100 rental units in the treatment area in both 2015 and 2021. Thirty-five SRPs meet the criteria. I run the DID analysis separately for the 28 small- to medium-size SRPs (land area <= 1km^2) and the 7 large-size SRPs (land area > 1km^2) because the impact of redevelopment could be qualitatively different depending on the project size (see Appendix, Figure A3-2 for the distribution of SRP size). Firstly, large-scale demolition and construction activities are more likely to adversely affect the pricing of nearby rental units through noise and air pollution. Secondly, large-size redevelopment projects, with greater land areas and stakeholders involved, may take longer to complete. The potentially long project duration lowers the expectation of short-term improvement in the built environment. After cleaning, I obtained a sample of 47,520 rental units for small- to medium-size SRPs and a

sample of 7, 872 rental units for large-size SRPs (Table 3-4). Regression analysis using different project size cutoffs (0.8 km^2 - 1.4 km^2) were run to ensure the robustness of results (see Appendix, Figure A3-3). The robustness check suggests that, for thresholds at 1, 1.2, and 1.4 km^2, there are consistent results demonstrating the differential impacts of shantytown demolition on rents by project size.

Table 3-4. Descriptive statistics on rental units.

	SRP <= 1km^2				SRP > 1km^2			
	2015		2021		2015		2021	
	T	C	T	C	T	C	T	C
Rent (yuan)	5,567	5,653	7,285	7,059	3,732	3,474	5,103	4,674
	(4,571)	(4,481)	(4,071)	(3,803)	(2,159)	(2,036)	(2,078)	(1,836)
Floor area (m2)	83	82	81	79	73	73	75	72
	(39)	(37)	(36)	(35)	(28)	(22)	(27)	(25)
Year built	1,995	1,997	1,996	1,996	1,998	1,997	1,999	1,998
	(13)	(12)	(14)	(13)	(14)	(11)	(14)	(13)
Bedrooms	1.9	1.9	2.0	1.9	1.9	1.9	2.1	2.0
	(.8)	(.8)	(.8)	(.8)	(.7)	(.6)	(.7)	(.9)
Distance to subway stop (km)	1.0	1.0	.7	.8	1.9	1.5	.9	1.0
	(.9)	(.9)	(.7)	(1.0)	(1.5)	(1.0)	(.6)	(.5)
Distance to top elementary school (km)	1.3	1.5	1.2	1.4	1.6	1.3	1.6	1.3
	(1.6)	(1.8)	(1.2)	(1.7)	(.7)	(.9)	(.8)	(1.0)
Distance to CBD (km)	12.0	11.3	10.9	10.8	14.0	14.6	13.9	15.2
	(8.0)	(8.0)	(7.0)	(7.5)	(3.7)	(3.2)	(3.8)	(3.4)
N	9,115	11,273	11,624	15,508	1,712	1,846	2,048	2,266

Notes: T = Treatment zone (0-400m), C = Control zone (400-800m). Rents are adjusted for inflation using the annual city-level CPIs for rental housing in 2015 yuan. Standard deviations are in parentheses.

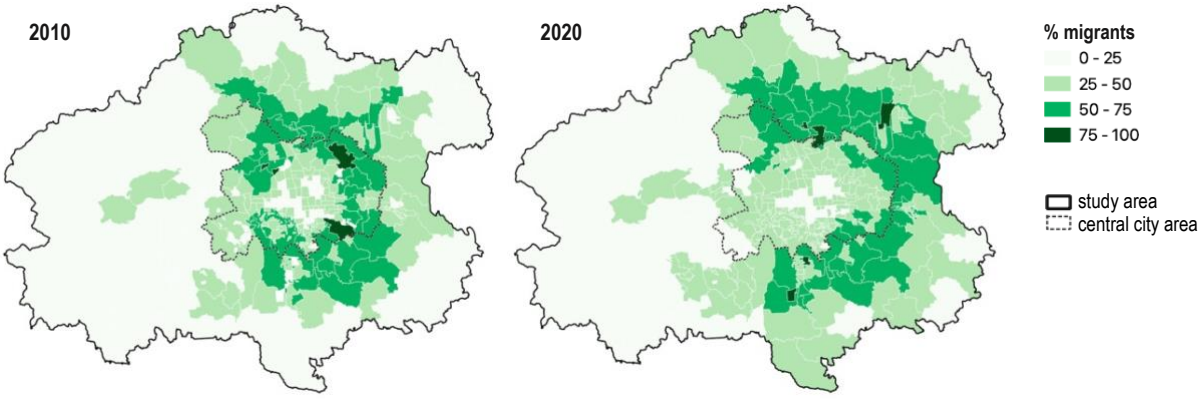
4 Results

Redevelopment and the Dispersal of Migrants

SRPs are associated with a decline in the share of migrant population at the subdistrict level. Most shantytown redevelopment occurred in the central city area between 2013 and 2020. About 57 km^2 of shantytown were demolished in the central city area, compared to 48 km^2 outside of the central

city area. Meanwhile, there was a clear shift in the spatial distribution of migrant population from the central city to the urban outskirt (Figure 3-5). The migrant population in the central city area declined from 4.3 million to 3.6 million from 2010 to 2020, while the migrant population outside of the central city increased from 2.4 million to 4.3 million. Logistic regression analysis at the subdistrict level shows that, on average, a standard deviation increase in shantytown demolished (about 1.9 km^2) is associated with a 0.089 increase in the predicted probability of migrant share decline between 2010 and 2020 (Table 3-5). According to the 2017 Chinese Migrant Dynamic Survey, over three-quarters of migrants in Beijing are renters. Migrant renters who live in shantytowns are not eligible for compensation in the redevelopment process (BMCHURD, 2013; Wu, 2016) and housing on site usually becomes much more expensive in the post-demolition period (Jin et al., 2021; Li et al., 2018; Lin et al., 2014; Liu and Wong, 2018). Without any type of housing assistance, migrant renters are very likely to be priced out of the local housing market and have to look for housing in more remote places.

Figure 3-5. The migrant population moved away from the central city area.



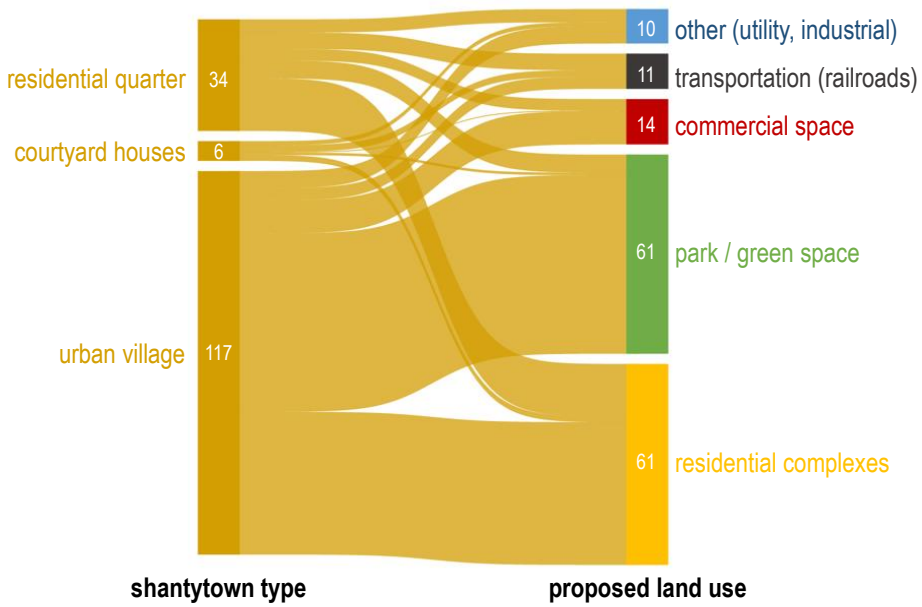
Source: 2010, 2020 Chinese Censuses

Table 3-5. Shantytown redevelopment and migrant share decline.

	Model 3-1. Migrant share decline
	AME
Demolished shantytown (km^2)	0.089**
Subdistrict population	0.078**
Subdistrict land area (km^2)	-0.269***
Pseudo R-squared	0.198
N	255

Notes: Results from logistic regression. Unit of analysis: Subdistrict. AME = Average Marginal Effect. *p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Figure 3-6. SRP land use change (N=157 projects)



Note: For projects that have multiple proposed land uses, each use is weighted equally, with all uses add up to 1.

Homeowners Get to Stay

Most shantytowns are being redeveloped into residential complexes, urban parks, and commercial spaces (Figure 3-6). The residential complexes constructed in SRPs often include resettlement housing for shantytown homeowners. Among the 113 SRPs with resettlement information available, over half (61 SRPs) construct resettlement housing on site, and 35 SRPs offer resettlement housing units to homeowners in the same subdistrict. In most cases, shantytown homeowners have the option to resettle in the same subdistrict and are thus able to benefit from the built environment improvement.

Table 3-6. Impacts of shantytown demolition on rents.

	SRP <= 1km^2	SRP > 1km^2
	Model 3-2. Ln(rent)	Model 3-3. Ln(rent)
0-400m ^	-0.011	0.054***
	(0.021)	(0.013)
Year 2021 †	0.283***	0.318***
	(0.019)	(0.016)
Within 400 m × Year 2021	0.035*	-0.062**
	(0.017)	(0.021)
Floor area (m^2)	0.008***	0.007***
	(0.000)	(0.001)
Number of Bedrooms	0.035***	0.078***
	(0.009)	(0.018)
Year built	0.005***	0.003***
	(0.001)	(0.001)
Distance to subway stop (km)	-0.046**	-0.023*
	(0.017)	(0.011)
Distance to top elementary school (km)	-0.024	-0.018
	(0.020)	(0.025)
Distance to CBD (km)	-0.015	-0.062*
	(0.009)	(0.024)
Sub-district fixed effects	✓	✓
Adjusted R-squared	0.825	0.776
N	47,520	7,872

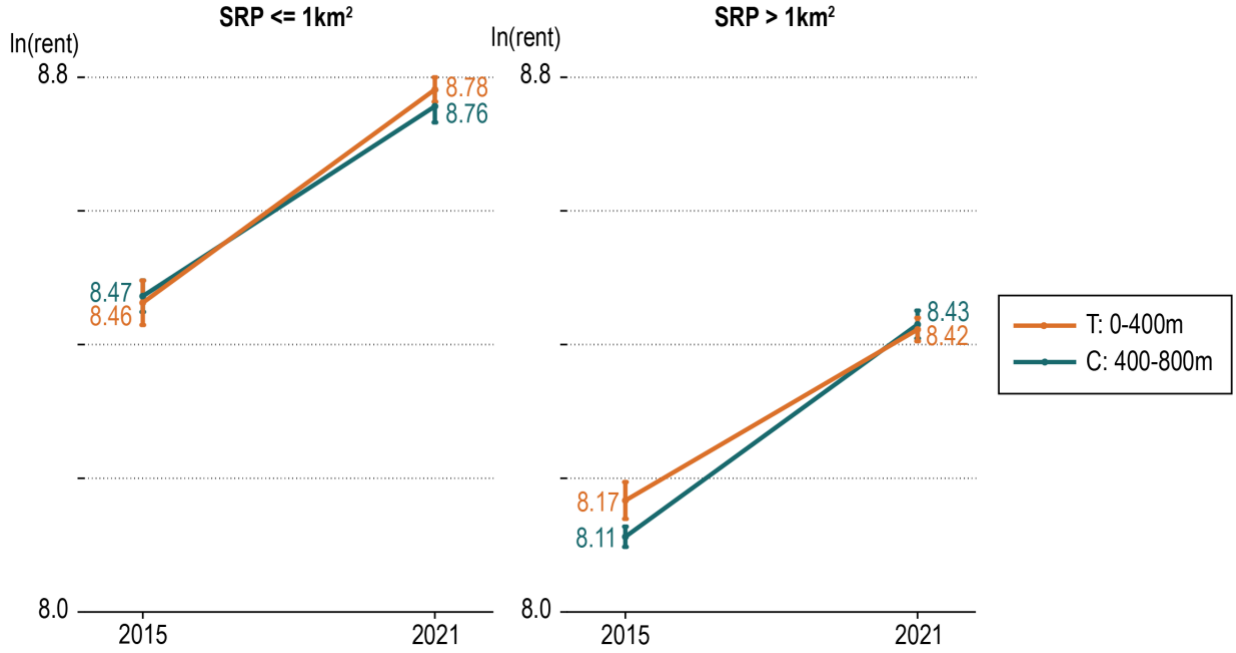
Notes: ^ Reference: 400-800m. † Reference: Year 2015. Rents are inflation-adjusted using the annual city-level CPIs for rental housing in 2015 yuan. Standard errors are in parentheses. Errors are clustered at the subdistrict level. *p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Increased Rent in the Vicinity

Demolition in small- to medium- size SRPs increases rent in the vicinity between 2015 and 2021, while demolition in large-size SRPs decreases rent in the vicinity (Table 3-6). The regression results suggest that, on average, SRPs no larger than 1 km^2 increase the rent price of units within 400m by 3.6% between 2015 and 2021, controlling for housing characteristics and locational amenities. On the contrary, SRPs over 1km^2 decrease the rent price of units within 400m by 6.0%. It is worth noting that the rent increase is across-the-board within the 800m study boundary (Figure 3-7). For large scale SRPs, the rent increase for units in the treatment zones is smaller than the ones in control zones. Overall, rents within 800m of the redevelopment sites increased between 2015 and 2021, and adjacency to small-to-medium-size SRPs resulted in a greater increase. For

migrant renters, this means a potential increase in housing cost burden and a higher risk of being priced out of their neighborhoods.

Figure 3-7. Rent increases in both the treatment and control areas from 2015 to 2021.



Note: Predictions with 95% confidence intervals from Model 2 and Model 3.

5 Discussion and Conclusion

This study finds that the demolition of small-to-medium-size shantytowns in Beijing contributes the dispersal of migrant renters by (1) removing affordable rentals in shantytowns; (2) not offering any type of housing assistance for displaced migrants; and (3) driving up rental prices in the vicinity. Results from the logit model indicate a positive correlation between land area devoted to SRPs and the decline of migrant share at the subdistrict level. This evidence, coupled with previous research showing that the cost of housing in redeveloped sites are higher than the pre-redevelopment period (Jin et al., 2021), form a strong circumstantial argument for the direct displacement hypothesis. The study did not directly examine the relationship between SRPs and

housing affordability on site, because most SRPs in the study were still undergoing construction and too few rental units were listed in 2021. More research is needed to confirm the direct displacement hypothesis using data set with on-site rental information for pre- and post-redevelopment periods.

