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ABSTRACT

Collateral constraints limit household migration to expensive locations by restricting financing for home purchases. Such endogenous location choice amplifies the impact of relaxing household borrowing constraints. Using China's cash-based shantytown renovation program (2015-2018) as a natural experiment, we provide evidence that cash resettlement—by converting illiquid shanty houses into cash—facilitated household location upgrading and raised house prices in more expensive locations. A dynamic spatial model with collateral constraints confirms household migration responses to the cash transfer. Quantitatively, endogenous migration amplifies household housing expenditure responses by around 40%, and is able to explain more than 20% of the housing price growth in 2016-2020.

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1 Introduction

House prices in China have risen dramatically over the past decade. Figure 1 Panel (a) shows that the most salient surge occurred between 2016 and 2020, with average prices increasing by more than 40% in just four years—a magnitude similar to the U.S. house price growth during the 2002-2006 housing boom (Mian and Sufi, 2011). Notably, this increase was not merely a continuation of the previous trend. Rather, house price growth accelerated markedly in 2016, likely in response to specific economic shocks.

A broadly shared interpretation of the U.S. housing boom during 2002-2006 emphasizes the important role of household credit conditions (Mian and Sufi, 2009). Subsequent studies further quantify the effects of relaxed mortgage borrowing limits during the boom (Favilukis et al., 2017; Kaplan et al., 2020). In China, instead of a significant relaxation of mortgage lending, a high-profile policy—the cash-based shantytown renovation program—effectively relaxed household credit conditions through large-scale cash transfers during this period.

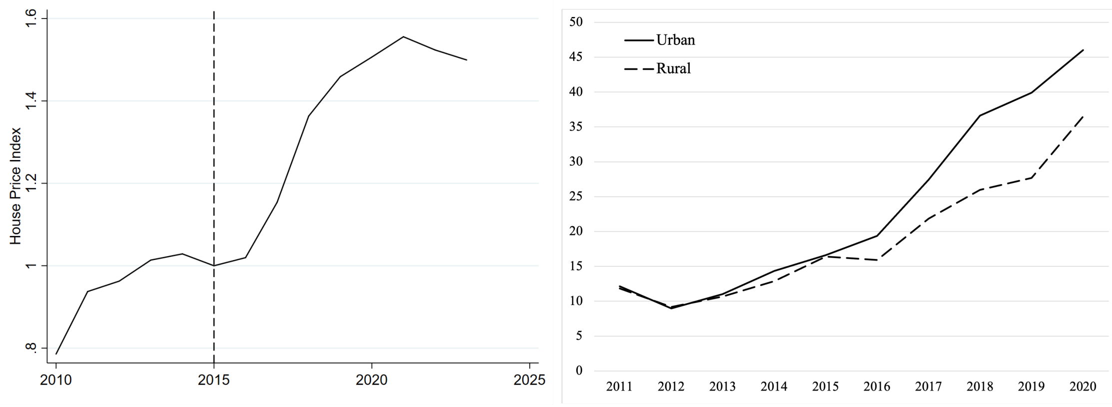
This paper examines how the shantytown renovation program with cash-based resettlement (or cash resettlement interchangeably) affected housing expenditures and house price growth in China after 2015. We use this program as a natural experiment to illustrate that household migration can amplify the effect of relaxing household borrowing constraints on housing spending, because households are more likely to face binding borrowing constraints when purchasing houses in desired cities than in their originating cities.

Shantytown renovation is an essential part of urban development in many countries.[1] Typically, shantytown renovation entails the resettlement of displaced residents, along with the reconstruction of public infrastructure and residential or commercial properties. In China, the shantytown renovation program has been a key part of Beijing's policy agenda since 2013. In 2015, the cash-based resettlement scheme was introduced, which essentially converts illiquid shanty houses into cash. During 2015-2018, the cash-based resettlement payments totaled more than four trillion RMB, and the authority and many others believe that it has contributed to the housing boom since 2015.[2]

To motivate our focus on migration, Figure 1 Panel (b) shows that intercity migration of urban households accelerated significantly since 2015, whereas migration of rural households,

[1]In the case of informal houses, shantytown renovation is also referred to as slum upgrading by UN Habitat.

[2]See the report from Reuters. If all cash compensation were spent on the 30% down payment of homes, with the remaining 70% financed by mortgages, total home sales would increase by about 13.3 trillion RMB. For comparison, total new house sales during 2011-2015 (2016-2020) were 24.7 (48.7) trillion RMB.



(a) House Price Index (b) Intercity Migration

Figure 1: House Price Growth and Household Migration in China, 2010-2023

Note: Panel (a) plots the average house price index (normalized to be one in 2015) based on sellers' posted ask prices across cities during 2010-2023 in China. See Section 2.2 for details on the construction. Panel (b) plots the number of intercity urban and rural migrant households per 1000 urban households.

who were not targeted by the program, followed the previous trend. These time trends suggest that household migration likely plays an important role in the overall impact of the program.

By combining micro-level household survey data from China Population Census with data on the shantytown renovation loans, we find strong evidence supporting the effect of cash resettlement on household migration and house prices. To measure the impact of cash resettlement on the housing market in the same city, we calculate $loan\_orig_o$, defined as the total cash resettlement amount distributed in the *o*riginating city, scaled by its 2014 house transaction value. To measure the impact on housing markets in other cities, we assume that money outflows between city pairs (as a result of cash resettlement) are proportional to the pre-existing migration network before 2015 and construct a Bartik-style variable, $loan\_dest_d$, with d indicating the *d*estination city. More specifically, $loan\_dest_d$ is defined as the sum of cash resettlement from all other originating cities multiplied by the share of their urban households that had migrated to destination city d before 2015, and then scaled by city d's 2014 house transaction value.

To our surprise, in cities with higher $loan\_orig$ house prices did not grow any faster after 2014. In contrast, in cities with higher $loan\_dest$, house prices accelerated significantly after 2014; new house supply also increased in these cities, though the response was temporary and limited in magnitude, reflecting the inelasticity of house supply.

More importantly, the effect of $loan\_dest$ on local house prices depends on the city-pair house price gap in 2014. We define a city-pair as having a high house price gap if the 2014 house price ratio (destination to originating city) exceeds the median value across all pairs, and low otherwise. Given any destination city d, we find that the effect of $loan\_dest$ constructed using originating cities with a high house price gap relative to d is roughly three times as large as the effect constructed using cities with a low house price gap. This pattern is consistent with cash-resettlement-induced migration being substantially stronger from lower-price to higher-price cities than across other city pairs.[3]

The above results point to an important role of households' borrowing constraints in shaping their mobility decisions. This echoes the "location asset" view in Bilal and Rossi-Hansberg (2021), which predicts that a relaxation of household borrowing constraints can induce location upgrading to more expensive cities by allowing for greater consumption smoothing in higher-tier cities. In our context, households originating from low-price cities are more likely to face binding borrowing constraints if they migrate to high-price cities and buy houses at the destination. The cash resettlement relaxes their borrowing constraints and induces more migration to these cities.

Consistent with this view, we find that migration-induced money flows constitute the key mechanism through which $loan\_dest$ affects local house prices. We posit two channels within this mechanism: a *downgrade mitigation effect* on pre-existing migrants and an *upgrade facilitation effect* on new migrants. First, we show that among pre-existing migrants in a given destination city in 2015—who may still retain homeownership in their originating cities—the fraction of cash recipients in their originating cities positively affects the likelihood that these urban migrants remain in the destination and become homeowners there by 2020; in contrast, we find no significant effect for rural migrants. Second, conditional on the same destination city, originating cities with a higher fraction of cash recipients experience a larger post-2014 increase in household out-migration to that destination, with no significant differential patterns observed prior to 2014. Importantly, we confirm that both patterns are stronger among city pairs with high house price gap in 2014, consistent with our hypothesis that cash resettlement mainly mitigates location downgrading for pre-existing migrants and facilitates location upgrading for new migrants.

These empirical results suggest an amplification effect of migration in how relaxing household borrowing constraints boosts housing demand. At the extensive margin, the relaxation of borrowing constraints induces more households to migrate to high-tier cities with higher wages,

[3]Recall that $loan\_dest$ is constructed in a Bartik-style manner, allocating cash-resettlement inflows according to the pre-2015 mobility network. In principle, one dollar of inflow from any origin should have a comparable effect on the same destination city. The fact that inflows from lower-price cities to higher-price destinations generate significantly stronger effects suggests that cash-resettlement-driven mobility is particularly pronounced along such price gradients.

and the resulting lifetime wealth increase leads to a jump in their housing spending. At the intensive margin, households in higher-tier cities face a more binding borrowing constraint than in their originating cities, resulting in a higher propensity to spend on housing per unit of cash transfer. We formalize these results in a simple model in Section 4.

To quantify the effect of cash resettlement and the amplification role of household migration, we then build a dynamic spatial general equilibrium model featuring consumption-savings decisions, borrowing constraints, and endogenous migration under incomplete markets. In the model, households live for a finite number of periods. In each period, they decide residence location, housing tenure (i.e., home purchase or rental), and consumption-savings. Their net debt balance cannot exceed a certain fraction of their housing value. Locations differ in terms of their productivity, amenity, and housing supply.

Our model differs from the existing literature (e.g. Favilukis et al., 2023; Giannone et al., 2023; Greaney, 2023) in a number of significant ways. First, we distinguish between liquid "normal" houses and illiquid "shanty" houses. Shanty houses, due to factors like insecure property rights and substandard conditions, cannot be sold or used as collateral and can only be used for owner residence. The cash resettlement program acts as a large-scale liquidity shock, effectively converting illiquid shanty houses into cash that households can deploy anywhere. Second, the model allows for spatial decoupling of residence and house ownership, which is a non-trivial feature that has long been ignored by most studies. In China, households often rent at their destination while retaining ownership of houses in their hometown cities.[4] Any local-based policies that target local homeowners may spillover to other cities due to this cross-city homeownership. Finally, we embed a strong homeownership preference, which is a salient feature of the Chinese housing market.[5] With strong homeownership preference, household credit conditions would matter even if they can rent (Kaplan et al., 2020).

When quantifying the model, we start with an initial distribution of households with different ages, savings, house types and sizes, and house/residence locations, based on the Population Survey Data of 2015 in China. We take one period to be five years. The cash resettlement program was implemented in the first period of 2016-2020. The joint consideration of housing tenure,

[4]Non-local homeownership is also non-trivial in the US. For instance, the 2017 NAR Investment & Vacation Home Buyer's Survey reports that from 2003 to 2016, vacation home buyers accounted for 12% of all home buyers, and these vacation homes were often located outside the owner's primary county of residence. The non-local homeownership rate would be substantial once we consider parents and children as a single household who live in different locations.

[5]This preference is driven not only by deep-seated cultural norms but also by crucial institutional factors, such as the common practice of tying access to public schools and other public services to local homeownership in China.

consumption-savings and migration decisions—combined with rich individual heterogeneity—generates non-linear policy functions over a large state space. We globally solves households' dynamic problems and tracks household distribution within and across locations over time. To reduce computational burden, we cluster all cities into five locations based on their geographic proximity and house prices in 2015. Such cluster largely preserves the geographic dispersion in house prices and migration—house prices decrease monotonically from top-tier location 1 to bottom-tier location 5 and the fraction of households receiving cash compensation increases monotonically from location 1 (0.6%) to 5 (6.0%).

We set land supply across cities such that, in the baseline economy with the cash-resettlement program, the equilibrium price path matches the observed data, and then solve for households lifetime decisions given these location-specific price paths. We calibrate the remaining model parameters to match key empirical moments on homeownership and migration over 2016-2020. The calibrated model successfully reproduces our main empirical findings on household migration. In particular, it predicts that cash resettlement reduces the downgrading of existing migrant residents in top-tier cities (tiers 1-3) and increases the upgrading of residents in lower-tier cities (tiers 4-5), with magnitudes comparable to those observed in the data.

To isolate the role of household migration, we consider a counterfactual voucher-based resettlement program (hereafter "voucher resettlement"), under which the voucher can be used only for local home purchases, thereby localizing the induced housing demand. In the model, the voucher program significantly attenuates both the downgrade-mitigation effect in top-tier cities and the upgrade-facilitation effect in lower-tier cities relative to the cash transfer. We next examine households housing expenditure responses to the resettlement transfer and compare the effects under cash and vouchers. Specifically, *housing expenditure multiplier* is defined as the increase in a households first-home purchase spending with resettlement relative to without resettlement, normalized by the compensation amount received. The multiplier averages 1.14 under cash resettlement but only 0.80 under vouchers, implying that endogenous migration amplifies the housing expenditure response by 42.5% ($= 1.14/0.80 - 1$).

The key insight of the paper is that household borrowing measured at current locations can substantially misrepresent their true borrowing constraints once households relocate to their desired cities. Prior to receiving a cash transfer, households may appear to borrow little because they reside in relatively inexpensive locations. However, their relevant–or "shadow"–borrowing constraint is determined by the housing markets of the cities they would optimally move to after the transfer. According to our model, households predicted to have larger borrowing at their current locations after the cash transfer do not exhibit higher multipliers, whereas borrowing measured conditional on their desired destinations strongly predicts higher multipliers.

Finally, we assess equilibrium price impacts of the program.[6] We find that absent the program that transforms illiquid housing assets to liquid wealth, the average house prices would decrease by about 4%. This aggregate price impact is entirely attributed to the amplification role of migration—the average house prices will drop similarly by 4% under the voucher resettlement. Across different locations, household migration under cash resettlement leads to price increases only in the top four locations, while the bottom location 5 experiences a price decline as the treated households (i.e., those receiving cash transfer) leave, leading to larger price disparities across locations.

Quantitatively, however, general equilibrium price adjustments have little impact on our migration results, as cash resettlement continues to generate similar downgrade-mitigation and upgrade-facilitation effects. As house prices would be lower absent the program—implying weaker housing demand—the cash multiplier rises slightly from 1.14 to 1.18.

Overall, in welfare terms, we find that relative to the baseline with cash resettlement program, households owning shanty housing in urban areas would suffer a 22.8% welfare loss in the absence of the program and a 5.3% loss under the voucher scheme. This underscores the value of retaining flexibility in allocating the transfer beyond local housing purchases.

Literature Review Our paper is related to three strands of literature. First, we contribute to the housing literature on household credit conditions. More than a decade after the Global Financial Crisis of 2007-09, a consensus has emerged regarding the crucial role of household credit conditions in the housing boom-bust cycle (Mian and Sufi, 2009, 2011; Di Maggio and Kermani, 2017; Justiniano et al., 2019). Yet there is less consensus on the degree to which changes in household credit conditions can explain the housing boom relative to other competing explanations (Piazzesi and Schneider, 2016; Favilukis et al., 2017; Kaplan et al., 2020). We add to the literature by introducing endogenous migration to the analysis. We document the relevance of migration and demonstrate that household migration can amplify the effect of relaxed borrowing constraints on housing demand with a dynamic spatial model.

Second, our work adds to the large and growing literature on quantitative spatial economics

[6] We assume the program affects residential land supply in a way that leads to the same amount of incremental house supply as requisitioned.

(Redding and Rossi-Hansberg, 2017).[7] The seminal work of Kleinman et al. (2023) incorporates capital investment into a dynamic spatial model with forward-looking migration decisions, with capital accumulation undertaken by immobile landlords. Recent studies further allow for forward-looking migration, consumption-savings, and housing tenure decisions (Bilal and Rossi-Hansberg, 2021; Favilukis et al., 2023; Giannone et al., 2023; Greaney, 2023; Greaney et al., 2025). Conceptually, our paper is most closely related to Bilal and Rossi-Hansberg (2021), who emphasize the role of location as an asset in facilitating consumption smoothing. Our quantitative model differs from theirs by explicitly modeling housing tenure and spending decisions, enabling us to study the interaction among migration, borrowing constraints, and housing expenditures. We highlight the amplifying role of mobility in strengthening housing demand when cash resettlement improves household credit conditions. Relative to Giannone et al. (2023) and Greaney (2023), our quantitative model incorporates rich intercity homeownership (i.e., decoupling of residence and house locations) and heterogeneity in house liquidity. This feature enables us to characterize both the "downgrade mitigation" effect of cash transfers on existing migrants and the "upgrade facilitation" effect on non-migrants.