Results from the DID analysis suggest that the demolition of small- to medium-size SRPs increases the nearby rental price by 3.6%, while the demolition of large-size SRPs decreases the nearby housing price by 6.0%. The negative causal relationship between demolition of larger-size shantytowns and declining rental price is likely due to the longer redevelopment period and more negative externalities (e.g., long-term noise, air pollution) created in the demolition and construction activities. More positive spillover effects on nearby rent are expected after the completion of large-scale SRPs. In the long-term, there is a substantial chance that Beijing municipal government's investment in shantytown redevelopment will result in declining housing affordability for low-income migrant renters through the positive spillover effects on nearby rental price.

Given the decreasing affordability and dispersal of the migrant population associated with shantytown redevelopment, complementing strategies are needed to maintain rental affordability and protect migrants' right to remain in their neighborhoods. Designing a participatory redevelopment process that recognizes migrant renters as important stakeholders and creating a more inclusive SRP compensation plan are possible ways to mitigate the negative impact of SRPs on the migrant population. Migrants work to build and sustain the city and they deserve the right to be able to benefit from what they have produced. A diverse workforce with migrants from different backgrounds is also beneficial to the urban and regional economy (Bove and Elia, 2017).

The state needs an alternative vision for Beijing that not only serves local homeowners, but also the migrant population that has contributed greatly to the city's development.

Due to the unavailability of the rental listing data prior to 2015 and the fact that most SRPs are still ongoing, this study focuses on the short-term impact of shantytown demolition on rental price in the vicinity. Because the rental listing data is only available for years 2015 and 2021, the study employs a DID design with two time periods (pre- and post-treatment), aggregating shantytown demolition between 2016 and 2020 as one treatment. The DID analysis does not account for the differential timing of shantytown demolition due to limited data availability. Future research is thus needed (1) to examine not only the impact of shantytown demolition, but also project completion, on nearby rental price; (2) to study the long-term impact of shantytown redevelopment on housing affordability on- and near-site; and (3) to account for the different timing of treatment using rental listing data from multiple years.

Notes

1. Third-tier cities refers to relatively developed prefecture-level cities with over 10 million population in the central city area. The Chinese city ranking system was published by Yicai Global (a Chinese financial magazine) in 2017. Beijing is classified as one of the four Tier-1 cities, i.e., the most developed metropolitan areas in China, according to Yicai Global.

2. Public housing renters ("*gongfang chengzuren*") are also eligible for compensation. Public housing renters are long-term tenants who have their *hukou* registered at the public housing address (BMCHURD, 2013). Migrant renters do not have local *hukou* and are completely excluded from compensation.

3. One rental unit corresponds to one SRP. When the treatment and control zones of different SRPs overlap, rental units in the overlapped area will be assigned to the nearest SRP (see Appendix, Figure A3-2).

4. Among the 35 SRPs completed between 2016 and 2020, only two meet the data cleaning criteria, which is not sufficient for a DID analysis.

References

Beijing Youth Daily (2013) The demolition of Dongjiao Market is coming to an end, the site will be redeveloped into National Advertisement Industrial Park. 17 October. Available at: https://www.chinanews.com.cn/sh/2013/10-17/5392644.shtml (accessed 5 February 2023).

Blanco H and Neri L (2023) Knocking it Down and Mixing it Up: The Impact of Public Housing Regenerations. 4319009, SSRN Scholarly Paper. Rochester, NY. DOI: 10.2139/ssrn.4319009.

BMCHURD (2013) Guidelines on Houisng Acquisition in the Central City Area. Available at: http://www.beijing.gov.cn/zhengce/zhengcefagui/201905/t20190522_57622.html (accessed 15 January 2023).

BMCHURD (2020) Shantytown Redevelopment. Available at: http://ghzrzyw.beijing.gov.cn/zhengwuxinxi/zxzt/zysj/msycc/czphqgz/202006/t20200601_1912864.html (accessed 16 January 2023).

Bove V and Elia L (2017) Migration, Diversity, and Economic Growth. *World Development* 89: 227–239. DOI: 10.1016/j.worlddev.2016.08.012.

CDPGBM (2019) 2019 Chaoyang District Budget Adjustment Plan (Draft). Available at: http://www.bjchy.gov.cn/affair/caizhengsz/czyjs/8a24fe836cf92481016cfba8c7c60254.html (accessed 16 February 2023).

CDPGBM (2022) 2021 Chaoyang District Budget Report. Available at: http://www.bjchy.gov.cn/affair/jcgk/jcjg/8a24fe837e33048d017e33565d470089.html (accessed 16 February 2023).

CDPGBM (2023) 2022 Chaoyang District Budget Report. Available at: http://www.bjchy.gov.cn/affair/caizhengsz/czyjs/4028805a85c0254b0185c2a937580322.html (accessed 14 February 2023).

Davidson M (2008) Spoiled Mixture: Where Does State-led `Positive' Gentrification End? *Urban Studies* 45(12). SAGE Publications Ltd: 2385–2405. DOI: 10.1177/0042098008097105.

Gao C (2017) Beijing: How Does a Tragic Fire Turn Into the Mass Eviction of Migrant Workers? *The Diplomat*, 27 November. Available at: https://thediplomat.com/2017/11/beijing-how-does-a-tragic-fire-turn-into-the-mass-eviction-of-migrant-workers/ (accessed 9 March 2020).

Goetz EG (2010) Desegregation in 3D: Displacement, Dispersal and Development in American Public Housing. *Housing Studies* 25(2). Routledge: 137–158. DOI: 10.1080/02673030903561800.

Goetz EG and Chapple K (2010) You gotta move: advancing the debate on the record of dispersal. *Housing Policy Debate* 20(2). Routledge: 209–236. DOI: 10.1080/10511481003779876.

Gress TH, Joseph ML and Cho S (2019) Confirmations, New Insights, and Future Implications for HOPE VI Mixed-Income Redevelopment. *Cityscape* 21(2). US Department of Housing and Urban Development: 185–212.

Hao P, Sliuzas R and Geertman S (2011) The development and redevelopment of urban villages in Shenzhen. *Habitat International* 35(2): 214–224. DOI: 10.1016/j.habitatint.2010.09.001.

He S, Zhang M and Wei Z (2020) The state project of crisis management: China's Shantytown Redevelopment Schemes under state-led financialization. *Environment and Planning A: Economy and Space* 52(3). SAGE Publications Ltd: 632–653. DOI: 10.1177/0308518X19882427.

Hsu J and Hsu Y (2013) State Transformation, Policy Learning, and Exclusive Displacement in the Process of Urban Redevelopment in Taiwan. *Urban Geography* 34(5). Routledge: 677–698. DOI: 10.1080/02723638.2013.778581.

Huang B, He X, Xu L, et al. (2020) Elite school designation and housing prices-quasi-experimental evidence from Beijing, China. *Journal of Housing Economics* 50: 101730. DOI: 10.1016/j.jhe.2020.101730.

Huang Y and Tao R (2015) Housing migrants in Chinese cities: current status and policy design. *Environment and Planning C: Government and Policy* 33(3): 640–660. DOI: 10.1068/c12120.

Immergluck D and Balan T (2018) Sustainable for whom? Green urban development, environmental gentrification, and the Atlanta Beltline. *Urban Geography* 39(4). Routledge: 546–562. DOI: 10.1080/02723638.2017.1360041.

Jin X, Ren T, Mao N, et al. (2021) To Stay or to Leave? Migrant Workers' Decisions During Urban Village Redevelopment in Hangzhou, China. *Frontiers in Public Health* 9. Available at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.782251 (accessed 26 February 2023).

Ki C and Jayantha W (2010) The Effects of Urban Redevelopment on Neighbourhood Housing Prices. *International Journal of Urban Sciences* 14. DOI: 10.1080/12265934.2010.9693685.

Kim AM and Eisenlohr A (2022) Community Land Trusts for Sustainably Affordable Rental Housing Redevelopment: A Case Study of Rolland Curtis Gardens in Los Angeles. *Cityscape* 24(1). US Department of Housing and Urban Development: 233–256.

Li T (2014) Shantytwon demolition costs 3 million yuan per household. *Beijing Youth Daily*, 19 November. Available at: http://finance.china.com.cn/roll/20141119/2797939.shtml (accessed 6 February 2023).

Li X, Kleinhans R and van Ham M (2018) Shantytown redevelopment projects: State-led redevelopment of declining neighbourhoods under market transition in Shenyang, China. *Cities* 73: 106–116. DOI: 10.1016/j.cities.2017.10.016.

Lin Y, De Meulder B, Cai X, et al. (2014) Linking social housing provision for rural migrants with the redevelopment of 'villages in the city': A case study of Beijing. *Cities* 40: 111–119. DOI: 10.1016/j.cities.2014.03.011.

Liu K (2019) Demystifying China's Shantytown Renovation Program and Its Effect on Real Estate Price. *The Chinese Economy* 52(3). Routledge: 249–262. DOI: 10.1080/10971475.2018.1548141.

Liu R and Wong T (2018) Urban village redevelopment in Beijing: The state-dominated formalization of informal housing. *Cities* 72: 160–172. DOI: 10.1016/j.cities.2017.08.008.

Liu Y, Tang S, Geertman S, et al. (2017) The chain effects of property-led redevelopment in Shenzhen: Price-shadowing and indirect displacement. *Cities* 67: 31–42. DOI: 10.1016/j.cities.2017.04.017.

Liu Y, Lin Y, Fu N, et al. (2018) Towards inclusive and sustainable transformation in Shenzhen: Urban redevelopment, displacement patterns of migrants and policy implications. *Journal of Cleaner Production* 173. Sustainable urban transformations towards smarter, healthier cities: theories, agendas and pathways: 24–38. DOI: 10.1016/j.jclepro.2016.09.224.

Liu Z (2017) 19 killed as fire sweeps through Beijing housing block. *South China Morning Post*, 19 November. Hong Kong. Available at: https://www.scmp.com/news/china/society/article/2120558/19-killed-fire-sweeps-through-beijing-accommodation-block (accessed 9 March 2020).

Lukens D (2021) Configurations of gentrification and displacement: chronic displacement as an effect of redevelopment in Seoul, South Korea. *Urban Geography* 42(6). Routledge: 812–832. DOI: 10.1080/02723638.2020.1742467.

Manzo LC, Kleit RG and Couch D (2008) "Moving Three Times Is Like Having Your House on Fire Once": The Experience of Place and Impending Displacement among Public Housing

Residents. *Urban Studies* 45(9). SAGE Publications Ltd: 1855–1878. DOI: 10.1177/0042098008093381.

Ministry of Finance and Ministry of Housing and Urban-Rural Development (2018) Administrative measures for pilot issuance of the local govenment's special bonds for shantytown redevelopment. Available at: http://www.beijing.gov.cn/zhengce/zhengcefagui/201905/t20190522_60940.html (accessed 27 April 2020).

Ossokina IV and Verweij G (2015) Urban traffic externalities: Quasi-experimental evidence from housing prices. *Regional Science and Urban Economics* 55: 1–13. DOI: 10.1016/j.regsciurbeco.2015.08.002.

Pearsall H (2010) From Brown to Green? Assessing Social Vulnerability to Environmental Gentrification in New York City. *Environment and Planning C: Government and Policy* 28(5). SAGE Publications Ltd STM: 872–886. DOI: 10.1068/c08126.

Peng Y and Tian C (2022) Removal and reconstruction: Multi-period price effects on nearby housing from urban village redevelopment. *Land Use Policy* 113: 105877. DOI: 10.1016/j.landusepol.2021.105877.

PGBM (2017a) Government opinion on the further regulation of shantytown redevelopment financing. Available at: http://www.gov.cn/xinwen/2017-11/06/content_5237580.htm (accessed 16 February 2023).

PGBM (2017b) Policy Guidance on the Dispersal of 'Non-capital' Functions (2017-2020). Available at: http://www.beijing.gov.cn/zhengce/zhengcefagui/201905/t20190522_59825.html (accessed 27 February 2023).

Qin S (2017) The Demolition of Nanyuan Shantytown was Started. Available at: http://house.people.com.cn/n1/2017/0308/c164220-29130818.html (accessed 17 February 2023).

Rattan A, Campese A and Eden C (2012) Modeling walkability. *Arc. User. Winter* 2012: 30–3.

Shao T (2013) Why Premier Li Emphasizes Shantytown Redevelopment So Much? Available at: https://cn.nytimes.com/real-estate/20131207/tc07shaoting/ (accessed 16 January 2023).

Shin HB (2008) Living on the edge: financing post-displacement housing in urban redevelopment projects in Seoul. *Environment and Urbanization* 20(2). SAGE Publications Ltd: 411–426. DOI: 10.1177/0956247808096120.

Shin HB (2009) Property-based redevelopment and gentrification: The case of Seoul, South Korea. *Geoforum* 40(5). Themed Issue: Land, Labor, Livestock and (Neo)Liberalism: Understanding the Geographies of Pastoralism and Ranching: 906–917. DOI: 10.1016/j.geoforum.2009.06.009.

State Council (2013) Guowuyuan guanyu jiakuai penghuqu gaizaogongzuo de yijian [Guidance from the state council on facilitating shantytown redevelopment]. Available at: http://www.gov.cn/zwgk/2013-07/12/content_2445808.htm (accessed 12 March 2020).

State Council (2018) Premier Li: Shantytown redevelopment needs to reflect the use value of housing. Available at: http://www.gov.cn/guowuyuan/2018-10/09/content_5328911.htm (accessed 16 February 2023).

The Economist (2017) In Beijing, the rich and poor are shocked. *The Economist*, 30 November. Available at: https://www.economist.com/china/2017/11/30/in-beijing-the-rich-and-poor-are-shocked (accessed 21 June 2020).

Untermann RK (1984) ACCOMMODATING THE PEDESTRIAN: ADAPTING TOWNS AND NEIGHBOURHOODS FOR WALKING AND BICYCLING. Available at: https://trid.trb.org/view/273263 (accessed 2 March 2023).

Wang H (2016) Largest wetland park in Northestern Beijing starts construction. *Beijing Daily*, 5 April. Beijing. Available at: http://yllhj.beijing.gov.cn/ztxx/mtjj/mtbd/201604/t20160405_115957.shtml (accessed 5 February 2023).

Wang S (2013) The State Council: Redevelop10 million housing units in 5 years. Available at: https://www.bjnews.com.cn/detail/155146585614349.html (accessed 16 January 2023).

Wen J and Nie H (2014) Yuedong Xinguan will be acquired and preserved by the government. *Beijing Times*, 9 January. Available at: http://culture.people.com.cn/n/2014/0109/c22219-24066924.html (accessed 14 February 2023).

Wong C, Qiao M and Zheng W (2018) 'Dispersing, regulating and upgrading' urban villages in suburban Beijing. *Town Planning Review* 89(6): 597–621. DOI: 10.3828/tpr.2018.41.

Wu F (2016) State Dominance in Urban Redevelopment: Beyond Gentrification in Urban China. *Urban Affairs Review* 52(5). SAGE Publications Inc: 631–658. DOI: 10.1177/1078087415612930.

Wu F and He S (2005) Changes in Traditional Urban Areas and Impacts of Urban Redevelopment: A Case Study of Three Neighbourhoods in Nanjing, China. *Tijdschrift voor Economische en Sociale Geografie* 96(1): 75–95. DOI: 10.1111/j.1467-9663.2005.00440.x.

Xinhua (2015) Beijing releases plan to address 'urban diseases'. Available at: http://english.www.gov.cn/news/top_news/2015/07/17/content_281475148679904.htm (accessed 27 February 2023).

Xinhua (2017) China Focus: Xiongan's key role is to receive Beijing's non-capital functions: vice premier. Available at: http://www.xinhuanet.com//english/2017-04/15/c_136209823.htm (accessed 27 February 2023).

Xu Z and Lin GCS (2019) Participatory urban redevelopment in Chinese cities amid accelerated urbanization: Symbolic urban governance in globalizing Shanghai. *Journal of Urban Affairs* 41(6). Routledge: 756–775. DOI: 10.1080/07352166.2018.1536420.

Ye X and Wen B (2017) The dispersal of 100,000 migrants in less than two years. *Beijing Evening News*, 9 July. Available at: http://www.xinhuanet.com//politics/2017-07/09/c_1121289271.htm (accessed 16 February 2023).

Yu C (2022) Dispersal of Non-capital Functions is the Key to the Creation of a Mordern Capital Metropolitan Area. Available at: https://export.shobserver.com/toutiao/html/524231.html (accessed 5 May 2023).

Yu L and Hou Y (2019) Demolition of 30,000m2 illegal constructions began outside the west gate of Beihang University. *Beijing Daily*, 2 August. Available at: http://www.beijing.gov.cn/gate/big5/www.beijing.gov.cn/gate/big5/www.beijing.gov.cn/ywdt/zwzt/sjzzcts/zxjz/201908/t20190802_1836136.html (accessed 16 February 2023).

Yuan Y and Song W (2020) Mechanism and Effect of Shantytown Reconstruction under Balanced and Full Development: A Case Study of Nanjing, China. *Sustainability* 12(19). 19. Multidisciplinary Digital Publishing Institute: 7979. DOI: 10.3390/su12197979.

Zhang L, Chen J, Hao Q, et al. (2018) Measuring the NIMBY effect in urban China: the case of waste transfer stations in metropolis Shanghai. *Journal of Housing and the Built Environment* 33(1): 1–18. DOI: 10.1007/s10901-017-9565-2.

Zhang N (2017) The demolition of old residential quarters surrounding Tiantan begins. *Beijing Evening News*, 8 March. Available at: http://www.xinhuanet.com//politics/2017-03/08/c_1120591868.htm (accessed 16 February 2023).

Zhao Z (2018) Shantytown redevelopment helped 100 million people to improve their living conditions in its first decade of implementation. *People's Daily*, 27 August. Available at: http://politics.people.com.cn/n1/2018/0827/c1001-30252340.html (accessed 12 November 2021).

Chapter 4. Housing Cost Burden, Homeownership, and Self-Rated Health among Migrant Workers in Chinese Cities: The Confounding Effect of Residence Duration

Abstract

Housing is a critical social determinant of health. Research on the impact of housing on health among migrants is more complex than that of the general population because of migrants' health decline over time: while migrants exhibit a health advantage upon arrival, they gradually lose it as they stay longer in the host city. Existing studies on migrants' housing and health have paid little attention to the confounding effect of residence duration and are thus prone to misleading results. Using data from the 2017 China Migrants Dynamic Survey (CMDS), this study fills in the gap by examining how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). The study shows that migrant workers with higher housing cost burden and longer residence duration tend to have worse SRH. Incorporating residence duration attenuates the crude association between homeownership and worse SRH. The results imply that the health decline among migrants can be attributed to the discriminatory *hukou* system—a system that limits migrants' access to social welfare and puts them in a socioeconomically disadvantaged position. The study thus emphasizes the removal of structural and socio-economic barriers faced by the migrant population.

1 Introduction

China has witnessed a surge in internal migration in the past few decades, primarily from rural to urban areas. The number of internal migrant workers increased from 6 million in 1982 to 236 million in 2019, representing an increase from 1% to 17% of the Chinese population (Chan, 2013;

National Bureau of Statistics of China, 2020). Most of the people migrated for better economic and employment opportunities. While migrants move to cities for a better living, the household registration (*hukou*) system has become a barrier for them to climb up the social ladder and integrate into the local communities (Wu and Wang, 2014; Zhang et al., 2014; Zhong et al., 2017). The internal migrants are Chinese citizens, but without local *hukou*, they can only have limited access to social welfare provided by local governments (Song and Smith, 2021). Due to institutional discrimination embedded in the *hukou* system, internal migrants in China are more likely to experience housing affordability problems than local residents (Huang and Tao, 2015; Wang et al., 2010; Zheng et al., 2009).

Housing is a key social determinant of health (Shaw, 2004). Housing-related financial stress, such as a high housing cost burden and a lack of homeownership, is found to be closely related to adverse health outcomes (Burgard et al., 2012; Frank et al., 2006; Joint Center for Housing Studies, 2019; Manturuk, 2012; Meltzer and Schwartz, 2016; Wang et al., 2019, 2021). However, although the influence of financial housing stress on the health of the general population is well established in the literature (ibid.), limited study has been conducted on the migrant population. It is important to study the housing determinants of health among migrants because while migrant workers have made great contributions to the local economy (Chan, 2010; Qian and Guo, 2019), their daily exposure to precarious and insecure housing situations (Huang and Tao, 2015; Lu and Qin, 2014; Wu and Wang, 2014) may jeopardize their health and ability to work.

Research on the impact of housing on health among migrant workers is more complex than that of the general population because of the health decline among migrants over time. When studying housing and health in the general population, it is necessary to adjust for socio-economic status (SES) because wealthier individuals tend to not only have lower housing stress but also

better health (Baker et al., 2013; Rohe and Lindblad, 2013). In this situation, SES is called a confounder as it is independently related to both the independent variable of interest (housing) and the outcome (health). Additional confounders emerge when it comes to the migrant population.

A decline of health over time was observed among (im)migrants in both China and other countries (Chen, 2011; Diaz et al., 2016; Fennelly, 2007; Lu and Qin, 2014). It refers to the phenomenon that while newly arrived (im)migrants tend to have better health than their local counterparts, the health advantage of the migrant population tends to decline as they stay longer in the host city. The health advantage upon arrival can be explained by the migrant health selection, where healthier individuals are more likely to migrate (ibid.). The negative association between residence duration and migrant health is found to be attributed to continuous exposure to acculturative stress, discrimination, and insufficient healthcare (Ahmed et al., 2016; Leong et al., 2013; Mazur et al., 2003).

Migrants' duration of stay in the host city is not only associated with deteriorating health but also related to a higher probability of owning a home in the city (Boehm and Schlottmann, 2008). We may also expect a decrease in housing cost burden as migrants stay longer and become established in the host city. Residence duration is thus a key confounder to be considered in the study of housing stress and migrant health.

Not taking account of residence duration in the study of housing and health among the migrant population can result in misleading conclusions. For instance, if residence duration was not incorporated as a covariate in the regression analysis, a potentially positive association between homeownership and migrant health could turn out to be insignificant. Researchers might end up with biased estimates if they fail to account for the fact that migrants who own a home in the host city also tend to have stayed longer in the city and thus are more likely to lose their health

advantage due to long-term exposure to poverty and a lack of access to healthcare. The positive health effect of owning a home and having lower housing cost burden can be canceled out by migrants' long-term exposure to institutional barriers in the host city and thus lead to flawed research results and inaccurate policy implications.

The purpose of this study is to examine how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). Specifically, I focus on two related research questions: (1) Is there an association between housing cost burden, homeownership, and migrant workers' self-rated health (SRH)? If so, to what extent? (2) Does the inclusion of residence duration modify the relationships of housing cost burden and homeownership with migrant SRH? The 2017 China Migrant Dynamic Monitoring Survey (CMDS) is used to answer the research questions.

I begin the article by reviewing the linkages between financial housing stress, health, and migration. Followed by the literature review are an overview of the data sources, data cleaning process, and descriptive statistics of migrant workers in the sample. I then present results from the logistic regressions on migrant health. I conclude with a summary of findings and a discussion on the research and policy implications.

2 Financial Housing Stress, Health, and Migration

Linking housing cost burden, homeownership, and health

Multiple pathways have been identified that link housing cost burden with people's health conditions. First, households with high housing cost burdens tend to spend less on food and healthcare (Fletcher et al., 2009; Frank et al., 2006; Joint Center for Housing Studies, 2019; King, 2018). Less spending on food and healthcare can lead to adverse physical health outcomes. It is

especially the case for migrants who live in large cities where the cost of living is higher. Second, residential instability resulted from high housing cost burden shows a negative association with health. Burgard et al. (2012) found that people who have recently experienced homelessness have a higher probability of reporting fair or poor health. Empirical evidence suggests that the negative effect of housing instability on health is mediated by a decrease in the sense of control and an increase in anxiety and stress (Daoud et al., 2016; Nettleton and Burrows, 1998; Ross and Squires, 2011).

Homeownership is found to have a positive impact on mental health, even after adjusting for selection bias (Rohe and Lindblad, 2013). Manturuk (2012) noted that homeownership is an endogenous variable correlated with other individual and household characteristics that may influence a person's health. Using propensity score matching to correct for the selection bias, Manturuk found that homeownership has an indirect impact on mental health that is fully mediated by the perceived sense of control.

The relationship between homeownership and people's physical health is less clear. On the one hand, Lindblad and Quercia (2015) found that homeownership exerts a positive influence on people's physical health, after controlling for sense of control and other potential confounders. On the other hand, by conducting in-depth interviews in three British regions, Smith et al. (2003) showed that the effect of homeownership on physical health can be negative when the mortgage payment stress is high. It is thus important to look at both homeownership and housing cost burden in the study of housing determinants of health.

Studies on the housing determinants of health in the Chinese context started to emerge in recent years as high-quality survey data became available. The current research mainly focuses on physical housing conditions such as overcrowding, availability of tap water, and access to a private

bathroom (Chen et al., 2021; Li and Liu, 2018; Wang et al., 2019; Xiao et al., 2020). A much smaller proportion of the empirical evidence establishes relationships between housing-related financial strains and health. Xie et al. (2021) found that, unlike research in other countries where homeowners exhibited better mental health than renters, homeowners in Guangzhou demonstrated a higher level of perceived stress. Y. Wang et al. (2021) examined the association between housing affordability and health using the 2016 wave of the China Family Panel Studies (CFPS). The authors found that unaffordable housing has a negative impact on the mental health of urban residents, adjusting for physical housing conditions and neighborhood environment. The study also investigated the impacts of housing affordability across different subgroups of the population (such as male vs. female, low-income vs. high income, and single vs. married) and uncovered significant inter-group differences in the housing effect on health. While Y. Wang et al. (2021) did not include migrant workers as a subgroup of their study, it is reasonable to expect the relationship between housing affordability and health to differ between migrant workers and local residents due to the *hukou*-based discrimination faced by the former group.

The hukou system

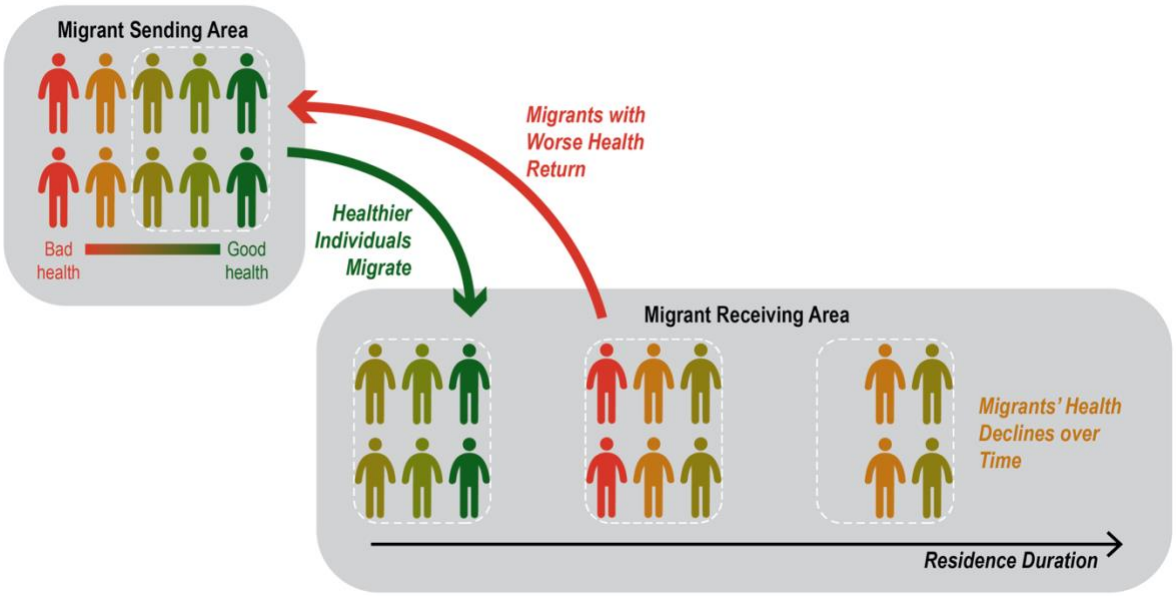
It is common for (im)migrants to have limited access to social welfare in their destinations. In China, migrant workers face greater affordability and health challenges compared to local residents because of the discriminatory *hukou* system. The *hukou* system, established in the late 1950s, assigns each individual a household registration identity, primarily based on place of birth (Song and Smith, 2021).[1] Individual hukou is directly tied to the social welfare that a person can access, which includes but not limited to healthcare, pension benefits, and housing assistance (Chen and Fan, 2016; Song, 2014; Zhou and Cheung, 2017). Owing to the lack of local *hukou*, migrants are

not eligible for most of the subsidized housing programs in large Chinese cities (Huang and Tao, 2015; Wang and Goetz, 2021). Limited access to housing and healthcare resources in the destination can exacerbate the financial housing stress of migrant workers and result in negative health outcomes. While being healthier than the local population due to self-selection in the migration process (Chen, 2011; Hu et al., 2008), migrants' health deteriorates as they stayed longer in the host society. The phenomenon is also known as the health decline among migrants, which is detailed below.

Health decline among migrants

Socio-economic status (SES) is a confounder that most studies on the housing determinants of health control for as it is associated with both people's health and their financial housing stress (Baker et al., 2013; Rohe and Lindblad, 2013). When we confine the research subject to migrant workers, additional individual-level characteristics need to be accounted for due to the health decline among migrants over time.