Third, we contribute to the literature on the housing market and migration in China. The recent downturn of the Chinese housing market has attracted considerable concern about potential risks of the real estate sector. Chang et al. (2026) document a paradox between surging land and property prices and plummeted transaction volumes during 2020-2022 and attribute this paradox to active management by local governments. Related to spatial spillover, Deng et al. (2022) exploit the local home purchase restrictions to study the effects of out-of-town home demand and policy spillovers. In terms of migration, Tombe and Zhu (2019) show that a large decline in migration costs following the reform of the Hukou system led to significant aggregate labor productivity growth between 2000 and 2005.

The remainder of the paper is organized as follows. We describe the institutional background and data in Section 2, present the empirical evidence in Section 3, develop the simple model in Section 4, lay out the dynamic spatial general equilibrium model in Section 5, and report the quantitative results in Section 6. We conclude in Section 7.

[7] This includes both static models (Ahlfeldt et al., 2015; Monte et al., 2018; Heblich et al., 2020; Delventhal et al., 2022; Hoelzlein, 2023; Tsivanidis, 2023; Couture et al., 2024) and dynamic models (Desmet et al., 2018; Caliendo et al., 2019, 2021; Bilal and Rossi-Hansberg, 2023; Fan et al., 2023; Kleinman et al., 2023; Cruz and Rossi-Hansberg, 2024; Balboni, 2025). These frameworks are employed to study a wide range of shocks and policy interventions, providing insights into how such changes affect the spatial distribution of economic activities.

2 Institutional Details and Data

We provide the institutional background of China's shantytown renovation program in this section, followed by a description of data sources used in the paper.

2.1 Institutional Background

The shantytown renovation program became a key part of the central government policy agenda since 2013, when Premier Li Keqiang took office. At his first press conference, he pledged that his administration would renovate over 10 million units of shanty homes. Shantytown renovation typically involves two resettlement approaches for displaced residents followed by reconstruction of public facilities and real estate properties. In-kind-based resettlement (i.e., property exchange) compensates displaced residents with alternative housing[8], whereas cash-based resettlement offers displaced residents cash to purchase homes from the housing market as they wish.

In-kind resettlement had been the dominant approach until 2015, when it was partially replaced by cash resettlement. In 2015, several real estate policies led to an unprecedented level of housing inventories held by developers, especially in lower-tier cities, with the total floor area of unsold inventories rising to 7.36 billion square meters, while new housing sales in 2015 only totaled 1.28 billion square meters.[9] To reduce this inventory overhang, Beijing started replacing in-kind resettlement with cash resettlement, under which the displaced residents would become home buyers in the housing market. From 2014 to 2017, the proportion of cash-based resettlement in shantytown renovations increased steadily. It was 9% in 2014, rose to 28% in 2015, further climbed to 48.5% in 2016, and peaked at 53.9% in 2017.[10]

To support the cash-based resettlement, the People's Bank of China (PBoC) provided policy banks, primarily the China Development Bank (CDB), with a long-term, low-interest-rate funding source through the Pledged Supplementary Lending (PSL) facility. These funds were then extended to local governments for the shantytown renovation projects. From 2014 to 2018, the PBoC injected over 3.5 trillion RMB via PSL, and the CDB extended around 4.0 trillion RMB of shantytown renovation loans.

The cash-based resettlement program effectively addresses the profound illiquidity inherent

[8] Local governments either construct the resettlement housing by themselves or mandate the private developers to set aside some house units for resettlement during land auctions in former shantytown areas.

[9] See the report from Guotai Junan Securities.

[10] See the news article from People's Daily.

in shantytown housing by converting these largely non-tradable assets into cash, often at valuations exceeding their impaired market potential. The illiquidity of shantytown housing stems from multiple reasons. First, many shanty homes were historically built on land with ambiguous ownership, and lack the official deeds required for formal market participation and bank mortgage financing (He et al., 2019; Yang et al., 2023). Second, houses in shantytowns often suffer from substandard construction, significant disrepair, and a lack of essential amenities, rendering them uncompetitive compared to formal housing alternatives (Wu, 2016; Hussain et al., 2021).[11]

The period following the widespread adoption of cash compensation coincided with a significant recovery in China's real estate market, which had been struggling with oversupply. Nationwide real estate prices rose sharply, and the government's goal of destocking was achieved as housing inventories fell substantially. However, recognizing the market's rapid overheating and the emerging risks of a housing bubble, policymakers began to scale back the program. By mid-2018, the central government started to curtail the use of cash compensation, and the CDB effectively halted new funding for shantytown renovation projects.[12]

2.2 Data

This section describes the three datasets used in our paper: i) shantytown renovation loan data from the CDB; ii) National Population Census data from the National Bureau of Statistics (NBS); and iii) housing market data from various sources.

Shantytown renovation loan data. Our analysis relies on a proprietary dataset of shantytown renovation loans from the China Development Bank (CDB), the primary policy lender for this national program.[13] The raw data span from 2005 to 2021, with total volume signed surging dramatically between 2014 and 2018 as shown in Figure A.1 in Appendix A.1. Loans signed during 2014-2018 are primarily used to finance cash resettlement and we analyze exclusively on the 2014-2018 cohort of loans to focus on the national cash-based resettlement policy.[14]

This loan data reveal several key characteristics of the policy financing. The financing is both large-scale and long-term. The average loan amount is 130 million RMB, with a median value of

[11]Using secondary market transaction data from CityRE, covering 19 major cities from 2015 to 2018, we find that the average turnover ratio (sales volume to stock ratio) for shantytown properties is only 5.83% of that of ordinary secondary market apartments. For more information regarding the illiquidity of shantytown housing, see also discussions by local government officials from Sichuan, Tianjin, and Jilin.

[12]See the news article from Reuters.

[13]The Agricultural Development Bank of China also provided some credit support. According to the report from China Securities, CDB accounts for more than 80% of all shantytown renovation loans from policy banks.

[14]See more details on data filtering in Appendix A.1.

58 million RMB, which is slightly larger than the median loan size of 40 million RMB granted by all banks to local government financing vehicles (LGFVs) (Gao et al., 2021). These loans have an average maturity of around 21 years. Consistent with the policy-driven nature of these loans, the interest rates are low, with an average of 3.90% and a median of 3.80%.

National population census data. To measure household migration, we utilize a representative sample of the National 1% Population Survey of 2015 and a representative sample of the National Population Census of 2020 from the National Bureau of Statistics. The 2015 (2020) sample covers approximately 0.22 (0.15) million urban households. For each household, we observe detailed demographics such as age, residence address, hukou registration type, hukou city,[15] homeownership status, house conditions, and migration year at the time of the survey. We identify intercity migration by comparing a household's residence city (destination) with its hukou city (origin). We focus on urban households because shantytown renovation programs primarily target households in urban shantytowns.

Housing market data. We combine housing market data from multiple sources. First, we get the total transaction floor area and value of all new houses at the city-year level from the WIND database. We then measure the city-level urban house stock in 2015 using the total floor area of urban houses in the Population Census of 2015 and extend the house stock series to other years by incorporating annual data on the sale area of new houses and the area of requisitioned houses.

Second, we construct a quality-adjusted house price index based on the house sellers' posted ask prices from CityRE during 2010-2023 (Deng et al., 2022).[16] Specifically, following Fang et al. (2016) and Chen et al. (2017), we adopt the hedonic price approach to generate the house price index for each city by running the following regression:

$$\log(ask_{i,b,c,t}) = \theta_{c,t} + \alpha_b + \varepsilon_{i,b,c,t}, \tag{1}$$

[15]The Chinese "hukou" system is a government-administered household registration system that officially identifies a person as a resident of a specific geographic area, thereby determining their eligibility for local social services and welfare benefits, such as public education and healthcare.

[16]To the best of our knowledge, the existing literature has developed two city-level price indexes for China: one by Fang et al. (2016), covering 120 cities from 2003 to 2013, and another by Deng et al. (2022), covering 307 cities from 2008 to 2017. Our index spans 307 cities from 2010 to 2023, allowing us to study long-run house prices after 2015. CityRE collects home-sellers' posted ask price; bid or actual transaction prices are not available.

Table 1: Data Summary

	Mean	St. Dev.	Obs
House price index	1.174	0.336	4484
House supply growth	0.063	0.056	3598
loan_orig	0.925	0.970	264
loan_dest	0.058	0.051	264
Fraction of cash recipients	0.063	0.066	328
Fraction of staying migrants	0.438	0.71	5881
Fraction of homeowner migrants	0.232	0.461	5881
Fraction of annual migrants, %	0.064	0.203	95120
Urban population, million	1.980	2.245	336
Urban wage per capita, thousand	48.743	0.991	309
GDP, billion RMB	219.9	296.9	315
House sale area, million Sq.Me	4.071	4.873	285
House Price, thousand RMB per Sq.Me	5.371	2.347	327
House inventory/house sale area	4.275	5.558	285
Home purchase restriction	0.110	0.313	327

Note: Summary statistics of our data. House supply growth is annual new supply relative to initial urban house stock during 2010-2022. The two variables, *loan_orig* and *loan_dest*, represent CDB loan amount at originating and destination cities scaled by the city's house transaction value in 2014. For each origin-destination city pair, the fraction of staying (homeowner) migrants is the share of existing migrants in the destination in 2015 who remained there (and owned a home) in 2020, and the fraction of annual migrants is the number of annual migrants from the origin city during 2011-2020, scaled by its total number of urban households in 2015. Except urban population (measured in 2010) and the indicator for home purchase restriction, the remaining city characteristics are measured in 2014.

and the quality-adjusted price index normalized to one in 2014 is then calculated as:

$$HPI_{c,t} = \exp\left(\hat{\theta}_{c,t} - \hat{\theta}_{c,2014}\right). \tag{2}$$

In equation (1), $ask_{i,b,c,t}$ is the ask price for house unit i in building block b in city c and year t, $\theta_{c,t}$ is the city-by-year fixed effect capturing the change in the quality-free house price, α_b is the building block fixed effect, and $\varepsilon_{i,b,c,t}$ is the error term. A building block typically consists of several uniform residential buildings constructed by the same developer and situated adjacent to one another. As each year's transactions involve different building blocks, this approach controls for quality changes arising from shifts in the transaction's building blocks over time. Unlike Fang et al. (2016), we do not include house characteristics in the regression because CityRE data do not contain them.

Table 1 reports summary statistics for the key variables used in this paper. The average house price index was 1.174 during 2010-2023 and the urban housing stock grew at an average annual rate of 6.3% from 2010 to 2022. The average fraction of urban households that receive the cash transfer is 6.3%. For each origin-destination city pair (i.e., hukou city-residence city), the fraction of the existing migrant households in 2015 that remained in the same destination (and owned local homes) in 2020 is 43.8% (23.2%) on average. Furthermore, annual migration at the city-pair level accounted for 0.064% of the origin city's urban households, on average, between 2011 and 2020.

3 Reduced-Form Empirical Analysis

In this section, we document the housing market responses to the cash resettlement and offer direct evidence that the cross-city effects reflect money flows via household migration. Importantly, our analysis reveals that the cash resettlement increases household migration to more expensive, previously unaffordable destinations, consequently inflating house prices in these locations.

3.1 Housing Market Responses: Baseline Reduced-Form Results

We first construct the measures of cash resettlement and housing market outcome variables and then present our baseline reduced-form results. In the following notations, t denotes year; $o, d, i \in \mathbf{N}$ denote city, with o denoting migrants' originating cities (i.e., hukou cities), d migrants' destination cities, and i generic cities.

Measures of cash resettlement. To measure the size of cash resettlement at the loan originating cities relative to the local housing market size, we scale $Loan_o$, the total amount of CDB loans received by city o and signed during 2014-2018, by the city's new house transaction value in 2014:

$$loan\_orig_o = \frac{Loan_o}{Sale_{o,14}}.$$

We do not have household-level data to calculate the exact flow of money (from cash resettlement) across cities via migration networks. We, however, can approximate it by using a Bartik-style variable, assuming that the money flow via household migration is proportional to the pre-existing migration network in 2015. Specifically, taking the 2015 survey data, we denote by N_o the total number of urban households from the originating (hukou) city o, among whom

$M_{o,d}$ resided in city d in 2015. We assume that the total money flow from city o to d is proportional to $Loan_o \cdot \frac{M_{o,d}}{N_o}$. We then aggregate $Loan_o \cdot \frac{M_{o,d}}{N_o}$ across all originating cities o and scale the sum by city d's new house transaction value in 2014:

$$loan\_dest_d = \frac{1}{Sale_{d,14}} \sum_{o \neq d} Loan_o \cdot \frac{M_{o,d}}{N_o}. \tag{3}$$

We acknowledge that this Bartik-style measure *loan_dest*, which only incorporates the pre-existing migration network in 2015, is an approximation and can differ from the actual money flow, because the migration response to cash transfers may differ from the migration response to various other shocks that shaped the pre-existing migration network. As we discuss below in Section 3.3, *loan_dest* is likely to underestimate the actual average cross-city money flow. However, our cross-sectional analysis only requires it to be proportional to the actual flow. To move beyond this approximation, we will perform heterogeneity analysis below to reveal household destination choices after receiving the cash transfer.

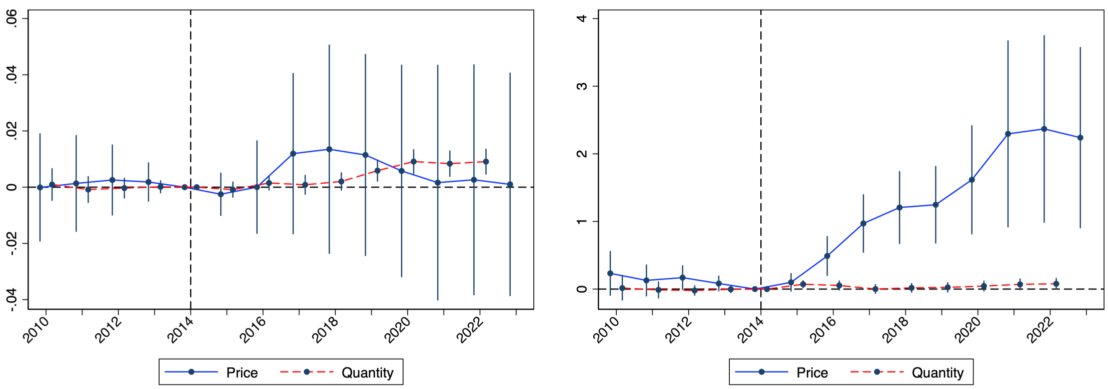
Table 1 reports that the size of cash resettlement in the originating cities is on average 92.5% of the city's house transaction value in 2014. Money flow to the destination cities, as captured by *loan_dest*, is on average 5.8% of the destination city's house transaction value in 2014. Throughout, we focus on *loan_dest*, which is at the core of our paper, and use *loan_orig* as a control for robustness checks.

Housing market outcomes. Finally, for the housing market outcomes, we use our quality-adjusted house price index, HPI_{it} given in Eq. (2), as the measure of price changes, and the house supply growth (i.e., new house supply scaled by the initial urban housing stock at the year beginning) as the measure of incremental supply.

Baseline regression results. We employ the following event study analysis to investigate the housing market responses to two cash resettlement measures constructed above:

$$y_{i,t} = \sum_{\tau \neq 2014} \mathbf{1}_{t=\tau} \cdot \left(\gamma_\tau \cdot loan\_orig_i + \beta_\tau \cdot loan\_dest_i + \Gamma_\tau \cdot Control_i \right) + \delta_i + \theta_{p(i),t} + \epsilon_{i,t}. \tag{4}$$

In specification (4), γ_τ captures the effect of cash resettlement in the same (originating) city, β_τ captures the effect of cash resettlement from other cities via migration to the destination city, δ_i controls for time-invariant city fixed effects, $\theta_{p(i),t}$ controls for any shocks at the province-year



(a) Originating Cities

(b) Destination Cities

Figure 2: Housing Market Responses at Origin/Destination Cities

Note: This figure plots the 95% confidence interval of the event study coefficient estimates as in regression (4). The left panel plots the effects of *loan_orig* and *loan_dest* on the house prices (in blue solid line) and house quantity (supply, in red dashed line) for originating cities, and the right panel plots those for destination cities. Standard errors are clustered by cities.

level, and $\epsilon_{i,t}$ is the error term. We also allow for differential time trends across cities by including time-varying effects of various city characteristics ($\Gamma_\tau \cdot Control_i$), including the logarithm of urban population, average urban wage income, GDP, new house sale area, house prices, and house inventory scaled by new house sale area, all measured in 2014, along with an indicator for whether the city has ever imposed home purchase restrictions (Deng et al., 2022).

We study house prices first. Panel (a) of Figure 2 plots the estimated $\{\hat{\gamma}_\tau\}$, which are coefficients on *loan_orig*. The panel shows that higher *loan_orig* is not associated with faster house price growth after 2015, contradicting the prevailing narratives in professional reports and the media.[17] Interestingly, Panel (b) of Figure 2, which plots $\{\beta_\tau\}$, shows strong and robust positive impacts of cash resettlement from other cities on local house price growth after 2014. Prior to 2014, cities with differential *loan_dest* exhibit no significant differences in the dynamics of house prices, supporting the parallel trend assumption for event study analysis. This points to the role of migration in how cash resettlement affects house prices in other cities.

Turning to housing supply, Panel (a) shows that cities with higher *loan_orig* did not experience an increase in housing supply before 2018, and saw only a modest 1% rise beginning in 2020. This pattern is consistent with shantytown renovation modestly expanding housing supply, albeit with a lag. In contrast, cities with higher *loan_dest* also experienced greater growth

[17]See, for example, a report from the Business Insider.

in housing supply, although the effect was temporary and economically small (Panel (b)), likely reflecting the inelastic nature of housing supply.[18]

3.2 Heterogeneous Responses across Different House Price Gaps

Household migration in response to increased financial wealth differs from the pre-existing migration network that is shaped by various forces. In Bilal and Rossi-Hansberg (2021), a relaxation of household borrowing constraints encourages households to upgrade to more expensive locations by allowing for more efficient consumption smoothing. In our context, households are more likely to face binding borrowing constraints when purchasing homes at destination cities with a larger house price gap relative to their origins. Consequently, by relaxing household borrowing constraints, the cash resettlement can facilitate location upgrading of new migrants or reduce location downgrading of existing migrants between city pairs with large house price gaps.

This logic implies that for a given destination city, cash resettlement from cities with lower house prices will have a larger impact on local house prices than that from other cities. We therefore construct $loan\_dest^h$, which counts the loan inflows from originating cities with $\frac{P_{d,14}}{P_{o,14}}$ above its median value of $p50$ in the sample, so that destination cities with relatively higher housing prices in 2014 have larger $loan\_dest^h$:[19]

$$loan\_dest^h_d = \frac{1}{Sale_{d,14}} \sum_{o \neq d, \frac{P_{d,14}}{P_{o,14}} > p50} Loan_o \cdot \frac{M_{o,d}}{N_o}. \tag{5}$$

We then modify specification (4) to allow the treatment effect of money inflow to differ by the city-pair house price gap (to save space, controls now include $loan\_orig$):

$$HPI_{i,t} = \sum_{\tau \neq 2014} \mathbf{1}_{t=\tau} \cdot \left(\beta^l_\tau \cdot loan\_dest_i + \Delta\beta_\tau \cdot loan\_dest^h_i + \Gamma_\tau \cdot Control_i \right) + \delta_i + \theta_{p(i),t} + \epsilon_{i,t}. \tag{6}$$

In (6), the coefficient β^l_τ on $loan\_dest$ only captures the impact of loans from originating cities whose $\frac{P_{o,14}}{P_{d,14}}$ sits *below* the median value $p50$, while the coefficient $\Delta\beta_\tau$ on $loan\_dest^h$ captures the additional effect on destination cities that receive money inflow from relatively low-house-price originating cities. Our hypothesis that funds are more likely to flow from low-house-price

[18] Recall the definition of $loan\_dest$ in Eq. (3), a city can have a higher value in $loan\_dest$ either because it has more immigrants or because of a larger cash resettlement from its immigrants' originating cities. In Appendix A, we show that after controlling for variation in $loan\_dest$ due to migration network, an increase in $loan\_dest$ due to the scale of cash resettlement in originating cities also has a positive effect on the local house price growth after 2015.

[19] This threshold value $p50$ is 1.24, slightly above one, which serves our purpose well as households are unlikely to face more binding constraints when migrating to cities with comparable house prices to their originating cities.

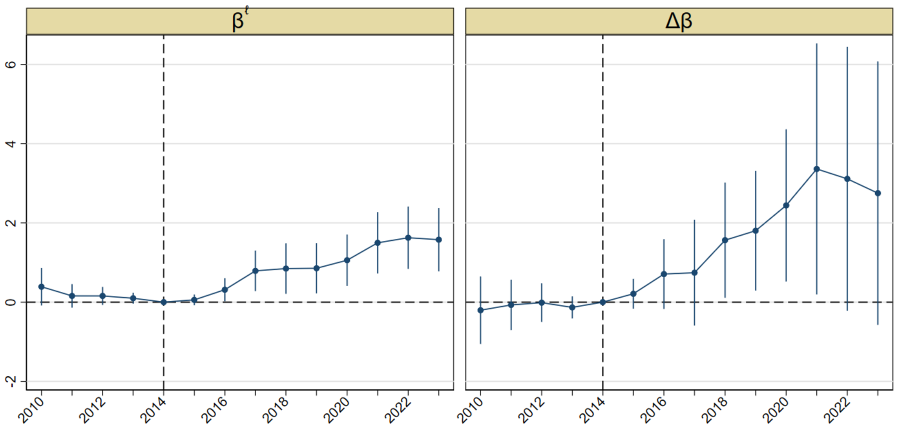


Figure 3: House Price Response to *loan_dest* by Originating Cities with Different Price Gaps

Note: This figure plots the 95% confidence interval of the event study coefficient estimates of β^l (left panel) and $\Delta\beta$ (right panel) in the regression (6). β^l is the baseline effect from low-price-gap originating cities while $\Delta\beta$ captures the additional effect from high-price-gap originating cities. Standard errors are clustered by cities.

originating cities to high-house-price destination cities predicts a significant $\Delta\beta_\tau$.

Figure 3, which shows that $\widehat{\Delta\beta}_\tau$ are not only positive but also statistically significant, confirms our hypothesis. Magnitude wise, $\widehat{\Delta\beta}_\tau$ in Panel (b) is about twice the estimate of $\widehat{\beta}^l_\tau$ in Panel (a), meaning that cash resettlement from relatively low-housing-price originating cities is twice more important than that from other cities. Note that the additional effect of $loan\_dest^h$ is not because the same one dollar inflow from different cities plays different roles in the destination city. Rather, the fact that inflows from lower-price cities to higher-price destinations generate significantly stronger effects suggests that cash-resettlement-driven mobility is particularly pronounced along such price gradients. We provide direct evidence for this claim in the next section.

3.3 Money Flow and Household Migration

In this section we use household survey data to establish two channels that link *loan_dest* to house prices: a *downgrade mitigation effect* on pre-existing migrants and an *upgrade facilitation effect* on new migrants.

The first channel, the downgrade mitigation effect, operates through pre-existing migrants residing in other cities if they or their parents retain ownership of properties in their originating cities. In case the parents own the properties, they may transfer part of the money to the child and purchase a smaller house for themselves; if they own a second property, they may transfer the entire sum.[20] This inter-generational transfer helps youngsters settle in more expensive destinations, mitigating the financial pressure to "downgrade" back to less expensive originating cities. We refer to money flows through these pre-existing migrants who stay in more expensive cities and spend the transfer there as the "downgrade mitigation" effect. The resulting impact of this channel on the destination's housing market can be captured by *loan_dest*.

The second channel applies to new migration triggered by cash resettlement. For non-migrants in originating cities who would like to move to a more expensive city but could not afford to, the windfall from cash resettlement received by them or their parents relaxes their financial constraints, facilitating an "upgrade" to more expensive destinations. We refer to money flows following these new migrants to more expensive destinations as the "upgrade facilitation" effect. This effect can also be captured by *loan_dest* since common factors like relational ties and bilateral migration costs/tendencies imply a strong correlation between the pre-existing and new migration networks.[21]

Downgrade mitigation. The Population Census data of 2020 enable us to examine, for the pre-existing migrants who left their originating cities before 2015, whether cash resettlement in their originating (hukou) cities affects their residence and homeownership status in 2020.

We first measure household exposure to the cash resettlement for each loan originating city o, by calculating the fraction of cash-receiving urban households as follows:

$$cash\_recipient_o = \frac{Loan_o}{\bar{H}_o P_{o,14}} \times \frac{1}{N_o}.$$

Here, $Loan_o$ is the total amount of CDB loans for cash resettlement, $\bar{H}_o$ is the average size of shanty houses based on the Population Census data of 2015, $P_{o,14}$ is the house price per unit area in 2014, and N_o is the number of urban households originating from (with hukou registered in) city o in 2015. The first term, $\frac{Loan_o}{\bar{H}_o P_{o,14}}$, represents the total number of cash recipients with houses in city o. Table 1 shows that the average fraction of cash recipients is 6.3% across all cities.

[20] Inter-generational support from parents to children is common in many countries (Rosenzweig and Wolpin, 1993; Rosenzweig and Zhang, 2014). This is particularly true in China: parents often assist children in purchasing homes by contributing to the down payment and the mortgage payments (Li and Shin, 2013). Recent media articles describe how young adults in China often rely on the combined financial resources of parents and even grandparents to buy homes in urban areas (see the news article from Financial Times).

[21] This second channel implies that *loan_dest* is at best proportional to—rather than equal to—the actual cross-city money flows due to cash resettlement, which makes the coefficients on *loan_orig* and *loan_dest* in (4) non-comparable.

We then run the following cross-sectional regression analysis:

$$y_{o,d} = \beta \cdot cash\_recipient_o + \delta_d + \theta_{p(o)} + Control_o + \epsilon_{o,d}. \tag{7}$$

We consider two outcome variables: i) $stay_{o,d}$, which is the share of existing migrants from o to d who remained in the destination city d by 2020, and ii) $own_{o,d}$, which is the share of existing migrants from o to d who not only remained but also owned houses in city d by 2020. Table 1 reports that the average value of *stay* is 43.8% and the average value of *own* is 23.2%.

It is worth highlighting that regression (7) is at originating-destination city-pair level; this allows us to include the destination city fixed effect δ_d to absorb any destination city-level factors—say hukou or other house purchase restrictions—that may affect the migrants' staying and house-purchasing decisions (Tian, 2024; An et al., 2024). Put differently, with δ_d, (7) examines how cash resettlement in the immigrants' originating cities affects their status in the same destination city. We do not include the originating city fixed effect because the treatment variable is defined at the originating city level. Instead, we include originating city-level controls together with the originating province fixed effect $\theta_{p(o)}$, as in our baseline regression (4).

Table 2 Panel A reports the results. In Columns (1)-(2), larger exposure to cash resettlement in their originating cities has a positive and significant impact on the probability that existing urban migrants in 2015 stay and become homeowners in the destination cities in 2020. A one-standard-deviation increase in *cash_recipient* would increase *stay* by 8.1% and *own* by 3.6%, which are economically important relative to the mean of 43.8% and 23.2%, respectively.

In Columns (3)-(4), we conduct placebo tests by repeating the same analysis for rural migrants. Rural households mostly own houses in rural areas, which are not the target of the shantytown renovation program. Indeed, we do not find any significant effect of cash resettlement on the rural migrants, suggesting that our results are not driven by any city-pair economic linkages that would affect both rural and urban migrants similarly.

Finally, following the analysis of heterogeneous effects across city-pairs with different house price gaps in Section 3.2, we divide all the city pairs with non-zero urban migrants before 2015 into two groups based on their relative house price gap in 2014, $\frac{P_{d,14}}{P_{o,14}}$, and then rerun (7). Table 2 Panel B reports the estimation results. In Columns (1)-(2) we run the regression only on the sample with a high house price gap, and find a positive and significant impact of cash resettlement in their originating cities on the households' probability of staying and becoming homeowners

Table 2: Intercity Money Flow Through Existing Migrants

Panel A: Baseline Results

	(1)	(2)	(3)	(4)
Hukou:	urban	urban	rural	rural
Dep Var:	stay	own	stay	own
cash_recipient	0.954***	0.477***	0.314	-0.011
	(2.81)	(2.26)	(1.30)	(-0.07)
Controls	Yes	Yes	Yes	Yes
Origin Province FE	Yes	Yes	Yes	Yes
Destination City FE	Yes	Yes	Yes	Yes
Pseudo-R2	0.220	0.156	0.28	0.228
Obs	5850	5850	2800	2800

Panel B: Heterogeneity with City-pair House Price Gap

	(1)	(2)	(3)	(4)	(5)	(6)
House Price Gap:	high	high	low	low	All	All
Dep Var:	stay	own	stay	own	stay	own
cash_recipient	1.424***	0.527**	0.354	0.357	0.187	0.331
	(3.08)	(1.92)	(0.816)	(1.08)	(0.443)	(1.05)
cash_recipient · High					1.349**	0.229
					(2.22)	(0.57)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Origin Province-High FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination City-High FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R2	0.253	0.199	0.204	0.182	0.252	0.190
Obs	2905	2905	2918	2918	5823	5823

Note: This table shows conditional on those urban households that have migrated to other cities before 2015, how the size of the cash-based resettlement in their originating cities affects the fraction that stay or own homes in the destination cities in 2020 (Panel A), and how such effects depend on the city-pair house price gap (Panel B). Standard errors are clustered by originating cities. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

in destination cities. In contrast, in Columns (3)-(4), the coefficient estimates are both smaller and insignificant for city pairs with a relatively low house price gap. In Columns (5)-(6), we perform the estimation using the full sample and interact *cash_recipient* with a dummy variable *High*, which equals one if the house price gap is higher than the median and zero otherwise. The coefficient estimate of the interaction term is statistically significant for *stay*; it is also positive but not large enough to be statistically significant for *own*.

In sum, our results are consistent with our hypothesis that households who migrate to cities with relatively high house prices are more likely to face binding borrowing constraints when purchasing local houses. Only with the cash compensation will they be able to buy the local houses and avoid location downgrading.

Upgrade facilitation. To test the upgrade facilitation effect, we calculate the fraction of annual migrants, $M_{o,d,t}/N_o$, defined as the share of urban households that migrate from city o to city d in year t, which we can measure for each year from 2011 to 2020 using the population survey data of 2015 and 2020.[22] We then calculate the average change in this migration intensity after 2014 as:

$$\frac{\Delta M_{o,d}}{N_o} = \frac{1}{6}\sum_{t=2015}^{2020}\frac{M_{o,d,t}}{N_o} - \frac{1}{4}\sum_{t=2011}^{2014}\frac{M_{o,d,t}}{N_o}.$$

We re-estimate (7) using $\frac{\Delta M_{o,d}}{N_o}$ as the dependent variable.[23] With the originating province fixed effect $\theta_{p(o)}$ and destination city fixed effect γ_d, the estimation investigates how cash resettlement across originating cities in the same province impacts changes in household migration to the same destination city after 2015.