Figure 4-1. The health decline among migrants over time



The health decline was first recognized in western countries where (im)migrants enter the host society with better health but then gradually lose their health advantage and converge to the health level of the natives (Escobar et al., 2000; Fennelly, 2007; Kennedy et al., 2015; McDonald and Kennedy, 2004; Parker Frisbie et al., 2001; Razum et al., 2000). The health advantage of the immigrant population has been ascribed to the self-selection in the migration process in which younger and healthier people are more likely to migrate and (im)migrants with deteriorating health conditions often choose to return to their hometowns (Figure 4-1). As migrants stay longer in the receiving area, their health gradually deteriorates. The health decline is found to be associated with continuous exposure to acculturative stress, discrimination, and inadequate access to healthcare and other social assistances (Ahmed et al., 2016; Leong et al., 2013; Mazur et al., 2003). The health decline has also been observed among the internal migrants in China. Using data from a household survey conducted in Beijing, Chen (2011) finds that the physical health advantage of urban-to-urban migrants in Beijing diminished as their residence duration increased. Xie (2019) uses a fifteen-city migrant survey conducted in China between 2008 and 2009 and find that longer residence duration was associated with worse mental health among migrants.

Residence duration in the host city can affect both migrants' housing stress and their health. Longer residence duration is not only linked with deteriorating health, but also found to be associated with higher probability of owning a home in the destination (Boehm and Schlottmann, 2008). Both immigrants in the US and internal migrants in China are found to rapidly progress into homeownership as they reside longer in the receiving areas (Fang and Zhang, 2016; Myers and Liu, 2005). Housing cost burden also fluctuates with migrant's length of stay in the destination. In the study of immigrant housing experience in the U.S., McConnell and Akresh (2010) found that immigrant housing cost burden varies by the time they spent in the country. They noted that

immigrants who stayed in the U.S. between 5 to 10 years have higher housing cost burdens, while immigrants in the country for more than 10 years have lower housing cost burdens than immigrants who arrived less than a year (ibid.). It is thus necessary to control for the confounding effect of residence duration in the study of the housing determinants of health among migrants.

Existing studies on financial housing stress and health fail to account for the health decline among migrants and are thus prone to biased results. Miranda et al. (2017) examine whether the association between homeownership and self-rated health differs by immigration status in the US. Without controlling for residence duration, the authors find that homeownership's association with better self-rated health is limited to US citizens. For non-citizen immigrants, homeownership is not protective for self-rated health. The result is problematic because it fails to control for the fact that non-citizen homeowners also tend to have longer residence duration in the US and thus are more likely to subject to health decline due to limited access to healthcare and other social benefits. If the duration of residence is not taken into account in the statistical modelling process, the positive effect of homeownership on (im)migrant health is likely to be canceled out by (im)migrant homeowners' longer exposure to acculturative stress and inadequate healthcare. Some studies (Li and Liu, 2018; Xie, 2019) include residence duration as a covariate but have not probed into how the incorporation of residence duration would alter the association between housing stress and health among (im)migrants. This paper aims to fill in the gap by examining the confounding effect of residence duration and how it relates to migrant's housing cost burden, homeownership, and health.

3 Data and Methods

The study uses data from the 2017 China Migrants Dynamic Survey (CMDS)--a nationally representative survey conducted by the National Health Commission of China. The survey took the 2016 data on internal migrants reported by 31 provinces in mainland China as the sampling frame. A stratified three-stage probability proportional to size (PPS) technique was used to sample migrants who were 15 years old and over who had stayed in the host city for at least one month without being granted local *hukou* (students and soldiers were excluded). The survey questions covered a broad range of topics, including basic demographic information of the respondents and their family members, employment, migration, health, and social integration. Because the survey did not include residents with local *hukou*, this paper focuses on the migrant worker population itself and explores the within-group differences.

In addition to the cross-sectional data on migrant workers, I also collected supplementary city-level data on population size from municipal statistical yearbooks. Given that the housing affordability problem among migrant workers is the most pronounced in large cities[2], I confined my study to the 50 largest Chinese cities by population in 2017 (Figure 4-2). These cities are not only vibrant regional economic centers but also major destinations for internal migration in China. Approximately 460 million people lived in these cities in 2017, constituting 33% of China's total population.

I excluded respondents who identified themselves as unemployed due to the lack of data on their working conditions[3]. To calculate the housing cost relative to income, I remove individuals who reported zero or negative income from the sample[4]. Moreover, I exclude respondents with the top 0.1% of housing cost burden values to avoid distortion resulting from extreme values[5].

Individuals with missing values in the variables of interest were also removed[6]. After data cleaning, I obtained a dataset of 78,081 migrant workers (Table 4-1).

Figure 4-2. The 50 largest Chinese cities by population

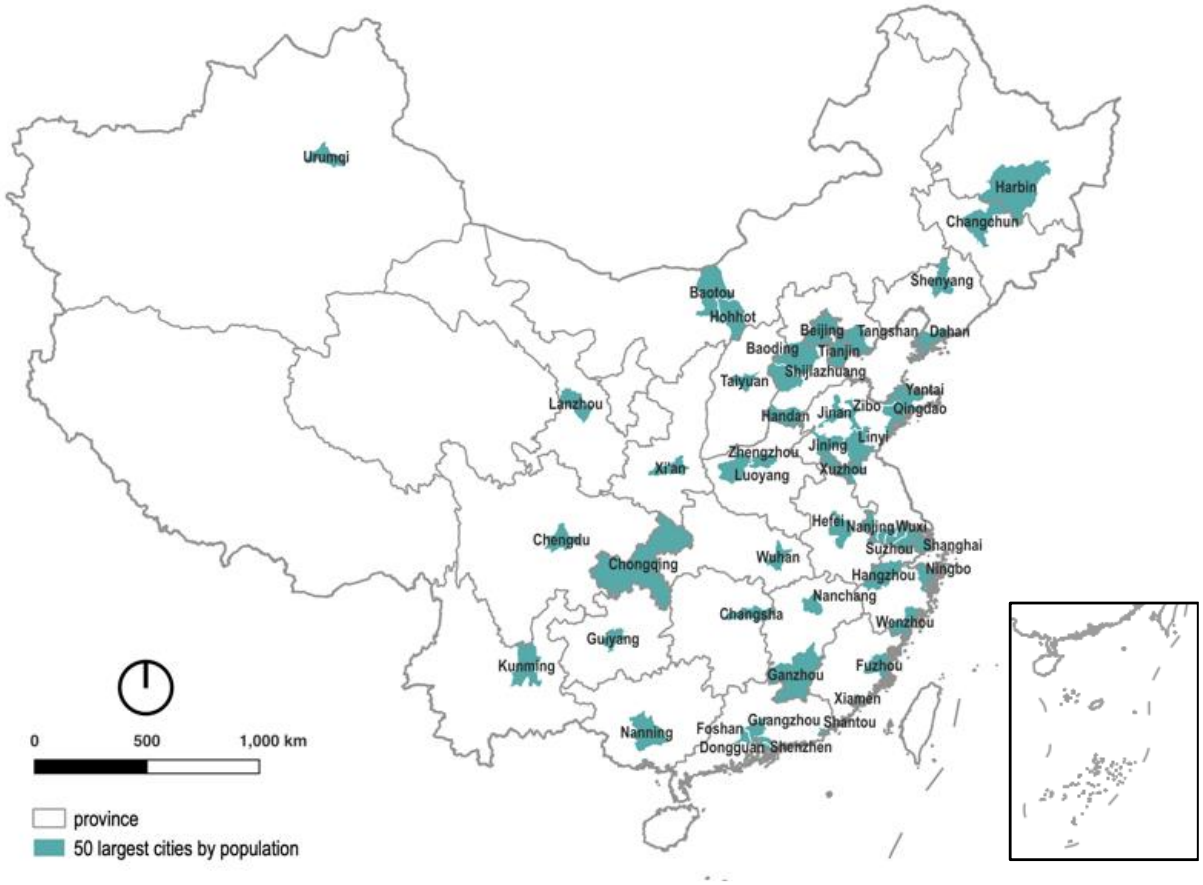


Table 4-1. Descriptive statistics and bivariate analyses (n=78,081)

Variable		Weighted Mean/percentage		Unweighted Mean/percentage		Average Marginal Effect (AME) †	
Self-rated health (%)	Good	85.6		85.8			
	Fair/poor/very poor	14.4		14.2			
Housing cost burden (mean)		12.5	(11.9)	13.8	(12.9)	-0.006	***
Homeownership (%)	Homeowner	16.8		22.7		-0.018	***
	Non-homeowner	83.2		77.3			
Residence duration	<1 year	15.9		14.9			
	1 to <5 years	36.5		40.5		-.015	***
	5 to <10 years	23.9		24.1		-.041	***
	>=10 years	23.7		20.5		-.074	***
Age (year, mean)		35.8	(9.6)	35.3	(9.7)	-0.070	***
Sex (%)	Female	44.1		43.8		-0.006	*
	Male	55.9		56.2			
Marital status (%)	Married	80.4		79.2		-0.061	***
	Not married	19.6		20.8			
Household size (mean)		3.1	(1.2)	3.0	(1.2)	-0.061	***
Education (%)	High school and above	43.5		45.0		0.052	***
	Middle school and below	56.5		55.0			
Monthly earnings (1,000 yuan, mean)		5.5	(4.7)	4.9	(4.1)	0.024	***
Work hours (mean)		54.8	(17.2)	55.1	(17.5)	-0.017	***
Occupation (%)	Senior Official/Manager/Professional	12.0		11.2			
	Clerical Support Worker	1.6		1.7		0.019	*
	Service and Sales Worker	51.0		59.0		-0.028	***
	Agricultural/Forestry/Fishery Worker	0.7		0.8		-0.110	***
	Manufacturing/Transport/Construction Worker	29.4		22.3		-0.020	***
	Other	5.3		5.0		-0.050	***
Labor contract (%)	Yes	83.9		81.5		0.025	***
	No	16.1		18.5			
Agricultural hukou (%)	Yes	80.4		76.9		-0.021	***
	No	19.6		23.1			
Family member with local hukou (%)	Yes	5.4		6.9		-0.002	
	No	94.6		93.1			

Notes: Standard deviations are in parentheses.
†Unweighted bivariate logistic regressions. AMEs for continuous variables are for a standard deviation increase.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Self-rated health (SRH) was used to capture the migrant's overall health status. As an assessment of individuals' subjective health at the time of the survey, SRH is a reliable predictor of mortality and other health outcomes (Benyamini, 2011). CMDS asked migrant workers to rate their health on a four-point scale ranging from 1 (very poor) to 4 (good). About 85.6% of the migrant workers in the sample reported themselves as having good health. Because SRH is a highly skewed variable, I created a binary variable with 1 indicating good health and 0 indicating fair/poor/very poor health. The dichotomization of SRH has been used in prior research in the fields of urban and housing studies (Collins et al., 2009; Kemppainen et al., 2020).

Logistic regression[7] is used to assess the association between financial housing stress and self-rated health. The logistic regression model has the following general specification:

$$\begin{aligned} Logit(Good\ SRH) = {} & \beta_0 + \beta_1(Housing\ Cost\ Burden) \\ & + \beta_2(Homeownership) \\ & + \beta_3(Demographics) \\ & + \beta_4(City\ Fixed\ Effects) \\ & + \beta_5(Residence\ Duration) \end{aligned} \quad (1)$$

Housing cost burden refers to the percentage of household income used on housing. It is calculated by dividing a household's monthly housing cost (on rent or mortgage payment) over its monthly income. Some employers provide rental subsidies or free dormitories for migrant workers. For migrant workers who received either type of rental support, a question was asked in the survey about the estimated market value of the rental support they received. I took the reported amount of rental assistance into account in the computation of the housing cost burden[8]. It is worth noting that the housing cost does not include utility costs due to limited data availability. Homeownership

is defined as owning a residence in the host city. As shown in Table 4-1, the weighted homeownership rate for migrant workers in the sample was 16.8% in 2017, significantly lower than the 80.8% overall homeownership rate in urban China (Gan, 2018).

Thirty percent of household income is commonly used as an upper threshold of housing affordability, indicating that households that pay over the limit as financially burdened (Leishman and Rowley, 2012; Schwartz and Wilson, 2008; Stone, 2006). Applying the thirty percent criterion, about 8.4% of the migrant workers were cost-burdened in 2017. This proportion is consistent with the previous literature on migrants' housing affordability in China (Huang and Tao, 2015; Li and Liu, 2018). When breaking down by homeownership (Table 4-2), the proportion of the cost-burdened is higher among the homeowners than the non-homeowners. Bivariate logit analysis shows that, on average, the probability of being housing cost burdened is 0.079 higher for migrants who own a home in the host city ($p<0.001$). Housing cost burden was treated as a continuous variable in the regression analysis. I have run models in which housing cost burden was coded as a categorical variable (using 30% of household income as the threshold). The size and direction of coefficients were consistent regardless of the housing cost burden measure utilized (see Appendix, Table A4-1).

Table 4-2. Housing cost burden, by homeownership

		Not cost burdened	Cost burdened (> 30% of income)
Weighted	Homeowner	83.4	16.6
	Non-homeowner	93.3	6.7
Unweighted	Homeowner	83.5	16.5
	Non-homeowner	91.4	8.6

Note: Relative frequency within each row.

Residence duration is treated as a categorical variable to make the analysis comparable to prior research (McConnell and Akresh, 2010). To ensure the robustness of the results, I have run

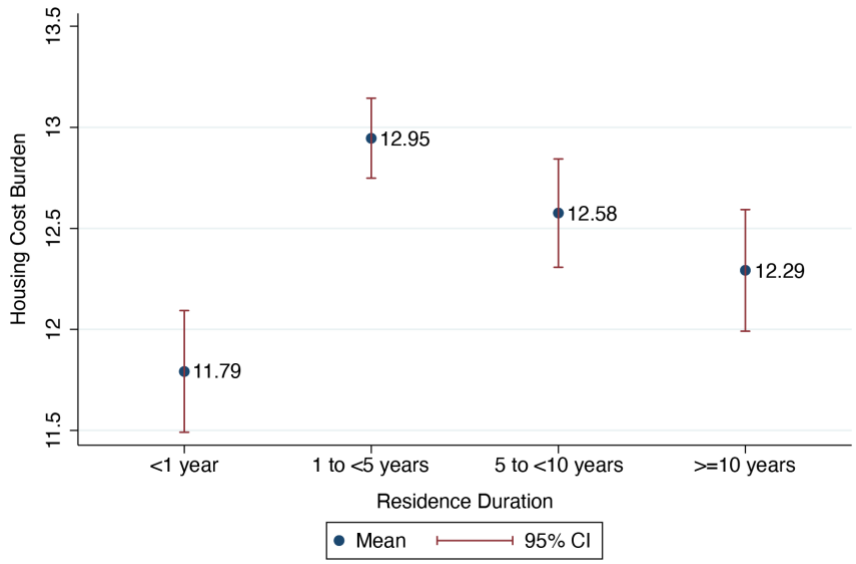
models in which residence duration was coded as a continuous variable (see Appendix, Table A4-2). The results were consistent regardless of the residence duration measure used. The crosstabulation between homeownership status and residence duration suggests that, aligning with prior research (Boehm and Schlottmann, 2008) the probability of being a homeowner increases as migrant workers stay longer in the host city (Table 4-3). Migrant housing cost burden varies by the time that they spent in the host city. Different from immigrants in the United States (McConnell and Akresh, 2010), internal migrants in China have the lowest housing cost burden upon arrival (Figure 4-3). The average housing cost burden of migrants who stayed in the host city between 1 to 5 years is statistically higher than that of migrants who arrived at the host city in less than one year ($p<0.001$). However, the average housing cost burden of long-term migrants (>=10 years) is not statistically different from that of the newly arrived migrants.