Table 3 reports the estimation results. In Column (1), we find a positive and significant impact of *cash_recipient* on the out-migration of households post-2015. To gauge the magnitude, we can calculate the average number of new intercity migrations induced per household receiving the cash transfer during the 2015–2020 period as follows:

$$\frac{1}{\#\text{Origin Cities}}\sum_{o}\Big(\sum_{d\in\mathbf{D}(o)}\sum_{t=2015}^{2020}\hat{\beta}\Big).$$

Here, $\mathbf{D}(o)$ represents the set of destination cities in the estimation for each originating city o. The calculation yields a value of 22%, meaning that on average, 22% of the cash-receiving households migrated to other cities by the end of 2020.

Columns (2)-(4) report the demographics of households that migrate in response to the cash resettlement, with the timing of the effect shown in Figure A.3. We find that these households are primarily of working age and relocate to other cities in pursuit of higher wages, rather than, for instance, retired parents moving to live with their children. The estimation reveals that among the 22.0% of cash recipients that migrated to other cities by 2020, 19.6% state the migration reason to be employment in the destination city, 18.0% are under 40 years old at the time of migration, and almost none are parents migrating to where their children were living. In Appendix A.3 we investigate the timing of the effect with an event study analysis using the city-pair annual panel data, and find that the effect on migration occurred only after 2014, with the magnitude peaking

[22]In case not all family members migrated to other cities, we use the migration status of the family head to identify household migration.

[23]We restrict our analysis to city-pairs with at least one migrant during 2011–2020 in the survey data.

Table 3: Intercity Money Flow Through New Migrants

Dep Var: $\Delta M/N$,%	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Households			House Price Gap		
	All	Work Purpose	Age<40	First Migrant	High	Low	All
cash_recipient	0.147***	0.131***	0.120***	0.147***	0.171***	0.091*	0.063
	(3.12)	(3.17)	(3.00)	(3.12)	(2.61)	(1.68)	(1.19)
cash_recipient·High							0.133*
							(1.72)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin Province FE	Yes	Yes	Yes	Yes			
Destination City FE	Yes	Yes	Yes	Yes			
Origin Province-High FE					Yes	Yes	Yes
Destination City-High FE					Yes	Yes	Yes
Pseudo-R2	0.132	0.139	0.122	0.132	0.133	0.163	0.158
Obs	9460	9460	9460	9460	4704	4723	9427

Note: This table shows the effect of *cash_recipient* on the city's urban household intercity migration, and how such effects depend on the city-pair house price gap (destination/origin) in 2014. Standard errors are clustered by originating cities. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

around 2018 and diminishing afterwards.

Finally, we confirm the heterogeneity result in Section 3.2 after dividing all city pairs into two groups based on $\frac{P_{d,14}}{P_{o,14}}$. Columns (5)-(6) report the estimation results for the two subsamples. Consistent with our conjecture, cash resettlement mainly facilitates household migration between city pairs with relatively larger house price gaps. The effect is positive but much smaller and insignificant for city pairs with relatively lower house price gaps. In Column (7) we interact *cash_recipient* with the dummy variable *High* indicating whether the city-pair house price gap is higher than the median value, whose estimated coefficient is positive and statistically significant. These results are consistent with our hypothesis that cash resettlement can facilitate location upgrading by relaxing household borrowing constraints in more expensive locations.

4 A Simple Model: Qualitative Insight

The empirical results draw the following picture. A group of households, empowered by a significant cash transfer, moved to—or remained in—more expensive cities (with better economic opportunities), which were previously unaffordable for them; and house prices in these destination cities increased as a result. We build a two-period model to illustrate the underlying mechanism and provide prediction on household mobility and housing spending.

4.1 The Setting

There are two locations indexed by $\ell \in \{H, L\}$, where house price P_ℓ and wage income w_ℓ are higher in H than in L. We take house prices and wages as given to focus on individual household's location choice and consumption-savings problem. We also assume $\beta \cdot R = 1$, where β is the household's exogenous discount factor and R is the exogenous gross return on savings.

Households have an initial wealth b_0, which follows a cumulative distribution function $F(b_0)$ with support $(0, \bar{b}_0)$. We will focus on how b_0 determines households' decisions. For simplicity, we assume that households make a one-time decision on housing service h at $t = 0$.[24] Households may borrow to buy houses, subject to a borrowing constraint limiting net borrowing $(-b_t)$ to a fraction of the house value in any period. We further assume that households face zero moving costs when they make their location choices.

4.2 Consumption, Savings, and Housing Decisions

Conditional on living in location ℓ, the household solves the following problem:

$$V_\ell(b_0) = \max_{h>0, \{b_t, c_t>0\}} \sum_{t\geq 0} \beta^t \cdot (\log(c_t) + \log(h)) \tag{8}$$

$$\text{s.t. } b_0 = c_0 + b_1/R + P_\ell h, \tag{9}$$

$$b_t + w_\ell = c_t + b_{t+1}/R \quad \text{for any } t \geq 1, \tag{10}$$

$$-b_t \leq (1 - \bar{\omega}) P_\ell h \quad \text{for any } t \geq 1. \tag{11}$$

Equation (9) is the household's budget constraint at $t = 0$, when it allocates its initial wealth b_0 on consumption, savings and housing. Equation (10) is the flow budget constraint for $t \geq 1$, in which the household earns local wage w_ℓ and makes consumption-savings decisions. Denoting lifetime labor income by $W_\ell \equiv \sum_{t\geq 1} \frac{w_\ell}{R^{t-1}}$, we can express the budget constraint (10) as the lifetime budget constraint $W_\ell + b_1 = \sum_{t\geq 1} \frac{c_t}{R^{t-1}}$. Finally, Equation (11) captures the borrowing constraint, i.e., net borrowing in any period cannot exceed $1 - \bar{\omega}$ fraction of the house value.

In our simple setting, the household faces the same problem for all $t \geq 1$. Given date-1 debt b_1, the full consumption smoothing policy implies that $b_t = b_1$ and $c_t = b_1(1 - \beta) + w_\ell$ for

[24] Allowing households to adjust housing at every date does not qualitatively affect the main results. When the collateral constraint is slack, the solution coincides exactly with that under the simplified assumption: the threshold for initial wealth is unchanged, and households optimally maintain constant housing from date 0 onward. When the constraint binds, optimal housing and consumption converge asymptotically to the unconstrained levels, as households gradually accumulate savings to relax the collateral constraint. More details are provided in Appendix B.2.

$t \geq 1$. This will be the optimal solution to (8) if b_1 satisfies the borrowing constraint. Substituting this optimal solution into the household's problem at $t = 0$, we can show that the borrowing constraint is binding if and only if b_0 is below a certain threshold $\hat{b}_0^\ell$:

$$b_0 \leq \hat{b}_0^\ell \equiv \frac{2 - 2\beta + \bar{\omega}\beta}{2 - \bar{\omega}} W_\ell, \ \ell \in \{H, L\}. \tag{12}$$

The borrowing constraint is more likely to bind for households with lower initial wealth (b_0) or higher lifetime wages (W_ℓ); the latter arises because higher-income households demand larger houses, but their initial wealth may be insufficient to meet the required down payment.

4.3 Household Location Choice

Households decide where to live at the beginning of date 0. Throughout this model, we assume that the model parameters satisfy Assumption 1 in Appendix B.1. Because the incremental utility from higher wage is decreasing in household initial wealth, there exists a threshold, $\check{b}_0$, such that households with $b_0 > \check{b}_0$ prefer to reside in the cheaper location L. We assume that $\check{b}_0$ is greater than $\hat{b}_0^H$, the wealth threshold below which the borrowing constraint binds at location H. We then have the following proposition.

Proposition 1. *Under Assumption 1, there exists a threshold $\tilde{b}_0$ such that households with $b_0 < \tilde{b}_0$ choose to live in location L while those with $b_0 \in (\tilde{b}_0, \check{b}_0)$ choose to live in location H.*

Intuitively, households with low initial wealth face a more binding borrowing constraint in H than in L. They cannot smooth current consumption and can only benefit from higher wage incomes in H through future consumption. The resulting utility increase cannot outweigh the higher housing cost in H under our parameter assumption, and as a result, they stay in location L. In contrast, households with high initial wealth can smooth consumption and thereby benefit more from higher future wage incomes in location H. The resulting utility increase outweighs the higher housing cost in H and hence they choose location H.

Figure 4 illustrates the household's optimal location choice when $\tilde{b}_0 > \hat{b}_0^L$. The pink and green lines represent the value of residing in location L and H, respectively. The two lines intersect at $\tilde{b}_0$. As b_0 increases from zero, the household resides in location L and transitions from a constrained to an unconstrained type. Once b_0 exceeds $\tilde{b}_0$, the household optimally relocates to location H and becomes a constrained type in H. It remains constrained until b_0 increases beyond $\hat{b}_0^H$, at

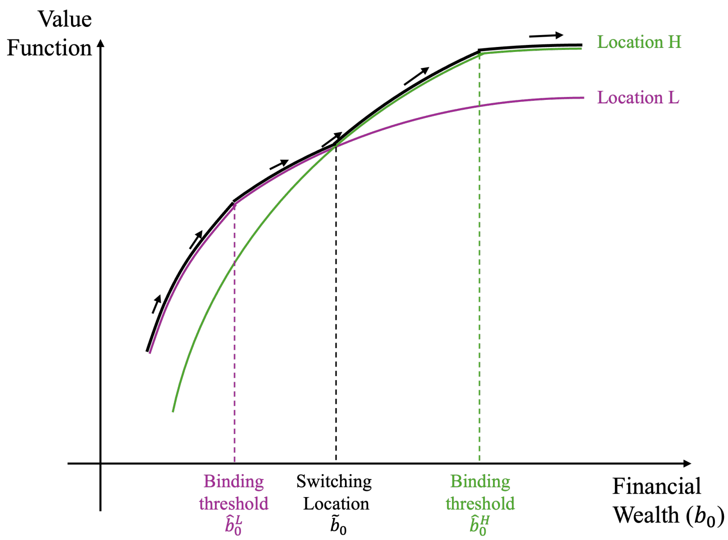


Figure 4: Location Value Function and Migration

which point it becomes unconstrained in H. In the case where $\tilde{b}_0 < \hat{b}_0^L$, the household relocates to H before becoming unconstrained in L.

4.4 The Housing Expenditure Multiplier

The housing expenditure multiplier, that is, households' marginal propensity to spend on housing per unit increase in their initial wealth b_0, is an important object in our quantitative model. We first fix the location and examine household housing expenditure multiplier, which is

$$Mult(b_0;\ell) \equiv \frac{\partial(P_\ell \cdot h(b_0;\ell))}{\partial b_0} = P_\ell \frac{\partial h(b_0;\ell)}{\partial b_0}. \tag{13}$$

This leads to the following proposition.

Proposition 2. *Given location ℓ, the housing expenditure multiplier satisfies the following properties:*

(1) It is higher when the borrowing constraint is binding than when it is not binding. Specifically, $Mult(b_0;\ell) > \frac{1}{2}$ if condition (12) holds and $Mult(b_0;\ell) = \frac{1}{2}$ if condition (12) does not hold.

(2) If the borrowing constraint is binding, $Mult(b_0;\ell)$ is higher when b_0 is lower or W_ℓ is higher.

Intuitively, when the borrowing constraint is not binding, households optimally allocate half of their additional wealth to housing purchase. When the borrowing constraint binds, households lack sufficient wealth to meet the down payment of desired housing purchase. In this case, the marginal propensity to spend on housing is greater than one half. Moreover, an increase in housing purchase following a wealth increase relaxes their borrowing constraint, allowing for additional borrowing to finance housing purchase. When b_0 is lower or W_ℓ is higher, the borrowing constraint is more binding, and thereby $Mult(b_0; \ell)$ is higher.

How does endogenous location choice come into play? When households can move, Proposition 1 implies that their optimal housing expenditure, denoted by $HouseExp(b_0)$, is:

$$HouseExp(b_0) = \mathbf{1}_{b_0 < \tilde{b}_0} \cdot P_L \cdot h(b_0; L) + \mathbf{1}_{b_0 > \tilde{b}_0} \cdot P_H \cdot h(b_0; H). \tag{14}$$

Accordingly, their housing expenditure multiplier under their optimal location choice is:

$$Mult(b_0) \equiv \frac{dHouseExp(b_0)}{db_0}. \tag{15}$$

We compare two scenarios. In scenario one, households are immobile and must remain in location L. In scenario two, households are free to migrate to their preferred locations. We are interested in how the option to migrate to location H affects the increase in housing spending following a marginal increase in households' initial wealth b_0.

Proposition 3. *Compared to the scenario in which households cannot migrate to location H, the expected increase in housing expenditures resulting from a marginal wealth transfer is strictly higher when households can freely migrate. That is,*

$$\mathbb{E}_{b_0}[Mult(b_0)] > \mathbb{E}_{b_0}[Mult(b_0; L)].$$

In general, a wealth increase generates two distinct effects on housing consumption. The first operates at the extensive margin, through households with wealth just below $\tilde{b}_0$. By Proposition 1, a marginal wealth increase induces these households to migrate to location H, where higher wages lead them to consume more housing. The second operates at the intensive margin. For those households that migrate to H under scenario 2, property (2) of Proposition 2 implies that their marginal propensity to spend on housing is strictly higher than it would be in L, as the borrowing constraint binds more tightly in H.[25]

Proposition 3, which we will quantitatively evaluate in Section 6, delivers the key insight of

[25] To see this more precisely, consider a uniform infinitesimal transfer $\varepsilon = db_0$ to all households. The transfer induces a mass $f(\tilde{b}_0) \cdot db_0$ of households at the threshold to migrate to H, each experiencing a discrete increase in housing consumption of $P_H h(\tilde{b}_0; H) - \frac{\tilde{b}_0 + W_L/R}{2}$. The intensive margin contribution is $db_0 \cdot \int_{\tilde{b}_0}^{\hat{b}_0^H} \left(Mult(b_0; H) - \frac{1}{2} \right) dF(b_0)$. Both effects are thus the same order of db_0, meaning that the extensive and intensive margins contribute at the same order.

our paper. In our quantitative analysis, cash resettlement corresponds to scenario two, under which households can migrate (but with standard moving costs). To reflect scenario one where households do not migrate, we consider a counterfactual form of transfer—voucher resettlement—which induces most households to stay in their originating locations by limiting the transfer to local housing spending. We then quantitatively compare how the housing expenditure multiplier differs between cash and voucher resettlement.

5 A Dynamic Spatial General Equilibrium Model

How much did the cash-based resettlement program contribute to China's housing boom since 2015? How important was migration in shaping the program's effects? To answer these questions, we extend the simple model in Section 4 to a dynamic spatial general equilibrium model and conduct quantitative analysis.

5.1 Locations and Households

Locations. There is a finite set of locations, $\mathcal{L} = \{1, 2, \ldots, L\}$. We use ℓ to index a generic location, d the destination location, and o the originating (house) location. Locations differ in labor productivity $Z_{\ell,t}$, land supply $L_{\ell,t}$, housing supply shifter B_ℓ, and amenities A_ℓ, all of which are exogenously given, with the first two varying over time.

Demographics and earnings. Households' age is indexed by $a = \{1, 2, \ldots, \bar{a}\}$. Households begin working at $a = 1$, survive to the next period with probability $p(a)$ for $a < \bar{a}$, and die with certainty at age $\bar{a}$. Upon death, they leave bequests of housing and assets (or debt) to the newborns with $a = 1$ who replace them.

In period t, household i receives wage earnings of $z_{i,t}G(a_i)W_{\ell,t}$, where $G(a_i)$ is an age-specific factor that captures the hump-shaped pattern of earnings over the life cycle, $z_{i,t}$ is an i.i.d. idiosyncratic income risk, and $W_{\ell,t}$ is the after-tax wage per effective unit of labor in location ℓ in period t.