Table 4-3. Homeownership, by residence duration

		Non-homeowner	Homeowner
Weighted	<1 year	94.6	5.4
	1 to <5 years	87.5	12.5
	5 to <10 years	80.2	19.8
	>=10 years	71.8	28.2
Unweighted	<1 year	91.4	8.6
	1 to <5 years	81.2	18.8
	5 to <10 years	72.2	27.8
	>=10 years	65.4	34.6

Note: Relative frequency within each row.

Figure 4-3. Housing cost burden, by residence duration (weighted)



I also controlled for demographic covariates, which include age, gender (female=1), marital status (married=1), household size, education attainment (high school and above=1), monthly earnings, work hours[9], occupation, labor contract (yes=1), type of hukou (agricultural=1)[10], and family member with local hukou (yes=1)[11]. The categorical variable occupation is employed to isolate the cross-occupation heterogeneity in health risks. The occupation covariate can partially capture the effect of physical work demand on health, since some occupations (e.g., agricultural workers) tend to have higher physical demand and worse working environment than others (Fan et al., 2015; Liu et al., 2012; Yu et al., 2012). City fixed effects were included to control for all between-city differences.

Unweighted data were employed in the regression analyses. I did not use sampling weights because (1) unnecessary weighting results in inefficient estimators without reducing bias (Bollen et al., 2016); (2) further comparison of marginal effects of variables of interest shows that the

differences between the weighted and unweighted models are not statistically significant (see Appendix, Table A4-3).

4 Results

The temporal dimension of financial housing burden and health

Longer residence duration is associated with a shifting level of housing cost burden, a higher probability of owning a home in the host city, and a lower probability of having good health. The relationship between residence duration and housing cost burden changes over time. Newly arrived (<1 year) and long-term (>=10 years) migrant workers have the lowest level of housing cost burden, while migrant workers who stayed in the host city between 1 to 5 years are, on average, the most housing cost burdened (Figure 4-3). Longer residence duration results in a higher probability of being a homeowner (Table 4-3). For a standard deviation increase in a migrant's residence duration (about 5.8 years), the migrant's probability of being a homeowner rises by 0.080 ($p<.001$). The same amount of increase in the residence duration decreases the migrant's probability of reporting good health by 0.027 ($p<.001$). The results are consistent with prior research on residence duration and its relationship with migrant homeownership (Boehm and Schlottmann, 2008; Myers and Liu, 2005) and health (Chen, 2011; Diaz et al., 2016).

Lower housing cost burden, better health

Four nested models of housing cost burden and homeownership on migrant SRH were tested (Table 4-4). The first model includes only housing cost burden and homeownership as the explanatory variables. Demographic covariates were added in the second model, and then city fixed effects in the third model. Residence durations were incorporated in the fourth model. It is worth noting that nested model comparisons are problematic for logistic regressions because of

the possible heterogeneity in the residual variances (Kuha and Mills, 2020; Long and Mustillo, 2018; Mood, 2010). When comparing the coefficients of different models on the same sample, y- or fully-standardization can solve the problem of unobserved heterogeneity. Here, I present the fully standardized coefficients. From Model 1 to 4, the Bayesian information criterion (BIC) indicates an increase in the model fit to the data, adjusting for model complexity.

The regression results suggest that the negative association between housing cost burden and migrant SRH is persistent, even after controlling for demographics, city fixed effects, and residence duration ($p<.001$ in Model 1-4). In Model 4, a one standard deviation increase in housing cost burden is associated with, on average, a 0.0259 standard deviation decrease in the log odds of being in good health ($p<0.001$). Higher housing cost burden, on average, leads to worse health among migrant workers.

The association between homeownership and health changes significantly after controlling for residence duration. In Model 1, the log odds of reporting good health for migrant homeowners are, on average, about a 0.0336 standard deviation lower compared to that for migrant non-homeowners ($p<0.001$), suggesting that owning a home in the host city is associated with worse health outcomes among migrant workers. The negative association between homeownership and good SRH no longer exists after residence duration is added to the model. Incorporating residence duration as a covariate greatly attenuates the negative association between homeownership and good health, which is observed when comparing the coefficients and p-values of Model 3 (-0.0129, $p<0.05$) and Model 4 (-0.0068, $p=0.277$). The linkage between owning a home in the host city and worse health is no longer statistically significant after all covariates are included.

Table 4-4. Logistic regressions on good health (n=78,081)

	Model 1	Model 2	Model 3	Model 4
Housing cost burden	-0.0250***	-0.0411***	-0.0257***	-0.0259***
Homeowner	-0.0336***	-0.0409***	-0.0129*	-0.0068
Demographics				
Age		-0.2599***	-0.2797***	-0.2698***
Female		-0.0422***	-0.0488***	-0.0486***
Married		-0.0079	0.0115	0.0131
Household size		-0.0029	-0.0065	-0.0021
High school degree and higher		0.0060	0.0135*	0.0129
Monthly earnings		0.0650***	0.0595***	0.0600***
Work hours in the past week		-0.0458***	-0.0424***	-0.0409***
Occupation (ref. Official/manager/professional)				
Clerical support worker		0.0141*	0.0183**	0.0180**
Service/sales worker		0.0360***	0.0409***	0.0418***
Agricultural/forestry/fishery worker		-0.0052	-0.0087	-0.0093
Manufacturing/transport/construction worker		0.0235*	0.0209*	0.0204*
Other		-0.0023	-0.0005	-0.0002
Labor contract		0.0282***	0.0246***	0.0262***
Agricultural hukou		-0.0283***	-0.0030	-0.0027
Family member with local hukou		0.0017	-0.0089	-0.0075
Residence duration (ref. <1 year)				
1 to <5 years				-0.0134
5 to <10 years				-0.0328***
>=10 years				-0.0480***
City fixed effects			Yes	Yes
Pseudo R2	0.0009	0.0477	0.0851	0.0858
BIC	63751	60935	59104	59088

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

The confounding effect of residence duration

Because logistic regressions are nonlinear in terms of the relationship between predictors and the probability of the outcome, we cannot only compare the fully standardized regression coefficients within each model to assess the cross-model difference (Mize et al., 2019). To assess a variable's effect change across different models, marginal effects are useful because they quantify effects in probabilities (instead of log odds) and they avoid the unobserved heterogeneity problem when comparing logit coefficients (Karlson et al., 2012). In Table 4-5, I examine how the average

marginal effects (AMEs) of housing cost burden and homeownership change when covariates are added to the model. The AME tells us how much the predicted probability would change for a discrete change in the variable of interest, averaging across all respondents. The AME of housing cost burden (+SD) does not change when residence duration is introduced to the model (Model4 - Model3), indicating no confounding effect of residence duration on the relationship between housing cost burden and migrant SRH (Figure 4-4).

Table 4-5. Cross-model difference in the average marginal effects (AMEs) of housing cost burden and homeownership on good health

Panel A: AME	Model 1 Housing cost burden + Homeownership	Model 2 + Demographics	Model 3 + City fixed effects	Model 4 + Residence duration
Housing cost burden (+SD)	-0.0056*** (0.0013)	-0.0093*** (0.0012)	-0.0057*** (0.0012)	-0.0058*** (0.0012)
Homeowner	-0.0182*** (0.0031)	-0.0223*** (0.0034)	-0.0068* (0.0033)	-0.0032 (0.0033)
Panel B: Cross-model difference		Model2 - Model1	Model3 - Model2	Model4 - Model3
Housing cost burden (+SD)		-0.0037*** (0.0004)	0.0036*** (0.0004)	-0.0001 (0.0000)
Homeowner		-0.0041** (0.0015)	0.0155*** (0.0014)	0.0036*** (0.0005)

Notes: Seemingly unrelated estimation (SUEST) is used to combine estimates from the four models and compare marginal effects. Standard errors are in parentheses.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

The comparison of marginal effects suggests that adjusting for residence duration significantly altered the effect of homeownership. A direct test of the difference in the AME of homeownership from Model 4 to Model 3 shows that adding residence duration significantly decreases the effect size of homeownership by 0.0033 (p<.001; see Panel B of Table 4-4). The significant change in AME indicates that the adverse health consequence associated with homeownership in Models 1-3 may be attributed to longer residence duration among migrant homeowners (Figure 4-5).

Figure 4-4. Higher housing cost burden, worse migrant SRH

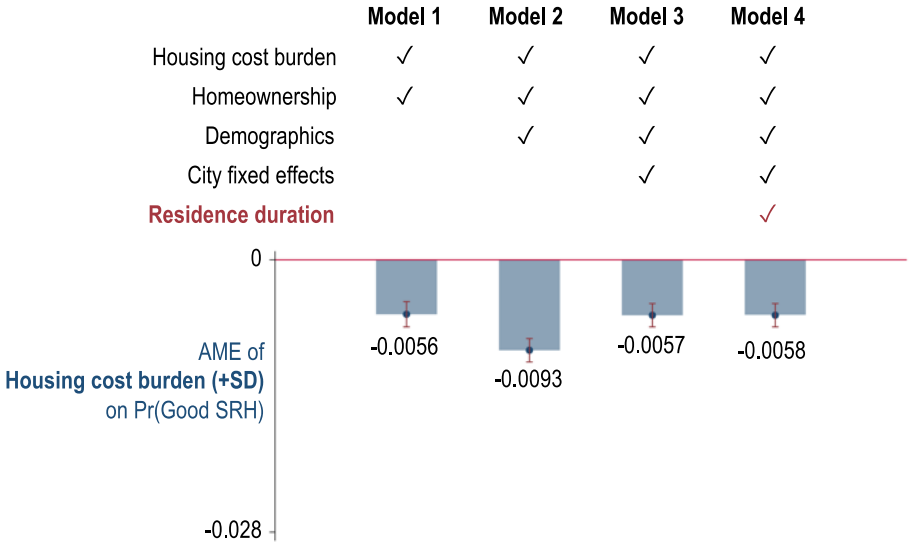
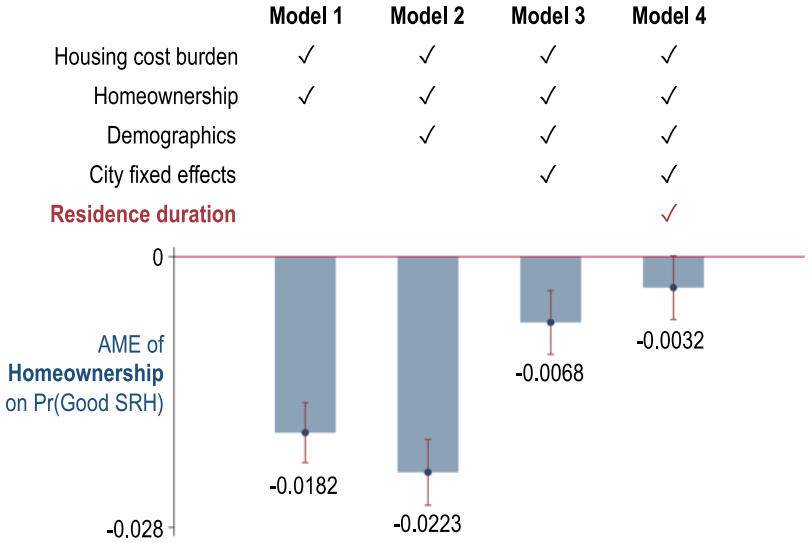


Figure 4-5. Residence duration attenuates the effect of homeownership



5 Discussion

In this article, I present results from a series of nested logistic regression models that examines how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). In general, migrant workers with higher

housing cost burden and longer residence duration tend to have worse SRH. There is no statistically significant relationship between homeownership and migrant SRH. While the bivariate analysis suggests a negative relationship between homeownership and health, the inclusion of residence duration in the multivariate analyses significantly attenuated the association between owning a home and worse SRH among migrant workers. This implies that the crude association between homeownership and worse health may be explained by longer residence duration in the host city among migrant homeowners.

The health decline among migrant workers in Chinese cities can be explained in multiple ways, all of which can be tied back to the discriminatory *hukou* system. First, for migrant workers, long-term residence in the host city often means persistent exposure to inadequate healthcare (Hesketh et al., 2008; Lu and Qin, 2014; Song and Smith, 2021) and *hukou*-based discrimination in the housing system (Huang and Tao, 2015; Huang and Yi, 2015; Liu et al., 2019). Long-term exposure to inadequate healthcare access can compound housing-related stress resulted from high housing cost burden or a lack of homeownership, leading to adverse health outcomes among migrants. Second, in the Chinese context, once migrants obtain local hukou, they are no longer considered as migrants anymore. Migrants with higher educational attainment and earnings are more likely to transition into local residents, thus are not included in CMDS. Long-term migrants who have not yet obtained the local hukou are more likely to be socioeconomically disadvantaged. Third, newly arrived migrants and long-term migrants may have different reference groups when they rate their health. It is possible that newly arrived migrants compare themselves with peers in the sending areas, and long-term migrants compare themselves with locals in the receiving cities. All explanations above can be traced back to the discriminatory *hukou* system, which limits migrants' access to social welfare (including healthcare and housing assistance) and puts them in

a socioeconomically disadvantaged position in the first place. The study thus calls for the removal of structural and socio-economic barriers embedded in the *hukou* system to advance the overall health of the migrant population.

The study also underscores the importance of adjusting for residence duration in the study of housing and health among migrants. Existing studies on migrants' housing status and health have rarely accounted for the confounding effect of migrants' length of stay in the host city and no study has probed into how the exclusion of residence duration may affect the relationship between housing-related factors and health. This study shows that residence duration in the host city plays a significant role in sorting individuals into different homeownership and health statuses. Long-term migrants are more likely to own a home in the host city and have worse health compares to newly arrived migrants. If we do not take migrant homeowners' long residence duration into account in the statistical analysis, homeownership's protective effect on health may be canceled out by migrant homeowners' longer exposure to inadequate healthcare and precarious housing conditions in the destinations. Therefore, to examine the relationship between housing and migrant health, researchers need to control for not only SES, but also residence duration and other migration characteristics that may constitute alternative explanations for this relationship.

Nevertheless, the extent to which we can adjust for the confounding effects hinges on the data we could access. While being up-to-date and having comprehensive geographical coverage, CMDS is a destination-based survey which cannot capture migrants who have returned to their hometowns due to health deterioration (Song and Smith, 2021). Given the missing return migrants in the survey data, the association between migrant's financial housing stress and health is likely to be biased towards the null. Moreover, CMDS does not provide information about physical housing conditions and neighborhood environment, which are found to be potential confounders

in the analysis of housing affordability and health (Li and Liu, 2015; Xie, 2019). Future research is thus needed (1) to include return migrants in the survey design; (2) to incorporate physical housing features, neighborhood characteristics in the analysis; (3) to test the moderating role of physical housing features on financial housing stress, controlling for migration-related confounders; (4) to examine the causal pathway underlying the association between residence duration, financial housing stress, and health among migrant workers in Chinese cities.

Notes

1. It is possible for migrants to transfer *hukou* from their hometown to the host city, but the chances are low in large cities due to the demanding criteria set by municipal governments (Liu and Shi, 2019).

2. Since 2014, it has become increasingly easy for migrant workers to obtain local hukou in small- and medium-sized cities (Chen and Fan, 2016). It is likely that the effects of financial housing stress on health among migrant workers in small- and medium-sized cities are similar to those among local residents.

3. About 16% of the migrants in the 50-city sample were unemployed at the time of the survey. Among those who were unemployed, about 13% had been looking for job in the past month, about 3% had lost the ability to work.

4. Since people who report zero or negative income are likely to be housing cost burdened, removing these individuals may potentially bias my results toward the null (i.e., there is no association between housing cost burden and migrant health).

5. The association between housing cost burden and migrant health becomes statistically insignificant when including the top 0.1% housing cost burden cases (see Appendix, Table A4-4). The housing cost burden of these extreme cases (n=78) ranges from 105 to 4560. Four extreme cases have a housing cost burden greater than 1000. If excluding the four cases, the regression results (see Appendix, Table A4-5) are consistent with the results that I present in the main text.

6. After removing unemployed individuals and individuals with extreme housing cost burden values, only three observations in the sample have missing values in the variables of interest.

7. I also estimated linear probability models with the same specification and got similar results (See Appendix, Table A4-6).

8. The estimated value of housing support was added both to the numerator (housing cost) and the denominator (household income).

9. Work hours was employed as a continuous variable in the analyses in the main text. I have run models in which work hours was coded as a categorical variable (using 40 hours as the threshold). The size and direction of coefficients were consistent regardless of the work hours measure utilized (see Appendix, Table A4-7).

10. There was an agricultural and non-agricultural divide (or urban-rural divide) in the *hukou* system, where people with urban *hukou* were entitled to social welfare benefits while those with rural *hukou* were not (Whyte, 2010). While the agricultural and non-agricultural classification was officially abolished in 2014 (Goodburn, 2014), the urban-rural divide may take decades to bridge. People with agricultural *hukou* may be more likely to sacrifice their health when encounter housing affordability problems.

11. Family members include immediate family members (spouse, parents, grandparents, children, grandchildren, siblings, and in-laws) who lived or did not live in the same household with the

respondent, and other relatives who lived in the same household with the respondent at the time of the survey.

Reference

Ahmed S, Shommu NS, Rumana N, et al. (2016) Barriers to access of primary healthcare by immigrant populations in Canada: a literature review. *Journal of immigrant and minority health* 18(6). Springer: 1522–1540.

Baker E, Bentley R and Mason K (2013) The mental health effects of housing tenure: causal or compositional? *Urban Studies* 50(2). Sage Publications Sage UK: London, England: 426–442.

Benyamini Y (2011) *Why Does Self-Rated Health Predict Mortality? An Update on Current Knowledge and a Research Agenda for Psychologists*. Taylor & Francis.

Boehm TP and Schlottmann A (2008) Housing Tenure, Expenditure, and Satisfaction Across Hispanic, African-American, and White Households: Evidence From the American Housing Survey. *Cityscape* 10(2). US Department of Housing and Urban Development: 95–158.

Bollen KA, Biemer PP, Karr AF, et al. (2016) Are Survey Weights Needed? A Review of Diagnostic Tests in Regression Analysis. *Annual Review of Statistics and Its Application* 3(1): 375–392. DOI: 10.1146/annurev-statistics-011516-012958.

Burgard SA, Seefeldt KS and Zelner S (2012) Housing instability and health: Findings from the Michigan recession and recovery study. *Social Science & Medicine* 75(12). Part Special Issue: Place, migration & health: 2215–2224. DOI: 10.1016/j.socscimed.2012.08.020.

Chan KW (2010) The Global Financial Crisis and Migrant Workers in China: 'There is No Future as a Labourer; Returning to the Village has No Meaning'. *International Journal of Urban and Regional Research* 34(3): 659–677. DOI: 10.1111/j.1468-2427.2010.00987.x.

Chan KW (2013) China: internal migration. *The encyclopedia of global human migration*. Wiley Online Library.

Chen C and Fan CC (2016) China's Hukou Puzzle: Why Don't Rural Migrants Want Urban Hukou? *China Review* 16(3). The Chinese University of Hong Kong Press: 9–39.

Chen J (2011) Internal migration and health: Re-examining the healthy migrant phenomenon in China. *Social Science & Medicine* 72(8): 1294–1301. DOI: 10.1016/j.socscimed.2011.02.016.

Chen N, Shen Y, Liang H, et al. (2021) Housing and Adult Health: Evidence from Chinese General Social Survey (CGSS). *International Journal of Environmental Research and Public Health* 18(3). Multidisciplinary Digital Publishing Institute: 916.

Collins PA, Hayes MV and Oliver LN (2009) Neighbourhood quality and self-rated health: A survey of eight suburban neighbourhoods in the Vancouver Census Metropolitan Area. *Health & Place* 15(1): 156–164. DOI: 10.1016/j.healthplace.2008.03.008.

Daoud N, Matheson FI, Pedersen C, et al. (2016) Pathways and trajectories linking housing instability and poor health among low-income women experiencing intimate partner violence (IPV): Toward a conceptual framework. *Women & Health* 56(2). Taylor & Francis: 208–225.

Diaz CJ, Koning SM and Martinez-Donate AP (2016) Moving Beyond Salmon Bias: Mexican Return Migration and Health Selection. *Demography* 53(6): 2005–2030. DOI: 10.1007/s13524-016-0526-2.

Escobar JI, Nervi CH and Gara MA (2000) Immigration and mental health: Mexican Americans in the United States. *Harvard review of psychiatry* 8(2). Taylor & Francis: 64–72.

Fan L, Niu H, Yang X, et al. (2015) Factors affecting farmers' behaviour in pesticide use: Insights from a field study in northern China. *Science of the Total Environment* 537. Elsevier: 360–368.

Fang Y and Zhang Z (2016) Migrant household homeownership outcomes in large Chinese cities - the sustained impact of hukou. *Eurasian Geography and Economics* 57(2). Routledge: 203–227. DOI: 10.1080/15387216.2016.1228075.

Fennelly K (2007) The" healthy migrant" effect. *Minnesota medicine* 90(3): 51–53.

Fletcher JM, Andreyeva T and Busch SH (2009) Assessing the effect of changes in housing costs on food insecurity. *Journal of Children and Poverty* 15(2). Routledge: 79–93. DOI: 10.1080/10796120903310541.

Frank DA, Neault NB, Skalicky A, et al. (2006) Heat or Eat: The Low Income Home Energy Assistance Program and Nutritional and Health Risks Among Children Less Than 3 Years of Age. *Pediatrics* 118(5). American Academy of Pediatrics: e1293–e1302. DOI: 10.1542/peds.2005-2943.

Gan L (2018) *An Analysis of Housing Vacancy in Chinese cities in 2017 [2017 Zhongguo Chengzhen Zhufang Kongzhi Fenxi]*. 21 December. CHFS (Survey and Research Center for China Household Finance)).

Goodburn C (2014) The end of the hukou system? Not yet. *University of Nottingham China Policy Institute Policy Papers 2*.

Hesketh T, Jun YX, Lu L, et al. (2008) Health Status and Access to Health Care of Migrant Workers in China. *Public Health Reports* 123(2). SAGE Publications Inc: 189–197. DOI: 10.1177/003335490812300211.

Hu X, Cook S and Salazar MA (2008) Internal migration and health in China. *The Lancet* 372(9651). Elsevier: 1717–1719. DOI: 10.1016/S0140-6736(08)61360-4.

Huang Y and Tao R (2015) Housing migrants in Chinese cities: current status and policy design. *Environment and Planning C: Government and Policy* 33(3): 640–660. DOI: 10.1068/c12120.

Huang Y and Yi C (2015) Invisible migrant enclaves in Chinese cities: Underground living in Beijing, China. *Urban Studies* 52(15). SAGE Publications Ltd: 2948–2973. DOI: 10.1177/0042098014564535.

Joint Center for Housing Studies (2019) The State of the Nation's Housing 2019. Available at: https://www.jchs.harvard.edu/state-nations-housing-2019 (accessed 14 September 2020).

Karlson KB, Holm A and Breen R (2012) Comparing Regression Coefficients Between Same-sample Nested Models Using Logit and Probit: A New Method. *Sociological Methodology* 42(1). SAGE Publications Inc: 286–313. DOI: 10.1177/0081175012444861.

Kemppainen T, Elovainio M, Kortteinen M, et al. (2020) Involuntary staying and self-rated health: A multilevel study on housing, health and neighbourhood effects. *Urban Studies* 57(5). SAGE Publications Ltd: 1049–1067. DOI: 10.1177/0042098019827521.

Kennedy S, Kidd MP, McDonald JT, et al. (2015) The Healthy Immigrant Effect: Patterns and Evidence from Four Countries. *Journal of International Migration and Integration* 16(2): 317–332. DOI: 10.1007/s12134-014-0340-x.

King C (2018) Food insecurity and housing instability in vulnerable families. *Review of Economics of the Household* 16(2). Springer: 255–273.

Kuha J and Mills C (2020) On group comparisons with logistic regression models. *Sociological Methods & Research* 49(2). SAGE Publications Sage CA: Los Angeles, CA: 498–525.

Leishman C and Rowley S (2012) Affordable housing. In: *The Sage Handbook of Housing Studies*. SAGE Publications Ltd, pp. 379–96.

Leong F, Park YS and Kalibatseva Z (2013) Disentangling immigrant status in mental health: Psychological protective and risk factors among Latino and Asian American immigrants. *American Journal of Orthopsychiatry* 83(2pt3). Wiley Online Library: 361–371.

Li J and Liu Z (2018) Housing stress and mental health of migrant populations in urban China. *Cities* 81: 172–179. DOI: 10.1016/j.cities.2018.04.006.

Lindblad MR and Quercia RG (2015) Why Is Homeownership Associated With Nonfinancial Benefits? A Path Analysis of Competing Mechanisms. *Housing Policy Debate* 25(2). Routledge: 263–288. DOI: 10.1080/10511482.2014.956776.

Liu T and Shi Q (2019) Acquiring a Beijing hukou: Who Is Eligible and Who Is Successful? *The China Quarterly*. Cambridge University Press: 1–14. DOI: 10.1017/S0305741019001541.

Liu X, Wang L, Stallones L, et al. (2012) Back pain among farmers in a northern area of China. *Spine* 37(6). NIH Public Access: 508.

Liu Yuqi, Zhang F, Liu Ye, et al. (2019) Economic disadvantages and migrants' subjective well-being in China: The mediating effects of relative deprivation and neighbourhood deprivation. *Population, Space and Place* 25(2): e2173. DOI: 10.1002/psp.2173.

Long JS and Mustillo SA (2018) Using predictions and marginal effects to compare groups in regression models for binary outcomes. *Sociological Methods & Research*. SAGE Publications Sage CA: Los Angeles, CA: 0049124118799374.

Lu Y and Qin L (2014) Healthy migrant and salmon bias hypotheses: A study of health and internal migration in China. *Social Science & Medicine* 102: 41–48. DOI: 10.1016/j.socscimed.2013.11.040.

Manturuk KR (2012) Urban Homeownership and Mental Health: Mediating Effect of Perceived Sense of Control. *City & Community* 11(4): 409–430. DOI: https://doi.org/10.1111/j.1540-6040.2012.01415.x.

Mazur RE, Marquis GS and Jensen HH (2003) Diet and food insufficiency among Hispanic youths: acculturation and socioeconomic factors in the third National Health and Nutrition Examination Survey. *The American journal of clinical nutrition* 78(6). Oxford University Press: 1120–1127.

McConnell ED and Akresh IR (2010) Housing Cost Burden and New Lawful Immigrants in the United States. *Population Research and Policy Review* 29(2): 143–171. DOI: 10.1007/s11113-009-9134-9.

McDonald JT and Kennedy S (2004) Insights into the 'healthy immigrant effect': health status and health service use of immigrants to Canada. *Social science & medicine* 59(8). Elsevier: 1613–1627.

Meltzer R and Schwartz A (2016) Housing Affordability and Health: Evidence From New York City. *Housing Policy Debate* 26(1). Routledge: 80–104. DOI: 10.1080/10511482.2015.1020321.

Miranda PY, Reyes A, Hudson D, et al. (2017) Reports of self-rated health by citizenship and homeownership, United States 2000–2010. *Preventive Medicine* 100: 3–9. DOI: 10.1016/j.ypmed.2017.03.006.

Mize TD, Doan L and Long JS (2019) A General Framework for Comparing Predictions and Marginal Effects across Models. *Sociological Methodology* 49(1). SAGE Publications Inc: 152–189. DOI: 10.1177/0081175019852763.

Mood C (2010) Logistic regression: Why we cannot do what we think we can do, and what we can do about it. *European sociological review* 26(1). Oxford University Press: 67–82.

Myers D and Liu CY (2005) The emerging dominance of immigrants in the US housing market 1970–2000. *Urban Policy and Research* 23(3). Taylor & Francis: 347–366.

National Bureau of Statistics of China (2020) *China Statistical Yearbook 2020*. Beijing: China Statistical Press. Available at: http://www.stats.gov.cn/tjsj/ndsj/2020/indexch.htm.

Nettleton S and Burrows R (1998) Mortgage debt, insecure home ownership and health: an exploratory analysis. *Sociology of health & Illness* 20(5). Wiley Online Library: 731–753.

Parker Frisbie W, Cho Y and Hummer RA (2001) Immigration and the health of Asian and Pacific Islander adults in the United States. *American journal of epidemiology* 153(4). Oxford University Press: 372–380.

Qian J and Guo J (2019) Migrants on exhibition: The emergence of migrant worker museums in China as a neoliberal experiment on governance. *Journal of Urban Affairs* 41(3). Routledge: 305–323. DOI: 10.1080/07352166.2017.1406788.

Razum O, Zeeb H and Rohrmann S (2000) The 'healthy migrant effect'–not merely a fallacy of inaccurate denominator figures. *International journal of epidemiology* 29(1). Oxford University Press: 191–192.