Preferences. Household utility from consumption good c, housing services $\tilde{h}$ and amenity $\widetilde{A}$ takes the following form:

$$u(c, \tilde{h}, \widetilde{A}; v, h, a) = e(a)\Big(\widetilde{A} + \frac{\big((1-\alpha_h)c^\eta + \alpha_h \tilde{h}^\eta\big)^{\frac{1-\sigma}{\eta}}}{1-\sigma}\Big) + v \cdot \zeta^h(a) - \mathbf{1}_{h=0} \cdot \xi^h. \tag{16}$$

Here, v equals 1 if the household lives in its own house and 0 otherwise, h is the size of house owned by the household, which can differ from housing services $\tilde{h}$ as explained below, and a is the household's age. The scale parameter $e(a)$ reflects deterministic changes in family size. We assume the amenity to be $\widetilde{A}_{\ell,o} = \frac{A_\ell + A_o}{2}$ for households with residence location ℓ and house location o.[26]

We introduce three parameters related to housing utility. First, to capture preferences for living in one's own house, we assume that it provides an additional utility $\zeta^h(a)$, which we calibrate to match the life-cycle profile of tenure choices. In addition, to govern the choice of house size, we assume that living in a rental house of size h' provides $\tilde{h} = h'$ housing services, whereas living in one's own house of size h provides $\tilde{h} = \psi^h h$ effective housing services. We calibrate ψ^h to match the ratio between the average size of owner-occupied and renter-occupied houses. Second, to capture the home purchase decision of non-homeowners (e.g., those who lost their houses in the shantytown renovation program), we assume that households lacking homeownership (i.e., $h = 0$) experience a utility loss of ξ^h, which is calibrated to match the estimated share of cash recipients who purchased new houses during 2016-2020.

Finally, the household evaluates the total bequest to its children w_b using the same CRRA utility, $\varphi(w_b) = \varphi \frac{w_b^{1-\sigma}}{1-\sigma}$.

Migration. To capture the essence of shantytown renovation program, we advance the existing literature (Giannone et al., 2023; Greaney, 2023) to accommodate the fact that household residence location ℓ and house location o can differ. This distinction affects migration costs as follows. Given ℓ and o, we assume the cost of moving to destination d, with the house location updated to o' in the next period, to be

$$\kappa_1(a) \cdot \mathbf{1}_{d \neq \ell} + \kappa_2(\ell, d) + \kappa_3 \cdot \mathbf{1}_{o' \neq o}. \tag{17}$$

The first two terms represent the migration cost when a household changes residence location, with $\kappa_1(a)$ varying with household age and $\kappa_2(\ell, d)$ varying across city pairs. We calibrate the age-dependent migration cost $\kappa_1(a)$ to match the average out-migration profile over the life cycle and $\kappa_2(\ell, d)$ to match the bilateral migration shares in the data. The third term, κ_3, applies when a household changes house location, which captures the disutility associated with losing the

[26] The dependence on A_o captures connections with originating cities, which arise due to, for instance, people's parents still residing in or their children going to school in location o.

connection with originating cities when households settle and own property in a new location. We calibrate κ_3 to match the observed share of households that change housing locations.

Finally, prior to moving, for each destination d, each household draws an i.i.d. location preference shock ϵ_d from a Type-I Extreme Value distribution with zero mean and scale parameter ν.

5.2 Households' Decisions

There is no aggregate uncertainty in this economy. Households have perfect foresight over aggregate variables such as wages, rents, and house prices. In what follows, we first characterize the continuation value at the beginning of each period given the household's residence and house locations, and then describe its migration choice at the end of the period.

Shanty versus normal houses. There are two types of housing assets: shanty ($s = 1$) and normal ($s = 0$). Households can rent or purchase normal houses, while shanty housing can only be occupied but not rented or traded.[27] Households treated by the shantytown renovation program will lose their illiquid shanty houses in exchange for cash equal to the value of the house at the market price before the first period.

Bellman equation. At the end of each period, after drawing the idiosyncratic location preference shock, the household makes location and housing tenure choices for the next period. To avoid tracking multiple housing locations for one household, we assume that a household must sell its existing house if and only if it purchases a new house. If the household's existing house is shanty, it will give up the shanty house when purchasing a new one, as the shanty house is illiquid. Because all households in our model start with one unit of house, this assumption ensures that households have exactly one unit of house throughout their lifetime unless they are treated by the shantytown renovation program. In case of being treated, they become non-homeowners and incur a utility loss of ξ^h in each period until they purchase a new normal house. We also assume that if they purchase a new house, they live in that house for that period. Therefore, households have three options in each period: (1) rent anywhere, (2) stay in their existing house, or (3) sell their existing house, purchase a new one and live in their new house.

At the beginning of period t, any household i is characterized by age $a_{i,t}$, residence location $\ell_{i,t}$, a house carried over from the previous period with size $h_{i,t}$, location $o_{i,t}$ and type $s_{i,t}$, and

[27] We have discussed the sources of shanty house illiquidity in Section 2.1.

cash on hand $w_{i,t}$. Cash on hand consists of liquid assets $b_{i,t}$ and current earnings, i.e., $w_{i,t} = b_{i,t} + z_{i,t}G(a_{i,t})W_{\ell_{i,t},t}$. To simplify notation, we drop the household index i. Given the household state vector $x_t = (a_t, w_t, h_t, o_t, s_t)$ and the current and previous residence locations ℓ and ℓ_{-1}, the household's value function is given by

$$V_{\ell_{-1},\ell}(x_t) = \begin{cases} \max\{V_{Rent,\ell}(x_t), V_{Buy,\ell}(x_t), V_{Stay}(x_t)\} - \Big(\kappa_1(a_t) \cdot \mathbf{1}_{\ell \neq \ell_{-1}} + \kappa_2(\ell_{-1}, \ell)\Big) & \text{if } \ell = o_t, \\ \max\{V_{Rent,\ell}(x_t), V_{Buy,\ell}(x_t) - \kappa_3\} - \Big(\kappa_1(a_t) \cdot \mathbf{1}_{\ell \neq \ell_{-1}} + \kappa_2(\ell_{-1}, \ell)\Big) & \text{if } \ell \neq o_t. \end{cases} \tag{18}$$

Here, $V_{Rent,\ell}(x_t)$ denotes the value of renting at ℓ, $V_{Buy,\ell}(x_t)$ the value of purchasing a new house at ℓ, and $V_{Stay}(x_t)$ the value of staying in previously owned house (which is an option available only when $\ell = o_t$). When the household purchases a new house at location $\ell \neq o_t$, it incurs a migration cost of κ_3 as specified in Equation (17).

The Bellman equation for $V_{Buy,\ell}(x_t)$, which is the value of purchasing home at ℓ, satisfies:

$$V_{Buy,\ell}(x_t) = \max_{\{c,h,b_{t+1}\}} u(c, \psi^h h, \widetilde{A}_{\ell,\ell}; 1, h, a_t) + p(a_t)\beta \mathbb{E}_{\epsilon_{t+1}}\Big[\max_{d \in \mathcal{L}} \Big\{\mathbb{E}_{z_{t+1}}[V_{\ell,d}(x_{t+1}) \mid b_{t+1}]$$
$$+ e(a_{t+1})\epsilon_{d,t+1}\Big\}\Big] + (1 - p(a_t)) \cdot \varphi(b_{t+1} + h_{t+1}P_{o_{t+1},t+1}(1 - s_{t+1})) \tag{19}$$

$$s.t.\ c + hP_{\ell,t}(1 + \tau^{h,b} + \delta^h) + \frac{1}{R}b_{t+1} = w_t + h_t P_{o_t,t}(1 - s_t)(1 - \tau^{h,s}) - F_{b,t}, \tag{20}$$

$$b_{t+1} \geq -(1 - \bar{\omega})P_{\ell,t}h,\ h \geq \underline{h}, \tag{21}$$

$$w_{t+1} = b_{t+1} + z_{t+1}G(a_{t+1})W_{d,t+1},\ h_{t+1} = h,\ o_{t+1} = \ell,\ s_{t+1} = 0,\ a_{t+1} = a_t + 1.$$

Given the decision to purchase a new house at location ℓ, the household chooses consumption c, house size h and savings b_{t+1}. Because the household will live in the newly purchased house, $v = 1$. With probability $p(a_t)$, the household survives and chooses the residence location d for period $t+1$ that offers the highest expected value. The expectation over z_{t+1} arises because z_{t+1} is realized after migration. With probability $1 - p(a_t)$, the household dies and leaves a bequest which includes liquid assets and the liquidated value of the house.

We now discuss constraints in problem (19). The first constraint (20) is the budget constraint, stating that the household's sources of funds consist of cash on hand w_t and proceeds from selling the previous house $h_t P_{o_t,t}(1 - s_t)(1 - \tau^{h,s})$ with $\tau^{h,s}$ denoting the housing sales tax; and the uses of funds consist of consumption c, new home purchase h at location ℓ, and asset position b_{t+1}. The home purchase incurs a deed tax $\tau^{h,b}$ and a per-unit maintenance cost of δ^h. The household faces an exogenous interest rate $R > 1$; the interest rate spread ι between the savings rate and the borrowing rate implies an additional financial cost of borrowing, given by $F_{b,t} = \iota \cdot \mathbf{1}_{b_{t+1}<0}|b_{t+1}|$.

In addition to the budget constraint, the debt carried into the next period cannot exceed a fixed fraction of the current value of the new house, with the haircut on collateral denoted by $\overline{\omega}$; see Equation (21). We also impose a minimum size requirement $\underline{h}$ on the new house.

The Bellman equations for $V_{Rent,\ell}(x_t)$ and $V_{Stay}(x_t)$ are analogous to Equation (19) and are presented in Appendix C. Renters allocate their cash on hand across consumption, rental housing services, savings, and their own housing maintenance costs. Those who live in their previously acquired house make consumption-savings decisions, after paying the housing maintenance costs. In all cases, the borrowing constraint must be satisfied.

Migration share. Conditional on the state variables x_{t+1} and the residence location ℓ in period t, the share of households moving to location d in period $t+1$ is:

$$\mu(d|\ell, b_{t+1}, x_{t+1} \backslash \{w_{t+1}\}) = \frac{\exp\left(\frac{1}{\nu}\frac{1}{e_{a_{t+1}}}\mathbb{E}_{z_{t+1}}[V_{\ell,d}(x_{t+1}) \mid b_{t+1}]\right)}{\sum_{d'} \exp\left(\frac{1}{\nu}\frac{1}{e_{a_{t+1}}}\mathbb{E}_{z_{t+1}}[V_{\ell,d'}(x_{t+1}) \mid b_{t+1}]\right)}. \tag{22}$$

5.3 Production and Equilibrium

Labor. We assume a linear production function in labor. Competitive equilibrium implies that the wage per effective unit of labor equals the labor productivity, i.e., $W_{\ell,t} = (1-\tau^W)Z_{\ell,t}$, where τ^W is the income tax rate.

Houses. We assume that in each location, new houses are produced by a representative home developer according to the following function:[28]

$$Y_{\ell,t} = B_{\ell,t} \cdot P_{\ell,t}^{\frac{\lambda}{1-\lambda}} L_{\ell,t} - Y_{\ell,t}^d, \tag{23}$$

where $B_{\ell,t} = B_\ell^{1/(1-\lambda)}(\frac{\lambda}{W_{\ell,t}})^{\frac{\lambda}{1-\lambda}}$. Here, B_ℓ is a housing supply shifter, $L_{\ell,t}$ is the land supply, and $Y_{\ell,t}^d$ is the existing housing units requisitioned and demolished by local governments, all of which are exogenously given.

Accordingly, the housing stock evolves as follows:

$$H_{\ell,t} = (1-\delta^h)H_{\ell,t-1} + Y_{\ell,t}. \tag{24}$$

[28]See Appendix C.2 for the micro-foundation.

Landlords. Rental supply comes from speculative landlords, who can trade in the housing market without any transaction costs. Their required rate of return from investing in rental houses is R_s, which is exogenously given. Here, s stands for "speculative." In equilibrium, we must have the following condition on rent-to-price ratio:[29]

$$\frac{R_{\ell,t}}{P_{\ell,t}} = 1 - \frac{1-\delta^h}{R_s} \cdot E^s[\frac{P_{\ell,t+1}}{P_{\ell,t}}] = 1 - \frac{1-\delta^h}{R_s} \cdot \left[1 + \rho(\frac{P_{\ell,t}}{P_{\ell,t-1}} - 1)\right]. \tag{25}$$

In Eq. (25), $E^s[\frac{P_{\ell,t+1}}{P_{\ell,t}}]$ is the landlords' extrapolative belief about future price growth, which we assume to be $1 + \rho(\frac{P_{\ell,t}}{P_{\ell,t-1}} - 1)$. Extrapolative belief is an important feature of the housing market, especially in China. The parameter $\rho = 0.2$ captures the extent of extrapolation, which we take from Li et al. (2026).

Competitive equilibrium. Given an initial distribution of households, the competitive equilibrium of our dynamic economy is defined by a sequence of prices $\{W_{\ell,t}, P_{\ell,t}, R_{\ell,t}\}$ and a distribution of household states $(x_{i,t}, \ell_{i,t-1}, \ell_{i,t})$ such that: a) the evolution of the household distribution is consistent with the individual household optimization problem, and b) the housing, rental, and labor markets clear in every location and in every period.

5.4 Quantification

We now quantify our dynamic spatial general equilibrium model. The joint consideration of housing tenure choice, consumption-savings under incomplete markets, and forward-looking location decisions—combined with rich spatial and individual heterogeneity—generates non-linear policy functions over a large state space.[30] We implement a solution method that globally solves the household's dynamic problem given aggregate states. We then track the distribution of individual states within and across locations, starting from an initial distribution. Once aggregated, this distribution, in turn, informs the equilibrium behavior of aggregate states.

Time, space, and equilibrium. Each period in our model represents five years. We take 2016–2020 as the first period, during which the cash-based resettlement program was implemented.

Given the computational challenges, we pool all the cities to form five locations based on their house prices in 2015. Location 1 consists of the top three cities—Beijing, Shanghai, and

[29] Equation (25) implies that $\frac{(1-\delta^h)E^s[P_{\ell,t+1}]}{P_{\ell,t}-R_{\ell,t}} = R_s$, meaning that the return from investing in this rental house is R_s.

[30] We cannot implement dynamic hat-algebra for counterfactual analysis, as this approach requires policy functions to be log-linear in state variables, as in Caliendo et al. (2019) and Kleinman et al. (2023).

Shenzhen, whose house prices far exceed those of other cities. Location 2 consists of the capital cities and another two cities with comparable house prices from the five most developed coastal provinces: Fujian, Guangdong, Jiangsu, Tianjin, and Zhejiang.[31] Location 3 consists of the other cities in these five provinces. Locations 4 and 5 consist of the capital and non-capital cities of other provinces, respectively.[32] Online Appendix Figure A.5 shows that this clustering largely preserves the geographic dispersion in house prices and, more importantly, the majority of household migration. Between 2016 and 2020, migration across these five locations accounts for 77% of all intercity migration. The percentage of households receiving cash compensation increases almost monotonically from location 1 to location 5—0.5% in location 1, 3.0% in 2, 2.8% in 3, 7.6% in 4, and 9.1% in 5.[33]

To obtain the location-level price paths, we aggregate the city-year level prices and wages to the location-period level by first taking the simple average across the five years within each period and then taking the population-weighted average across cities in each location. At the city level, we use observed real house prices and real wages prior to 2021,[34] and extrapolate future real house prices and real wages, assuming that real house prices and wages grow at the OECD's forecasted real GDP growth rate until 2060 and at an annual rate of 1% thereafter.[35]

We directly construct the pre-2016 distribution of individual states based on the representative sample of the National 1% Population Survey Data of 2015 and the China Household Finance Survey data of 2015 and 2017, as detailed in Appendix C.3. Table 4 reports summary statistics on the household demographics by treatment status in this initial distribution. Treated households are slightly older and less wealthy in terms of savings and owned housing size.