Rohe WM and Lindblad M (2013) Reexamining the social benefits of homeownership after the housing crisis. *Boston: Joint Center for Housing Studies of Harvard University*.

Ross LM and Squires GD (2011) The personal costs of subprime lending and the foreclosure crisis: a matter of trust, insecurity, and institutional deception. *Social Science Quarterly* 92(1). Wiley Online Library: 140–163.

Schwartz M and Wilson E (2008) Who Can Afford To Live in a Home?: A look at data from the 2006 American Community Survey.: 13.

Shaw M (2004) Housing and Public Health. *Annual Review of Public Health* 25(1): 397–418. DOI: 10.1146/annurev.publhealth.25.101802.123036.

Smith SJ, Easterlow D, Munro M, et al. (2003) Housing as health capital: how health trajectories and housing paths are linked. *Journal of social issues* 59(3). Wiley Online Library: 501–525.

Song Q and Smith JP (2021) The citizenship advantage in psychological well-being: An examination of the Hukou system in China. *Demography* 58(1). Duke University Press: 165–189.

Song Y (2014) What should economists know about the current Chinese hukou system? *China Economic Review* 29: 200–212. DOI: 10.1016/j.chieco.2014.04.012.

Stone ME (2006) What is housing affordability? The case for the residual income approach. *Housing Policy Debate* 17(1). Routledge: 151–184. DOI: 10.1080/10511482.2006.9521564.

Wang S, Cheng C and Tan S (2019) Housing Determinants of Health in Urban China: A Structural Equation Modeling Analysis. *Social Indicators Research* 143(3): 1245–1270. DOI: 10.1007/s11205-018-2022-0.

Wang Y and Goetz EG (2021) No Place in the City: The Segregation of Affordable Formal Private Rentals in Beijing. *Housing Policy Debate* 0(0). Routledge: 1–15. DOI: 10.1080/10511482.2020.1858925.

Wang Y, Mao Z and Wang D (2021) Housing affordability and mental health in urban China: a cross-sectional study. *Housing Studies*. Taylor & Francis: 1–21.

Wang YP, Wang Y and Wu J (2010) Housing Migrant Workers in Rapidly Urbanizing Regions: A Study of the Chinese Model in Shenzhen. *Housing Studies* 25(1). Routledge: 83–100. DOI: 10.1080/02673030903362019.

Whyte MK (2010) *One Country, Two Societies: Rural-Urban Inequality in Contemporary China*. 1st ed. Harvard University Asia Center. DOI: 10.2307/j.ctt1sq5t74.

Wu W and Wang G (2014) Together but Unequal: Citizenship Rights for Migrants and Locals in Urban China. *Urban Affairs Review* 50(6). SAGE Publications Inc: 781–805. DOI: 10.1177/1078087413518172.

Xiao C, Yang Y, Xu X, et al. (2020) Housing Conditions, Neighborhood Physical Environment, and Secondhand Smoke Exposure at Home: Evidence from Chinese Rural-to-Urban Migrant Workers. *International Journal of Environmental Research and Public Health* 17(8). 8. Multidisciplinary Digital Publishing Institute: 2629. DOI: 10.3390/ijerph17082629.

Xie L, Zhou S and Zhang L (2021) Associations between Objective and Subjective Housing Status with Individual Mental Health in Guangzhou, China. *International Journal of Environmental Research and Public Health* 18(3). Multidisciplinary Digital Publishing Institute: 930.

Xie S (2019) Quality matters: housing and the mental health of rural migrants in urban China. *Housing Studies* 34(9). Routledge: 1422–1444. DOI: 10.1080/02673037.2019.1577956.

Yu W, Ignatius T, Li Z, et al. (2012) Work-related injuries and musculoskeletal disorders among factory workers in a major city of China. *Accident Analysis & Prevention* 48. Elsevier: 457–463.

Zhang M, Zhu CJ and Nyland C (2014) The Institution of Hukou-based Social Exclusion: A Unique Institution Reshaping the Characteristics of Contemporary Urban China. *International Journal of Urban and Regional Research* 38(4): 1437–1457. DOI: 10.1111/j.1468-2427.2012.01185.x.

Zheng S, Long F, Fan CC, et al. (2009) Urban Villages in China: A 2008 Survey of Migrant Settlements in Beijing. *Eurasian Geography and Economics* 50(4). Routledge: 425–446. DOI: 10.2747/1539-7216.50.4.425.

Zhong H, Xu J and Piquero AR (2017) Internal Migration, Social Exclusion, and Victimization: An Analysis of Chinese Rural-to-Urban Migrants. *Journal of Research in Crime and Delinquency* 54(4). SAGE Publications Inc: 479–514. DOI: 10.1177/0022427816676861.

Zhou S and Cheung M (2017) Hukou system effects on migrant children's education in China: Learning from past disparities. *International Social Work* 60(6). SAGE Publications Ltd: 1327–1342. DOI: 10.1177/0020872817725134.

Chapter 5. Conclusion

In this work, I look at the interconnectedness between state-led redevelopment, housing affordability, and the migrant population in Chinese cities. The three essays fill in the current research gap by (1) understanding the geography of rental affordable housing in recent years; (2) examining the causal relationship between state-led redevelopment and rental housing affordability; (3) investigating the relationship between declining housing affordability and migrant health.

A common thread in this dissertation is that due to the state-led urban redevelopment, housing in Chinese cities has become less affordable in recent years. The declining housing affordability jeopardizes migrant workers' residential stability and health. Chapter 2 looks at the segregation of affordable formal rental housing in Beijing between 2015 and 2021 using rental listing data from a real estate brokerage company. Chapter 3 investigates the spatial patterns of shantytown redevelopment projects (SRPs) in Beijing from 2013 to 2020 and examines the impact of SRPs on nearby rental housing prices with a Difference-in-Differences (DID) design. Chapter 4 explores how the incorporation of residence duration alters the relationship between housing cost burden and homeownership with migrant self-rated health (SRH) using data from the 2017 China Migrants Dynamic Survey (CMDS).

Key Findings

In Chapter 2, I find that the availability of affordable formal rentals decreased drastically in Beijing's central city area between 2015 and 2021, and the remaining affordable units in the city center became increasingly segregated from higher-priced rentals. When compared across rentals of different price ranges, the affordable rentals turned out to be the most segregated in both 2015

and 2021, with a city-level index of dissimilarity of 0.74 and 0.80 respectively. Overall, it has become increasingly difficult for low-income households to find a place to live in the city. In other words, if the trend continues, low-income renter households will soon have no place to live in the central city. Low-income renters in Beijing, who are predominantly migrants from other parts of the country, contributed greatly to the city's economic development and cultural diversity and deserve the right to housing in the central city. To ensure low-income renters' right to live in the city, policy responses are needed to preserve and increase affordable housing stock in central locations.

The findings in Chapter 3 show that the demolition of small-to-medium-size shantytowns in Beijing contributes both to the direct and indirect displacement of migrant renters by (1) removing affordable housing units in shantytowns; (2) not offering any type of housing assistance for displaced migrants; and (3) driving up rental costs in the vicinity. Given the decreasing affordability and dispersal of the migrant population associated with shantytown redevelopment, complementing strategies are needed to maintain rental affordability and protect migrants' right to remain in their neighborhoods. Designing a participatory redevelopment process that recognizes migrant renters as important stakeholders and creating a more inclusive SRP compensation plan are possible ways to mitigate the negative impact of SRPs on the migrant population. Migrants work to build and sustain the city and they deserve the right to be able to benefit from what they have produced. The state needs an alternative vision for Beijing that not only serves local homeowners, but also the migrant population that has contributed greatly to the city's development.

In Chapter 4, the findings suggest that migrant workers with higher housing cost burdens and longer residence duration tend to have worse self-reported health (SRH). I also find that, if not controlling for migrants' residence duration in the host city, homeownership would be negatively

associated with migrants' SRH. Incorporating residence duration attenuates the crude association between homeownership and worse SRH. The crude association between homeownership and worse health may be explained by longer residence duration in the host city among migrant homeowners. The health decline among migrant workers over time can be tied back to the discriminatory *hukou* system—a system that limits migrants' access to social welfare and puts them in a socioeconomically disadvantaged position. The study thus emphasizes the removal of structural and socioeconomic barriers faced by the migrant population.

Contributions

The three essays contribute to the understanding of the production of housing inequality in China's rapid urbanization process. In these studies, I test housing phenomena that are typically examined in the Western context: (1) residential segregation by income (Bischoff and Reardon, 2014; Fry and Taylor, 2012; Watson, 2009), (2) the spillover effects of redevelopment (Castells, 2010; Hanson and Rohlin, 2013; Tach and Emory, 2017), and (3) housing as a determinant of health (Dunn et al., 2006; Swope and Hernández, 2019). Chapter 2 sheds light on the decreasing affordable rental stock and the increasing residential segregation by income in China's capital city. Chapter 3 shows that small- to medium-size SRPs in Beijing increase rental prices in neighboring areas. Chapter 4 demonstrates that housing-related financial stress, together with a longer duration of stay in the host city, contribute to worse SRH among migrants in Chinese cities. These studies provide evidence of rising residential segregation, redevelopment-induced displacement, and the housing instability that migrants face in China's urbanization process.

The three essays approach the housing affordability problem in urban China from multiple perspectives, with implications for policy evaluation and decision-making. Chapter 2 describes the

increasing segregation of affordable private rentals in Chinese cities. It demonstrates a clear need for policies that focus on providing affordable housing for low-income households, especially in central locations. Chapter 3 contributes to the literature by looking at the causal relationship between urban redevelopment and neighborhood housing affordability. The research findings provide insights into how state-led redevelopment may shape the geography of urban poverty. The study finds a negative impact of small- to medium-sized SRPs on rental affordability, which raises the concern of SRP-induced displacement of low-income migrant renters. Some studies on China's urban redevelopment (Lai et al., 2014; Tian, 2008; Zhu, 2019) underplay the negative effect of urban redevelopment imposed on low-income tenants and claim that the removal of shantytowns is necessary to promote efficient land use and reduce inequality. My research findings countered their arguments by bringing attention to the adverse impact of redevelopment on migrant renters. The negative impact of SRPs on marginalized/vulnerable populations (e.g., migrant workers, low-income renters) should be considered in the evaluation of SRPs. Complementing strategies are needed to maintain rental affordability on and near the redevelopment sites. In Chapter 4, I argue that the discriminatory *hukou* system limits migrants' access to adequate housing and social benefits, thus being the root cause of their health decline. As a result, structural barriers embedded in the *hukou* system need to be removed to advance the overall health of the migrant population.

Directions for Future Research

The three essays identify challenges and opportunities for future research. The online rental listing data used in Chapter 2 does not include units that are never publicly advertised and are instead rented through personal networks. It is thus valuable for future studies to move beyond the online listings and explore formal private rentals rented through other channels. Due to data constraints,

Chapter 3 focuses on the short-term impact of shantytown demolition on nearby rental prices. Future research is needed (1) to examine not only the impact of shantytown demolition, but also project completion, on nearby rental price; (2) to study the long-term impact of shantytown redevelopment on housing affordability on- and near-site; and (3) to account for the different timing of treatment using rental listing data from multiple years.

The China Migrants Dynamic Survey (CMDS) data used in Chapter 4 is a destination-based survey that does not include migrants who have returned to their hometowns. The survey also has no information on migrants' physical housing conditions and neighborhood environment. Future research is thus needed (1) to include return migrants in the survey design; (2) to incorporate physical housing features, and neighborhood characteristics in the analysis; (3) to test the moderating role of physical housing features on financial housing stress, controlling for migration-related confounders; (4) to examine the causal pathway underlying the association between residence duration, financial housing stress, and health among migrant workers in Chinese cities.

Findings from Chapters 2 and 3 indicate a potential connection between the increasing segregation of affordable rentals and the large-scale urban redevelopment in Beijing. Is the rise of segregation a product of state-led redevelopment programs? What is the social meaning of the outcomes (the rise of segregation by income, the displacement of migrant renters) that state-redevelopment produce? These questions are worth exploring.

Findings from Chapters 3 and 4 together have implications on the potentially negative health outcome shantytown redevelopment may bring to the displaced migrant renters. Increasing residential instability resulting from SRPs may have detrimental impacts on the health of migrant renters. The relationship between SRPs and migrant health would be another area that is worth investigating.

When juxtaposing findings from Chapters 2-4 together, we inevitably come across the questions of whose rights are being recognized/denied in China's urbanization process and why. While the three Chapters improve our understanding of the housing affordability problem from an empirical perspective, more theoretical works are needed to interrogate the institution that constructs housing as a scarce resource and creates the housing affordability problem in the first place.

References

Bischoff K and Reardon SF (2014) Residential segregation by income, 1970–2009. *Diversity and disparities: America enters a new century* 43. Citeseer.

Castells N (2010) HOPE VI Neighborhood Spillover Effects in Baltimore. *Cityscape* 12(1). US Department of Housing and Urban Development: 65–98.

Dunn JR, Hayes MV, Hulchanski JD, et al. (2006) Housing as a Socio-Economic Determinant of Health: Findings of a National Needs, Gaps and Opportunities Assessment. *Canadian Journal of Public Health* 97(Suppl 3): S12–S17. DOI: 10.1007/BF03405392.

Fry R and Taylor P (2012) The Rise of Residential Segregation by Income. In: *Pew Research Center's Social & Demographic Trends Project*. Available at: https://www.pewresearch.org/social-trends/2012/08/01/the-rise-of-residential-segregation-by-income/ (accessed 9 April 2023).

Hanson A and Rohlin S (2013) Do spatially targeted redevelopment programs spillover? *Regional Science and Urban Economics* 43(1): 86–100. DOI: 10.1016/j.regsciurbeco.2012.05.002.

Lai Y, Peng Y, Li B, et al. (2014) Industrial land development in urban villages in China: A property rights perspective. *Habitat International* 41: 185–194. DOI: 10.1016/j.habitatint.2013.08.004.

Swope CB and Hernández D (2019) Housing as a determinant of health equity: A conceptual model. *Social Science & Medicine* 243: 112571. DOI: 10.1016/j.socscimed.2019.112571.

Tach L and Emory AD (2017) Public Housing Redevelopment, Neighborhood Change, and the Restructuring of Urban Inequality. *American Journal of Sociology* 123(3). The University of Chicago Press: 686–739. DOI: 10.1086/695468.

Tian L (2008) The Chengzhongcun Land Market in China: Boon or Bane? — A Perspective on Property Rights. *International Journal of Urban and Regional Research* 32(2): 282–304. DOI: 10.1111/j.1468-2427.2008.00787.x.

Watson T (2009) Inequality and the Measurement of Residential Segregation by Income in American Neighborhoods. *Review of Income and Wealth* 55(3): 820–844. DOI: 10.1111/j.1475-4991.2009.00346.x.

Zhu J (2019) *Urban Development in China under the Institution of Land Rights*. Routledge.