We calibrate land supply and house requisition such that the observed paths of house prices, rental prices and wages in different locations correspond to the equilibrium price paths in our baseline economy with the cash-based shantytown renovation program. Specifically, with the initial household distribution and the time sequence of $\{W_{\ell,t}, P_{\ell,t}, R_{\ell,t}\}$, we solve households' dynamic problems. We then calculate land supply and house requisition, $\{L_{\ell,t}, Y^d_{\ell,t}\}$, as residuals

[31] The two non-capital cities are Wenzhou (in Zhejiang) and Xiamen (in Fujian).

[32] We exclude all regions located to the west of the Hu Huanyong Line, as well as Hainan Island (Banerjee et al., 2020). The Hu Huanyong Line, also known as the Aihui-Tengchong Line, divides China into two parts with markedly different population density: the eastern part accounts for 43% of the territory and 94% of the population (Chen et al., 2016). By 2015, migration to and from these excluded regions accounts for 10% of all intercity migration.

[33] In our data, 70.4% of cash recipients are in location 5, 17.8% in 4, 8.1% in 3, 2.8% in 2, and 0.9% in 1.

[34] We use $\hat{\theta}_{c,t}$ from Equation (1) as the measure of house prices prior to 2021. We do not use the observed house prices and wages during 2022-23 to avoid any unexpected shocks in the COVID-19 period.

[35] See OECD's real GDP long-term forecast here.

Table 4: Household Demographics and Location Characteristics

		Mean	St. Dev.	Obs
Treated HHs	age (a)	6.861	2.959	7916
	savings, RMB (b)	93076.468	1.71e+05	7916
	house size, sqm (h)	81.693	49.441	7916
	shanty type (s)	1.000	0.000	7916
Non-treated HHs	age (a)	6.186	2.802	171768
	savings, RMB (b)	2.06e+05	4.11e+05	171768
	house size, sqm (h)	99.225	42.215	171768
	shanty type (s)	0.240	0.427	171768
Locations	effective wage, RMB (W)	4.46e+05	1.42e+05	5
	house price, RMB/sqm (P)	19452.356	17719.520	5
	5-yr rent/price	0.120	0.034	5

to clear the housing market for all (ℓ, t) in the baseline economy.

Parameter calibration. A subset of parameters is either calibrated based on values from the existing literature or externally determined without solving the model. The remaining parameters are internally calibrated to match key empirical moments related to wealth distribution, housing tenure choice, and migration behavior. The detailed description of the parameter calibration is given in Appendix C.3, with Table A.1 and Figure A.7 presenting all the parameters and related data moments.

6 Model Mechanism and Policy Evaluation

In this section, we use our quantitative model to evaluate how the program affects household location choices and housing expenditures, and to quantify the amplifying role of migration.

6.1 Policy Regimes

We analyze three policy regimes. The first is cash-based resettlement; as explained in Section 5.4, the observed paths of house prices and rental prices in different locations correspond to the equilibrium prices under this policy regime (by recovering land supply paths). The second is a no-resettlement scenario, where households continue to own their shanty houses without cash compensation (for more details, see Section 6.3.)

The third is a voucher-based resettlement, which we use to isolate the effect of migration. Unlike cash, the voucher is restricted to purchasing houses in the local market over the household's lifetime, thereby localizing the housing demand generated by the compensation, although households may still rent or use their non-voucher savings to purchase houses elsewhere. Voucher resettlement is a more implementable policy than directly restricting mobility. The difference in household responses between cash and voucher resettlement captures the migration effect. [36]

We first analyze individual household behaviors under these three policy regimes in Section 6.2, taking the observed equilibrium paths of house prices and rents as given. In Section 6.3, we solve for equilibrium price paths under each regime, and examine how general equilibrium forces affect household behaviors.

6.2 Partial Equilibrium Analysis

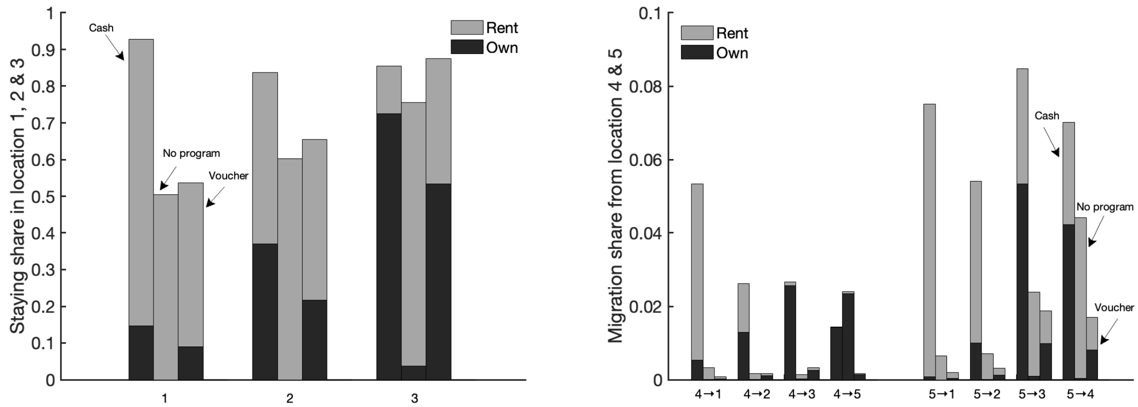
Cash resettlement versus no resettlement. We first examine households' reactions to the cash transfer and confirm that our quantitative model can replicate the key empirical findings reported in Section 3.3. Specifically, holding fixed the observed price paths, we solve the model under the cash resettlement program, and compare it to the one without such program.

Figure 5 plots the migration and housing tenure decisions of treated households predicted by the model for the period of 2016—2020. Panel (a) reports the staying share of treated households from the top three residence locations and Panel (b) the migration share of treated households from the bottom two residence locations.

In Panel (a), we focus on treated households whose residence and shanty house locations differ in 2015. We examine their staying probability and housing tenure choices in expensive locations, with full results reported in Figure A.8 in Appendix D. For households initially residing in location 1, relative to no resettlement, cash resettlement mitigates downgrading to lower-tier locations by more than 40% in total, with about 15% of them purchasing new houses in location 1. Similar patterns hold for households initially residing in locations 2 and 3, whose out-migration rates decrease by 24% and 10% respectively, relative to no resettlement. The mitigation of location downgrading, and the fact that these effects are more pronounced in more expensive locations, echo our empirical findings on the downgrade mitigation effect in Section 3.3.

Panel (b) reports results for treated non-migrants who initially lived in their own houses in 2015. We focus on households initially residing in locations 4 and 5, with full results for all

[36]In Proposition 3 of the two-location model (Section 4), migration is shut down entirely for clarity. In practice, fully restricting migration is not feasible; the voucher system represents a real-world policy aimed at localizing demand.



(a) Downgrade Mitigation

(b) Upgrade Facilitation

Figure 5: Household Migration and House Tenure Choice: Cash, No, & Voucher Resettlement

Notes: Panel (a) plots the share of treated existing migrants in 2015 who remain in the 2015 location during 2016-2020. Panel (b) plots the share of treated non-migrants in 2015 who out-migrates from each residence location to each destination in 2016-2020. The three bars correspond to cash (left), no (middle), and voucher resettlement (right), with colors indicating housing tenure choices in the new residence location.

locations reported in Figure A.8. For households from location 5, relative to no resettlement, cash resettlement increases upgrading to locations 1-4 by approximately 20% in total, with about 10% of new migrants purchasing houses at the destination, mostly in Locations 3 and 4 rather than the more expensive locations 1 and 2. For households initially from location 4, cash resettlement reduces downgrading to location 5 and facilitates upgrading to locations 1-3 by nearly 10%. The induced location upgrading from lower-tier origins echo our empirical findings on the upgrade facilitation effect in Section 3.3.

Voucher resettlement. Figure 5 also presents household location and housing tenure choices in 2016-2020 under the voucher resettlement. The voucher resettlement substantially reduces, but does not completely eliminate, the downgrade mitigation and upgrade facilitation effects.

In Panel (a), fewer existing migrants in the top three locations remain in these locations or purchase houses under the voucher than cash resettlement. However, although households cannot finance home purchases with the voucher in these locations, voucher resettlement still leads to more purchasing houses in these locations compared with the no-resettlement scenario. This is because households have a strong preference to purchase new houses after their only houses are requisitioned, and some of them choose to become homeowners in residence locations.

In Panel (b), substantially fewer non-migrants from the bottom two locations upgrade their location with vouchers. Similar to Panel (a), as they lose their only houses, some of the few out-migrating households purchase new homes in other locations. The majority remain in their house locations and use the voucher to purchase normal local houses, as shown in Figure A.8.

Housing expenditure multipliers. Proposition 3 in the two-location model demonstrates that the interaction between borrowing constraints and location choices significantly affects housing expenditures. To investigate this formally, we calculate a *housing expenditure multiplier*:

$$\text{Housing Expenditure Multiplier} = \frac{\Delta\text{Expected First Home Purchase w. vs w/o Transfer}}{\text{Dollar Amount of Transfer}},$$

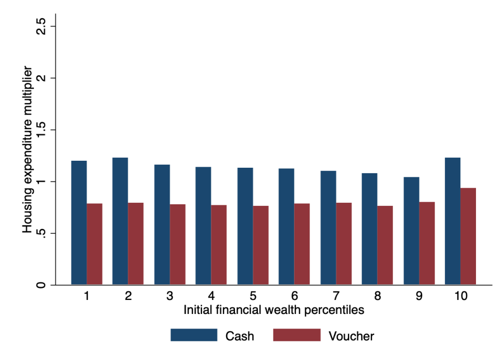
which can be calculated in a partial equilibrium context as in Section 4. Because households—especially those upgrading locations—may transition gradually into homeownership after receiving transfer, we calculate the multiplier based on the household first home purchase over its lifetime.[37] Specifically, we track each household's first home purchase across states and over time, discount expected lifetime expenditures to the initial 2016-2020 period, and compute the difference with and without the transfer, normalized by the transfer amount.

We find that under cash resettlement, the housing expenditure multiplier is always positive, with an average value of 1.14 and a median value of 0.86, and 10% of the treated households exhibit values above 2.5. These large multipliers arise because, after receiving the cash transfer, households can supplement it with personal savings or mortgage financing and move to a place with higher wages, enabling them to spend beyond the amount received.

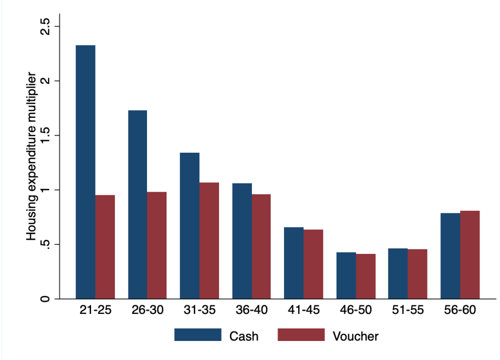
The average multiplier declines substantially under the voucher resettlement, with an average value of 0.80 and a median value of 0.72, and only 10% of the treated households exhibit values above 1.28. Therefore, endogenous migration amplifies the average household housing expenditures in response to the transfer by a factor of 42.5% ($= 1.14/0.80 - 1$).

Figure 6 shows how the multiplier varies across resettlement schemes and household characteristics in 2015. Panel (a) indicates that the multiplier varies little across wealth levels. Wealthier households generally show marginally lower multipliers, as they face less binding borrowing constraints and therefore increase housing spending by less per unit of transfer. Panel (b) shows a sharp decline in the cash multiplier with age: the youngest cohort exhibits values of nearly 2.3, consistent with the finding that younger households are more mobile as they benefit from

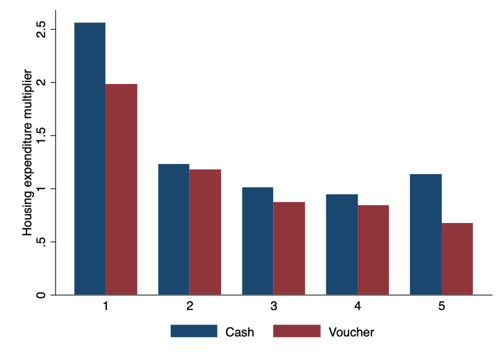
[37] Home purchase spending is recorded as zero for households that rent during the specified time period before they purchase their first houses.



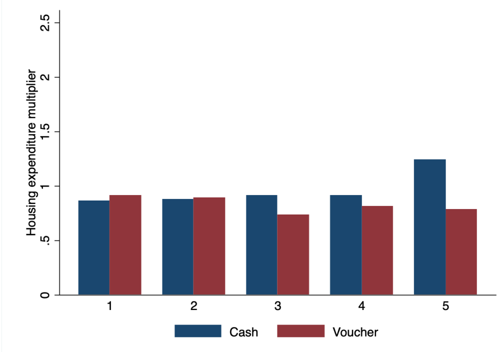
(a) Wealth



(b) Age



(c) Residence location



(d) House location

Figure 6: Lifetime Housing Expenditure Multiplier, Cash vs Voucher Resettlement

Note: This figure plots the average lifetime housing expenditure multiplier for different household wealth, age, and residence location and house location under cash and voucher resettlement.

higher-tier locations over a longer time horizon. Interestingly, without the amplifying role of migration, the voucher multiplier for the young cohorts declines substantially.

Panel (c) reveals that the cash multiplier is highest for households residing in location 1. About 70% of the treated households in location 1 in 2015 owned shanty houses elsewhere. Due to the downgrade mitigation effect, many stayed in location 1 with the cash transfer, often taking on high leverage to purchase local housing and exhibiting a high multiplier. Without the option to spend the money in location 1, the voucher multiplier is substantially lower for residence location 1, consistent with the smaller downgrade mitigation effect of vouchers in Figure 5. Finally, Panel (d) shows little variation in the multiplier across house locations—except for location 5, which has the highest cash multiplier, as some households upgrade locations and take on greater leverage to purchase housing than households from other locations.

In summary, our quantitative model echoes our key empirical findings that cash resettlement can mitigate location downgrading and facilitate location upgrading, and such location adjust-

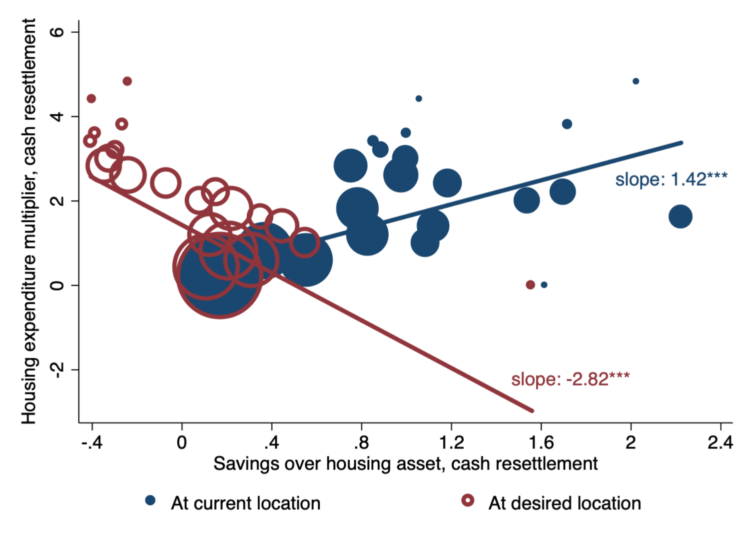


Figure 7: Household Borrowing Constraint and Housing Expenditure Multiplier

Note: This figure shows the relationship between shanty homeowners' housing expenditure multiplier (y-axis) and their optimal savings-to-housing asset ratio (x-axis) in 2016-2020 under the two scenarios following a cash transfer: (1) purchasing a house at the current location (in blue), and (2) purchasing a house at the desired location with free migration (in red). For simplicity, we focus on non-migrants from location 5 ($o = \ell = 5$).

ments substantially amplify the housing expenditure responses to the transfer.