Appendices

Figure A3-1. Rental unit only corresponds to the nearest SRP.

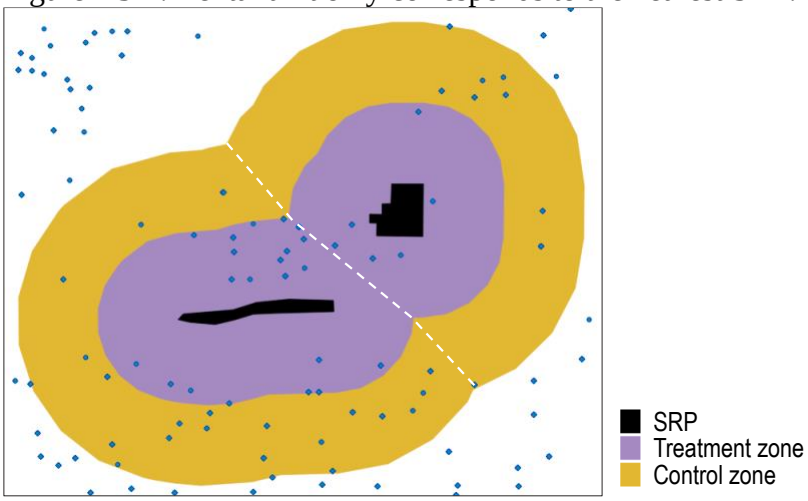


Figure A3-2. SRP size, 2016-2020.

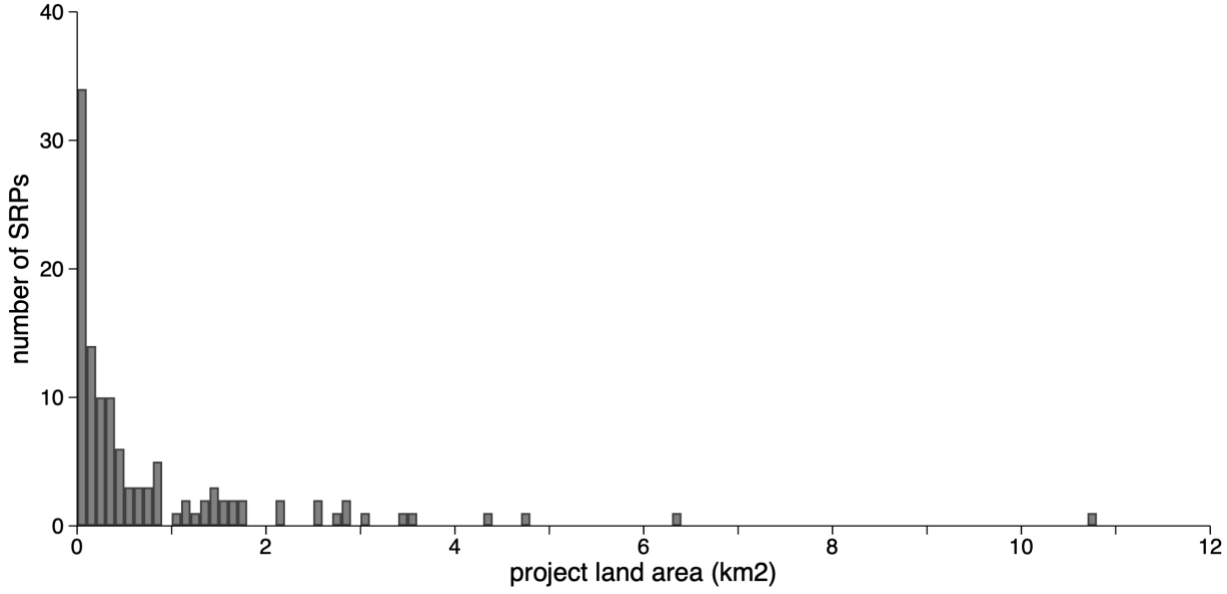
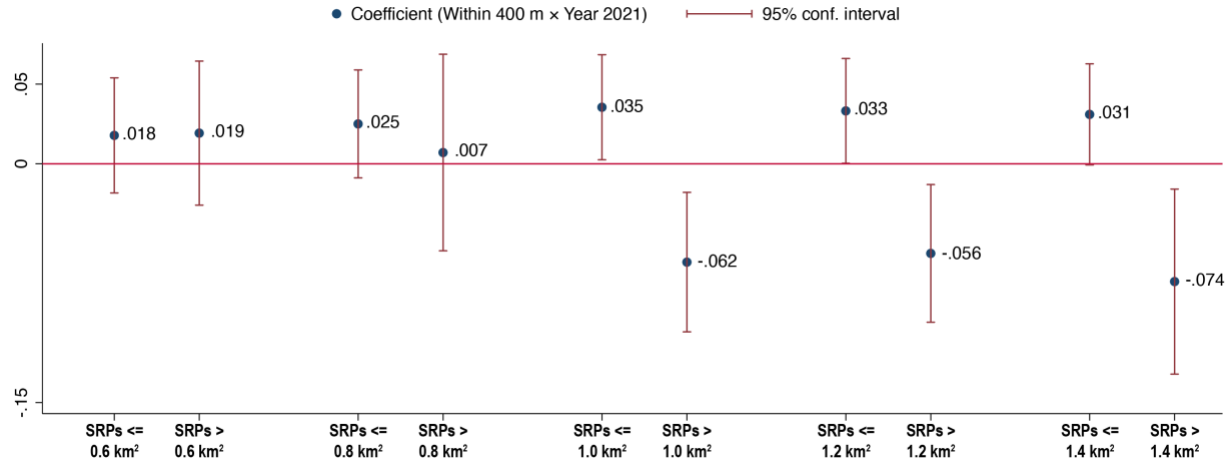


Figure A3-3. Impacts of shantytown demolition on rents, by different project size cutoffs.



Notes: Coefficients in the figure are from models with the same specification as Model 3-2 and Model 3-3. The only difference is the cutoff used to separate small-to-medium-size SRPs from large-size SRPs. The figure suggests that, for thresholds at 1, 1.2, and 1.4 km^2, there are consistent results showing the differential impacts of shantytown demolition on rent by project size.

Table A3-1. Impacts of shantytown demolition on rents, categorical treatment.

	SRP <= 1km^2	SRP > 1km^2
	Model A3-1. ln(rent)	Model A3-2. ln(rent)
0-200m #	-0.039	0.078*
	(0.023)	(0.033)
200-400m #	-0.013	0.028
	(0.034)	(0.022)
400-600m #	-0.022	-0.004
	(0.024)	(0.028)
Year 2021 †	0.268***	0.319***
	(0.023)	(0.024)
0-200m × Year 2021	0.058*	-0.074*
	(0.023)	(0.028)
200-400m × Year 2021	0.047	-0.052
	(0.025)	(0.032)
400-600m × Year 2021	0.030	-0.003
	(0.020)	(0.026)
Floor area (m^2)	0.008***	0.007***
	(0.000)	(0.001)
Number of Bedrooms	0.035***	0.078***
	(0.009)	(0.018)
Year built	0.005***	0.003***
	(0.001)	(0.001)
Distance to subway stop (km)	-0.047**	-0.023*
	(0.017)	(0.010)
Distance to top elementary school (km)	-0.025	-0.018
	(0.019)	(0.026)
Distance to CBD (km)	-0.015	-0.066*
	(0.009)	(0.025)
Sub-district fixed effects	✓	✓
Adjusted R-squared	0.826	0.777
N	47,520	7,872

Notes: # Reference: 600-800m. † Reference: Year 2015. Rents are inflation-adjusted using the annual city-level CPIs for rental housing in 2015 yuan. Standard errors are in parentheses. Errors are clustered at the subdistrict level. *p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-1. Logistic regressions on good health, housing cost burden as categorical (n=78,081)

	Model A4-1	Model A4-2	Model A4-3	Model A4-4
Housing cost burdened	-0.0234***	-0.0259***	-0.0178***	-0.0175**
Homeowner	-0.0308***	-0.0369***	-0.0100	-0.0038
Demographics				
Age		-0.2592***	-0.2792***	-0.2694***
Female		-0.0421***	-0.0488***	-0.0486***
Married		-0.0082	0.0116	0.0131
Household size		-0.0015	-0.0058	-0.0014
High school degree and higher		0.0036	0.0124	0.0117
Monthly earnings		0.0654***	0.0597***	0.0602***
Work hours in the past week		-0.0455***	-0.0423***	-0.0408***
Occupation (ref. Official/manager/professional)				
Clerical support worker		0.0140*	0.0183**	0.0180**
Service/sales worker		0.0336***	0.0397***	0.0406***
Agricultural/forestry/fishery worker		-0.0037	-0.0079	-0.0084
Manufacturing/transport/construction worker		0.0274**	0.0228*	0.0223*
Other		-0.0023	-0.0005	-0.0002
Labor contract		0.0270***	0.0240***	0.0256***
Agricultural hukou		-0.0276***	-0.0027	-0.0023
Family member with local hukou		0.0025	-0.0084	-0.0070
Residence duration (ref. <1 year)				
1 to <5 years				-0.0139
5 to <10 years				-0.0329***
>=10 years				-0.0480***
City fixed effects			Yes	Yes
Pseudo R2	0.0009	0.0472	0.0849	0.0857
BIC	63753	60969	59114	59099

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-2. Logistic regressions on good health, residence duration as continuous (n=78,081)

	Model A4-5
Housing cost burden	-0.0262***
Homeowner	-0.0062
Demographics	
Age	-0.2682***
Female	-0.0493***
Married	0.0113*
Household size	-0.0027
High school degree and higher	0.0128**
Monthly earnings	0.0597***
Work hours > 40 in the past week	-0.0408***
Occupation (ref. Official/manager/professional)	
Clerical support worker	0.0180***
Service/sales worker	0.0419***
Agricultural/forestry/fishery worker	-0.0091**
Manufacturing/transport/construction worker	0.0204**
Other	-0.0002
Labor contract	0.0260***
Agricultural hukou	-0.0023
Family member with local hukou	-0.0069
Residence duration	-0.0386***
City fixed effects	Yes
Pseudo R2	0.0858
BIC	59067

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-3. Average marginal effects (AMEs) of variables of interest, weighted vs. unweighted models.

	Model A4-6 Weighted	Model A4-7 Unweighted	Cross-Model Difference
Housing cost burden +SD	-0.0028	-0.0059***	-0.0031
	(0.0020)	(0.0013)	(0.0024)
Homeowner	0.0053	-0.0036	-0.0089
	(0.0061)	(0.0034)	(0.0069)
Residence duration (ref. <1 year)			
1 to <5 years	-0.0036	-0.0057	-0.0021
	(0.0061)	(0.0039)	(0.0072)
5 to <10 years	-0.0198**	-0.0167***	0.0031
	(0.0068)	(0.0042)	(0.0080)
>=10 years	-0.0200**	-0.0266***	-0.0066
	(0.0069)	(0.0045)	(0.0082)

Notes: Seemingly unrelated estimation (SUEST) is used to combine estimates from Model A5-A6 and compare marginal effects. Controlled for demographic covariates and province fixed effects. AMEs for continuous variables are for a standard deviation increase. Standard errors are in parentheses.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-4. Logistic regressions on good health, including the top 0.1% housing cost burden cases (n=78,159).

	Model A4-8 Housing cost burden + Homeownership	Model A4-9 + Demographics	Model A4-10 + City fixed effects	Model A4-11 + Residence duration
Housing cost burden	-0.0080	-0.0129*	-0.0054	-0.0057
Homeowner	-0.0331***	-0.0394***	-0.0115	-0.0052
Residence duration				
1 to <5 years				-0.0139
5 to <10 years				-0.0331***
>=10 years				-0.0485***

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-5. Logistic regressions on good health, excluding cases with housing cost burden above 1000 (n=78,155)

	Model A4-12 Housing cost burden + Homeownership	Model A4-13 + Demographics	Model A4-14 + City fixed effects	Model A4-15 + Residence duration
Housing cost burden	-0.0246***	-0.0359***	-0.0236***	-0.0239***
Homeowner	-0.0333***	-0.0404***	-0.0125*	-0.0063
Residence duration				
1 to <5 years				-0.0138
5 to <10 years				-0.0332***
>=10 years				-0.0485***

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-6. Linear probability models on good health (n=78,081)

Panel A: ME	Model A4-16 Housing cost burden + Homeownership	Model A4-17 + Demographics	Model A4-18 + City fixed effects	Model A4-19 + Residence duration
Housing cost burden (+SD)	-0.0057*** (0.0013)	-0.0094*** (0.0013)	-0.0057*** (0.0013)	-0.0058*** (0.0013)
Homeowner	-0.0183*** (0.0031)	-0.0214*** (0.0034)	-0.0057 (0.0034)	-0.0027 (0.0035)
Panel B: Cross-model differences		(Model A4-17) – (Model A4-16)	(Model A4-18) – (Model A4-17)	(Model A4-19) – (Model A4-18)
Housing cost burden (+SD)		-0.0036*** (0.0004)	0.0036*** (0.0004)	-0.0000 (0.0000)
Homeowner		-0.0031* (0.0015)	0.0157*** (0.0014)	0.0030*** (0.0005)

Notes: Results from linear regressions. ME = Marginal Effect. Seemingly unrelated estimation (SUEST) is used to combine estimates from the four models and compare marginal effects. Standard errors are in parentheses.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Table A4-7. Logistic regressions on good health, work hours as categorical (n=78,081)

	Model A4-20	Model A4-21	Model A4-22
Housing cost burden	-0.0421***	-0.0265***	-0.0266***
Homeowner	-0.0400***	-0.0120	-0.0057
Demographics			
Age	-0.2603***	-0.2801***	-0.2699***
Female	-0.0414***	-0.0476***	-0.0475***
Married	-0.0090	0.0106	0.0121
Household size	-0.0048	-0.0085	-0.0039
High school degree and higher	0.0085	0.0167*	0.0159*
Monthly earnings	0.0639***	0.0588***	0.0594***
Work hours > 40 in the past week	-0.0359***	-0.0265***	-0.0258***
Occupation (ref. Official/manager/professional)			
Clerical support worker	0.0134*	0.0178**	0.0175**
Service/sales worker	0.0332***	0.0366***	0.0378***
Agricultural/forestry/fishery worker	-0.0054	-0.0092	-0.0097*
Manufacturing/transport/construction worker	0.0245**	0.0209*	0.0204*
Other	-0.0017	-0.0003	0.0000
Labor contract	0.0251***	0.0219***	0.0237***
Agricultural hukou	-0.0286***	-0.0035	-0.0031
Family member with local hukou	0.0019	-0.0085	-0.0071
Residence duration (ref. <1 year)			
1 to <5 years			-0.0129
5 to <10 years			-0.0330***
>=10 years			-0.0489***
City fixed effects		Yes	Yes
Pseudo R2	0.0472	0.0845	0.0853
BIC	60963	59138	59120

Notes: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).