Housing expenditure multiplier and borrowing constraint. To illustrate the importance of endogenous mobility in understanding household housing expenditure, we highlight that households' borrowing at the current location—where they stay before the cash transfer relaxes their borrowing constraints—does not accurately measure their true borrowing constraint. Households may wish to upgrade to a more expensive location but remain in less expensive locations if the borrowing constraint restricts consumption smoothing and reduces their utility at more expensive locations. Consequently, they may have low borrowing at current location, yet their constraint is more accurately reflected by the borrowing that they will have at desired locations.

Figure 7 illustrates this mechanism. Imagine a policymaker seeking to assess households borrowing constraints and the multiplier effect of a cash transfer on housing expenditure. If he were to (mistakenly) rule out endogenous migration and compute the savings-to-housing asset ratio for 20162020 under the assumption that households purchase a new home in their current city after receiving the transfer, then our model predicts that the relationship between this mismeasured ratio and the true multiplier would follow the pattern depicted by the blue circles in Figure 7. We observe that households with this ratio closer to the borrowing constraint (toward the left) do *not* exhibit larger multipliers—in fact, they display smaller multipliers.

The key insight of our model is that the above-mentioned ratio is mismeasured because it ignores endogenous location choice. What matters instead is the savings-to-housing asset ratio—plotted as red circles—that these households would have at their desired locations, i.e., where they would migrate once the cash transfer relaxes their borrowing constraint. Once we take this into account, as Figure 7 shows, households with a savings-to-housing asset ratio closer to the borrowing limit exhibit substantially larger multipliers.

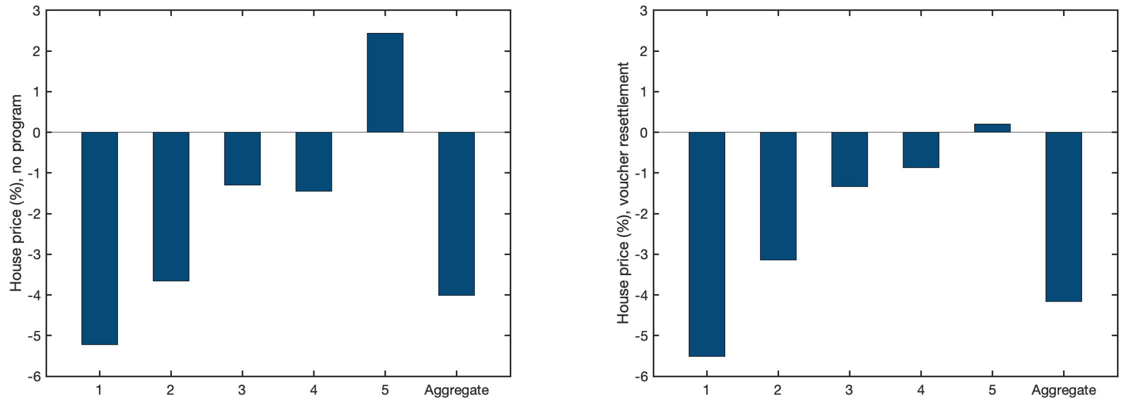
6.3 General Equilibrium Effect on House Prices and Migration

The household responses analyzed in Section 6.2 are based on the observed price paths from the baseline, cash-based resettlement equilibrium. We now allow migration affects the equilibrium prices and are interested in how these general equilibrium forces shape household responses.

Compared to cash resettlement, the voucher scenario features the same land supply schedule but different housing demand in different locations. For the no-resettlement scenario, we must specify how the resettlement program has affected land supply. In the baseline economy, some shanty houses are requisitioned and demolished, but local governments increase land supply from requisitioned properties for new construction. We assume that one square meter of requisitioned housing yields half a square meter of land, which, results in approximately the same housing supply as requisitioned as the equilibrium floor-to-area ratio is around 2 in each location. Further, we assume that this additional land supply is phased in equally over two periods to account for construction time. Thus, the equilibrium price effects of the program stem not from direct changes in supply but from enhanced housing asset liquidity, altered migration decisions, as well as lags in new construction.

Equilibrium price changes Figure 8 shows the change in house prices under the no resettlement and voucher resettlement scenarios, relative to the baseline cash resettlement economy. Absent the program, average house prices in 2016-20 would fall by more than 5% in location 1, nearly 4% in location 2, and roughly 1% in location 3 and 4, while rising by about 2% in location 5. The program thus amplifies house price disparities between high- and low-tier locations.

The average house price decline absent the program, weighted by the local housing value, is around 4%. If we fit a linear trend to the house price index before 2015, the predicted house price in 2020 is lower than the observed price by around 20%. Thus, the model explains about



(a) No Resettlement

(b) Voucher Resettlement

Figure 8: Counterfactual Resettlement Programs and House Price Relative to Baseline, 2016-2020

Note: This figure plots the change in equilibrium house prices across locations under the no resettlement and voucher resettlement economy, relative to the baseline with cash resettlement. x-axis indicates 1-5 locations and aggregate.

20% of the detrended price growth during 2016-2020. Of course, this estimate depends on the strength of belief extrapolation; as shown in Figure A.11, increasing the extrapolation parameter ρ in (25) from our baseline value of 0.2 to 0.25 boosts the average price impact from 4% to 7.5%. Note that our assumption on speculation is conservative because in our model only landlords form extrapolative expectations, whereas Kaplan et al. (2020) treat all households as speculators.

To assess the role of migration, Panel (b) shows that equilibrium prices are significantly lower under voucher resettlement relative to the baseline, in all locations except 5. Comparing Panel (b) with (a), vouchers result in almost the same price consequences in location 1–3 as the no-resettlement scenario. In other words, the large price impacts of cash resettlement in the top three locations are all attributed to household location choices. Overall, voucher resettlement barely generates any aggregate price impacts.

Migration, housing expenditure multipliers, and welfare. The equilibrium price adjustment barely affects the estimated effect on household migration in 2016-2020. Figure A.9 in the appendix presents the general equilibrium version of Figure 5. Absent the program, lower house prices in locations 1-4 and higher price in location 5 would result in less location downgrading and more upgrading. However, lower house prices in locations 1-4 also make extrapolative landlords less optimistic about future price growth, prompting them to raise rents, which in turn increases downgrading and reduces upgrading. In locations 1-2, the second effect dominates, leading to a slightly larger downgrade mitigation effect of cash resettlement. In locations 4-5, the two effects offset each other, yielding a similar upgrading effect.

Moving to the housing spending multiplier, as lower house prices in locations 1-4 lead to less housing spending absent the program, the multiplier is slightly larger when taking into account equilibrium price adjustment. The average cash multiplier is 1.18, with a median value of 0.91, compared to the mean value of 1.14 and the median value of 0.86 without equilibrium price adjustment. The average voucher multiplier is 0.84, with a median value of 0.77. Migration amplifies the multiplier by a factor of 40.5% ($= 1.18/0.84 - 1$).

Finally, absent the program, the welfare of the treated households, measured in lifetime consumption goods, would drop by around 22.8% on average.[38] Households value the migration option: compared to the cash resettlement, voucher will reduce the recipient households' welfare by about 5.3% on average. On the other hand, the welfare of non-treated households due to equilibrium price adjustments depends on their location. Absent the program, those in locations 1-4 will win while those in location 5 would lose. On average, their welfare increases by 0.18%.

7 Conclusion

This paper demonstrates that studies of household borrowing constraints which omit endogenous location choice systematically understate the severity of borrowing constraints and consequently underestimate household responses to borrowing-constraint relaxation.

We test this hypothesis in the context of China's cash-based shantytown renovation program (2015-2018). Reduced-form evidence indicates that cash transfers relaxed borrowing constraints, enabling households to migrate to more expensive locations previously beyond their purchasing reach. Using a dynamic spatial general equilibrium model with endogenous migration and borrowing constraints, we find that such location upgrading behavior substantially amplifies the household housing spending response and the programs equilibrium price impacts. These results imply that policymakers seeking to stimulate household spending should target households for whom the true—rather than the observed—borrowing constraint is more binding.

[38]Formally, the lifetime welfare of a household with state (x_0, ℓ) is given by $\nu \log \left(\sum_d \exp \left(\frac{1}{\nu} \frac{1}{e_{a_0+1}} \mathbb{E}_{z_1} [V_{\ell,d}(x_1)|x_0] \right) \right)$, which incorporates both the option value of migration and the subsequent tenure choice in the destination location. To express the above welfare $\overline{V}_\ell(x_0)$ in consumption-equivalent units, we construct a constant lifetime consumption path $c(x_0, \ell)$ so that $\overline{V}_\ell(x_0) = \sum_{a=a_0}^{\overline{a}} \beta^{a-a_0} \frac{c(x_0,\ell)^{1-\sigma}}{1-\sigma}$. We then compute percentage changes in this consumption-equivalent measure to quantify welfare changes; e.g., the welfare change of household (x_0, ℓ) from the baseline economy with cash resettlement to the counterfactual economy with no-resettlement is $\frac{c(x_0,\ell)^{\text{no program}} - c(x_0,\ell)^{\text{cash}}}{c(x_0,\ell)^{\text{cash}}}$.

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Online Appendix

A Data and Empirical Results

A.1 Data

The raw data, spanning from 2005 to 2021, contain 37,725 individual loans across 13,112 contracts for 6,398 shantytown renovation projects, totaling 5.04 trillion RMB. For each loan, we observe the signing date, total withdrawal amount, interest rate, and maturity. We first select loans signed during 2014–2018, which contains 34,966 loans (11,621 contracts) totaling 4.33 trillion RMB. To ensure the accuracy of our city-level matching, from this subsample we further exclude 3,788 loans (1,469 contracts) associated with provincial-level consolidated lending facilities, as these cannot be reliably attributed to a specific city. This procedure yields our final sample of 31,178 loans across 10,152 contracts, representing a total loan volume of 4.04 trillion RMB.

Figure A.1 plots the distribution of the grant quarters of our sample CDB loans.

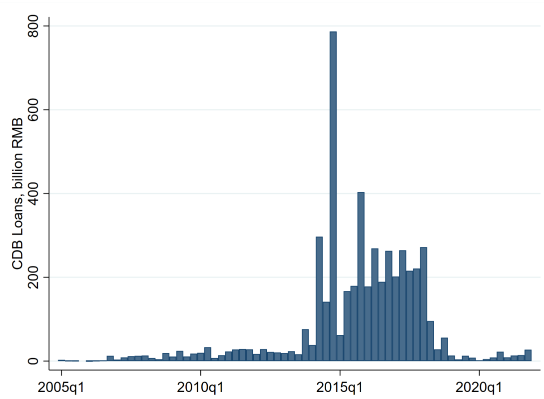


Figure A.1: Quarterly Amount of CDB Loans Granted

Note: This figure plots the amount of CDB shantytown renovation loans granted in each quarter.

A.2 Housing Market Responses

The variation in *loan_dest* is driven by both the migration network and the cash resettlement in the immigrants' originating cities. To show our results are specific to the cash resettlement program rather than some other shocks that also transit through the migration network, we

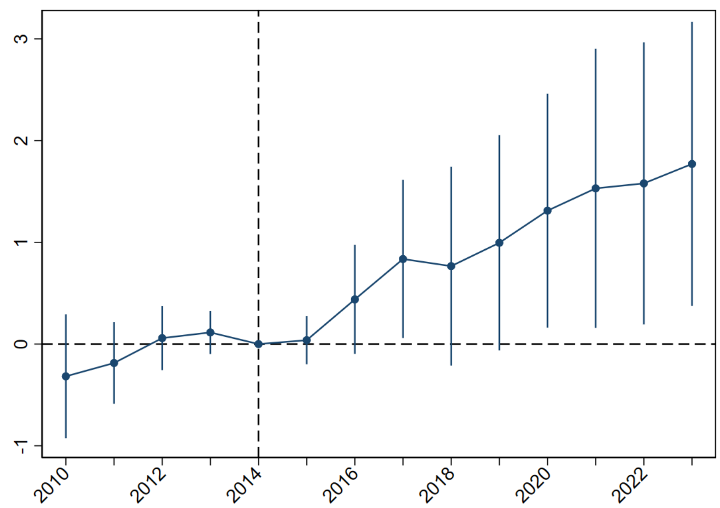


Figure A.2: Effect of *loan_dest* After Controlling for Migration Network

Note: This figure plots the 95% confidence interval of the event study coefficient estimates of $loan\_dest^{Cash}$ after controlling for $loan\_dest^{Mig}$. Standard errors are clustered by cities.

decompose *loan_dest* as follows:

$$loan\_dest_d = \underbrace{\frac{1}{Sale_{d,14}} \sum_{o \neq d} \overline{Loan} \cdot \frac{M_{o,d}}{N_o}}_{loan\_dest_d^{Mig}} + \underbrace{\frac{1}{Sale_{d,14}} \sum_{o \neq d} (Loan_o - \overline{Loan}) \cdot \frac{M_{o,d}}{N_o}}_{loan\_dest_d^{Cash}},$$

where $\overline{Loan} = \frac{1}{N} \sum_o Loan_o$. We then estimate Equation (4) by replacing *loan_dest* with ($loan\_dest^{Mig}$, $loan\_dest^{Cash}$). Figure A.2 shows that on top of the variations in migration network ($loan\_dest^{Mig}$), variation in cash resettlement in the immigrants' originating cities ($loan\_dest^{Cash}$) can also predict house prices growth in the destination cities after 2014, which confirms that our results are driven by not only the migration network but also the size of cash resettlement in these immigrants' originating cities.

A.3 New Intercity Migration

To investigate the timing of the effect on intercity migration, we conduct event study analysis on the city-pair panel data with the following specification:

$$\frac{M_{o,d,t}}{N_o} = \sum_{\tau \neq 2014} \beta_\tau \cdot \mathbf{1}_{t=\tau} \cdot cash\_recipient_o + \alpha_{o,d} + \theta_{p(o),t} + \gamma_{d,t} + \Gamma_t \cdot Controls_{o,d,t} + \epsilon_{o,d,t}. \quad (26)$$

In Equation (26), we use 2014 as the base year and include the city-pair fixed effect $\alpha_{o,d}$ and the originating province-by-year fixed effect, $\theta_{p(o),t}$, to control for large heterogeneity across different provinces. In addition, we include $\gamma_{d,t}$, the destination city-by-year fixed effect, to control for any time-varying factors in the destination city that might affect household migration, such as hukou and home purchase restrictions. With $\alpha_{o,d}$, $\theta_{p(o),t}$ and $\gamma_{d,t}$, the estimation investigates how cash resettlement across cities within the same province impact changes in household migration to the same destination city after 2015. Moreover, we include additional controls for robustness, including the previous tendency of households moving from o to d, $\sum_{2011 \leq t \leq 2014} \frac{M_{o,d,t}}{N_o}$, and whether city o and d are directly connected via the high-speed railway in year t.

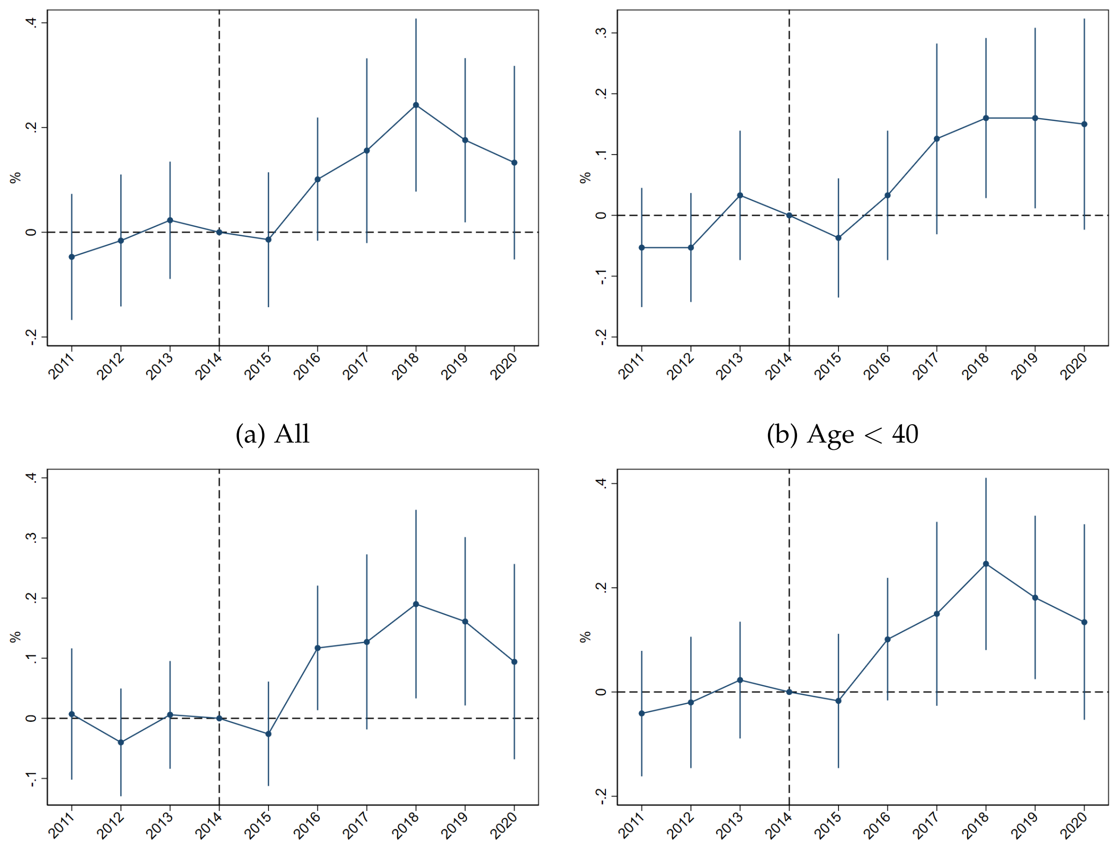
Figure A.3 Panel (a) plots the estimated coefficients $\{\hat{\beta}_\tau\}$. The coefficient estimates are both insignificant and close to zero before 2014, supporting the parallel trend assumption for event studies. After 2014, we find a significant and positive treatment effect, indicating that cities with more households receiving the cash compensation experience more household migration. The effect peaked around 2018 and diminished afterwards, consistent with the timing of the cash resettlement as shown in Figure A.1.

We examine the demographics of households that migrate in response to the cash resettlement. We hypothesize that these households are primarily of working age and relocating to other cities in pursuit of higher wages, rather than, for instance, retired parents moving to live with their children. To test this hypothesis, we restrict to migrant households for whom: (1) the family head was under 40 years old at the time of migration, (2) the stated reason for migration was employment in the destination city, and (3) no other family members had migrated to the same destination city before the family head in that year. We then repeat the estimation of Equation (26) using these subsets of migrants.

Panel (b)-(d) in Figure A.3 reports the results. We find similar effect as shown in Panel (a), regardless how we restrict the migrant households.

A.4 Spatial Dispersion of House Prices

One implication of the heterogeneous effect with respect to the city-pair house price gap is that, cities with higher house prices should be more affected by the spatial diffusion of the cash resettlement, as these cities have larger house price gap with other cities. In contrast, cities with lower house prices shall be less affected through the migration network. To test this implication, we divide the cities into two groups based on their house prices in 2014 and estimate Equation



(a) All (b) Age < 40

(c) Migration for Working (d) Non-followers

Figure A.3: Robustness Checks for Intercity Migration

Note: This figure plots the 95% confidence interval of the effect of *cash_recipient* on the city's urban household intercity migration. We restrict to households with age smaller than 40, claiming migration for working purposes, and with no family member coming to the destination city before, respectively. Standard errors are clustered by cities.

(4) using these two subsamples separately.

Figure A.4 shows the results. Consistent with our prediction, in cities with higher house prices, the effect of *loan_dest* is much larger than in cities with low house prices in 2014. The differences in the coefficient estimates, as reported in the last graph, are all statistically significant except that in 2015.

B Proofs and Supplementary Materials for the Two-location Model

B.1 Proofs

Parameter Assumption

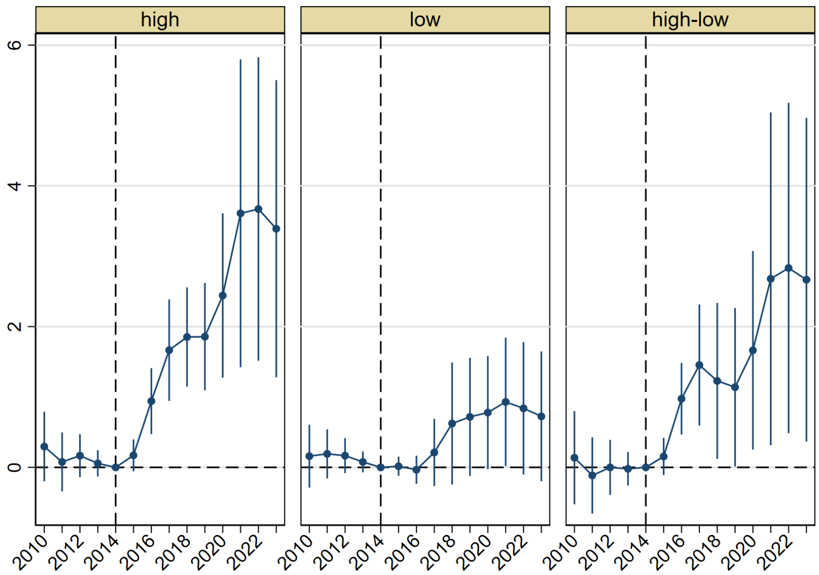


Figure A.4: House Price Response at Destination Cities by House Price

Note: This figure plots the 95% confidence interval of the event study coefficient estimates of *loan_dest* on the house prices at the destination cities for cities with high house price, low house price, and the difference of the coefficient estimates. Standard errors are clustered by cities.

Assumption 1. *Suppose the following holds: i)* $2\log(\frac{W_H}{W_L}) > \log(\frac{P_H}{P_L})$*; ii)* $\beta\log(\frac{W_H}{W_L}) < \log(\frac{P_H}{P_L})$*; iii)* $\hat{b}_0^H < \check{b}_0$ *where* $\hat{b}_0^H = \frac{2-2\beta+\bar{\omega}\beta}{2-\bar{\omega}}W_H$ *and* $\check{b}_0 \equiv \frac{1}{R}\frac{W_H - W_L\cdot(P_H/P_L)^{1/2}}{(P_H/P_L)^{1/2}-1}$*; and iv)* $\bar{b}_0 < \check{b}_0$*.*

Proof for Proposition 1

Proof. When the borrowing constraint is not binding, a household's value function from living in location ℓ is

$$V_\ell^u(b_0) = \frac{2}{1-\beta}\log(b_0 + W_\ell/R) - \frac{1}{1-\beta}\log(P_\ell) + \text{Constant} \tag{27}$$

When the borrowing constraint is binding, the optimal housing consumption is:

$$P_\ell h(b_0;\ell) = \frac{1}{4}\left(\frac{(1+\beta)b_0}{1-\beta+\beta\bar{\omega}} + \frac{(2-\beta)W_\ell}{1-\bar{\omega}} - \sqrt{\left(\frac{(1+\beta)b_0}{1-\beta+\beta\bar{\omega}} + \frac{(2-\beta)W_\ell}{1-\bar{\omega}}\right)^2 - \frac{8b_0}{1-\beta+\beta\bar{\omega}}\frac{W_\ell}{1-\bar{\omega}}}\right) \tag{28}$$

In this case, as $\frac{b_0}{W_\ell} \to 0$, the housing expenditure $P_\ell h(b_0;\ell) \to \frac{1}{2-\beta}\frac{b_0}{1-\beta+\beta\bar{\omega}}$ and consumption

$c_0 \to \frac{1-\beta}{2-\beta} b_0$, and as a result,

$$V_\ell^c(b_0) \xrightarrow{\frac{b_0}{W_\ell} \to 0} \frac{2-\beta}{1-\beta}\log(b_0) + \frac{\beta}{1-\beta}\log(W_\ell) - \frac{1}{1-\beta}\log(P_\ell) + \text{Constant} \tag{29}$$

With the first inequality in Assumption 1, for $b_0 \in [0, \check{b}_0)$, we have $V_H^u(b_0) > V_L^u(b_0)$. With the second inequality in Assumption 1, for sufficiently small b_0, we have $V_H^c(b_0) < V_L^c(b_0)$.

The value function from residing in location ℓ is given by:

$$V_\ell = \mathbf{1}(b_0 \geq \hat{b}_0^\ell) \cdot V_\ell^u + \mathbf{1}(b_0 < \hat{b}_0^\ell) \cdot V_\ell^c$$

Therefore, there exists a cutoff value $\tilde{b}_0$ such that $V_L > V_H$ if and only if $b_0 < \tilde{b}_0$. □

Proof for Proposition 2

Proof. When the borrowing constraint is binding, the marginal propensity to consume on housing, $Mult(b_0;\ell) \equiv \frac{\partial P_\ell h(b_0;\ell)}{\partial b_0}$, is the following:

$$Mult(b_0;\ell) = \frac{b_0(1-\bar{\omega})(1+\beta)^2 - \left(2-\beta+\beta^2\right) W_\ell(1-(1-\bar{\omega})\beta)}{-4(1-\bar{\omega})(1-(1-\bar{\omega})\beta)^2\sqrt{\left(\frac{b_0(1+\beta)}{1-(1-\bar{\omega})\beta} + \frac{(2-\beta)W_\ell}{1-\bar{\omega}}\right)^2 - \frac{8b_0W_\ell}{(1-\bar{\omega})(1-(1-\bar{\omega})\beta)}}} + \frac{1+\beta}{4-4(1-\bar{\omega})\beta}. \tag{30}$$

We first examine the monotonicity of $Mult(b_0;\ell)$ under the binding borrowing constraint.

$$\frac{\partial Mult(b_0;\ell)}{\partial W_\ell} = \frac{2b_0(1-\beta)\beta W_\ell}{\begin{pmatrix} (b_0(\bar{\omega}-1)(\beta+1) - (\beta-2)W_\ell((\bar{\omega}-1)\beta+1))^2 + \\ 4b_0(1-\bar{\omega})(1-\beta)\beta W_\ell(1-(1-\bar{\omega})\beta) \end{pmatrix}\sqrt{\left(\frac{b_0(\beta+1)}{(\bar{\omega}-1)\beta+1} + \frac{(\beta-2)W_\ell}{\bar{\omega}-1}\right)^2 + \frac{8b_0W_\ell}{(\bar{\omega}-1)((\bar{\omega}-1)\beta+1)}}}$$

$$\frac{\partial Mult(b_0;\ell)}{\partial b_0} = \frac{2(\beta-1)\beta W_\ell^2}{\begin{pmatrix} (b_0(\bar{\omega}-1)(\beta+1) - (\beta-2)W_\ell((\bar{\omega}-1)\beta+1))^2 + \\ 4b_0(1-\bar{\omega})(1-\beta)\beta W_\ell(1-(1-\bar{\omega})\beta) \end{pmatrix}\sqrt{\left(\frac{b_0(\beta+1)}{(\bar{\omega}-1)\beta+1} + \frac{(\beta-2)W_\ell}{\bar{\omega}-1}\right)^2 + \frac{8b_0W_\ell}{(\bar{\omega}-1)((\bar{\omega}-1)\beta+1)}}}$$

Because $\beta \in (0,1)$ and $\bar{\omega} \in (0,1)$, We have $\frac{\partial Mult(b_0;\ell)}{\partial W_\ell} > 0$ and $\frac{\partial Mult(b_0;\ell)}{\partial b_0} < 0$. These results imply that, for a given b_0, households with higher wages (W_ℓ) exhibit a stronger propensity to spend on housing consumption when receiving additional wealth. Conversely, for a given W_ℓ, households with lower initial wealth exhibit a stronger propensity to spend on housing consumption when receiving additional wealth. Intuitively, households with higher wages and lower initial wealth are more constrained by the borrowing constraint, leading to a heightened marginal propensity to consume on housing.

Since $Mult(b_0;\ell)$ decreases with household wealth when the borrowing constraint is binding, to show $Mult(b_0;\ell) > \frac{1}{2}$, it is sufficient to show this relationship holds at the cutoff wealth $\hat{b}_0^\ell$. If $Mult(\hat{b}_0^\ell;\ell) > \frac{1}{2}$, then $Mult(b_0;\ell) > \frac{1}{2}$ whenever the borrowing constraint is binding.

Substitute $\hat{b}_0^\ell$ for b_0 in Equation (30), we have the following:

$$Mult(\hat{b}_0^\ell;\ell) = \frac{1-\beta+\beta\bar{\omega}}{2(1-\beta)+\beta\bar{\omega}^2} > \frac{1}{2}$$

The last inequality is because $0 < \bar{\omega} < 1$ and $0 < \beta < 1$.

□

Proof for Proposition 3

Proof. As we will show below, households will spend weakly more on housing consumption in response to a positive wealth transfer when they can migrate, regardless of their initial wealth b_0. Therefore, the proposition holds regardless of the distribution of the wealth transfer across different households. To ease notation, below we consider a wealth transfer independent of the household initial wealth.

In the absence of migration option, all households remain in location L. The expected housing expenditure multiplier is given by:

$$\mathbf{E}_{b_0}\left[Mult(b_0;L)\right] = \int_0^{\bar{b_0}} Mult(b_0;L)dF(b_0) = \int_0^{\hat{b}_0^L} Mult(b_0;L)dF(b_0) + \int_{\hat{b}_0^L}^{\bar{b_0}} \frac{1}{2}dF(b_0),$$

where $Mult(b_0;L)$ is determined by Equation (30) for $\ell = L$.

When migration is allowed, households can choose their location. We first consider the case where $\hat{b}_0^L < \tilde{b}_0$. The expected housing expenditure multiplier is given by:

$$\begin{aligned}\mathbf{E}_{b_0}\left[Mult(b_0)\right] = &\int_0^{\hat{b}_0^L} Mult(b_0;L)dF(b_0) + \int_{\hat{b}_0^L}^{\tilde{b}_0} \frac{1}{2}dF(b_0) + f(\tilde{b}_0)\left(P_H h(\tilde{b}_0;H) - \frac{\tilde{b}_0 + W_L/R}{2}\right) \\ &+ \int_{\tilde{b}_0}^{\hat{b}_0^H} Mult(b_0;H)dF(b_0) + \int_{\hat{b}_0^H}^{\bar{b_0}} \frac{1}{2}dF(b_0).\end{aligned}$$

We compare $\mathbf{E}_{b_0}\left[Mult(b_0;L)\right]$ (no migration) with $\mathbf{E}_{b_0}\left[Mult(b_0)\right]$ (migration allowed), the difference is as follows:

$$\mathbf{E}_{b_0}\left[Mult(b_0)\right] - \mathbf{E}_{b_0}\left[Mult(b_0;L)\right] = \int_{\tilde{b}_0}^{\hat{b}_0^H}\left(Mult(b_0;H) - \frac{1}{2}\right)dF(b_0) + f(\tilde{b}_0)\left(P_H h(\tilde{b}_0;H) - \frac{\tilde{b}_0 + W_L/R}{2}\right) \tag{31}$$

The first term of (31) is strictly positive by Proposition 2. This term captures those that choose to reside in location H facing binding borrowing constraint, and an marginal increase in their wealth would lead to more housing consumption spending than if they had stayed in location L.

The second term of (31) captures those switchers, i.e., those that used to be indifferent about migration and choose to migrate in response to the wealth transfer. Upon migration, their housing consumption jumps from $\frac{b_0+W_L/R}{2}$ to $P_H h(\tilde{b}_0;H)$. We will show this jump is positive.

Consider the previous optimization problem of these marginal households. As their borrowing constraint is not binding in L, the first-order conditions with respect to c_0 and h is:

$$\frac{1}{c_0}-\frac{\beta R}{1-\beta}\frac{1}{W_\ell+b_1}=0$$
$$\frac{1}{1-\beta}\frac{1}{P_\ell h}-\frac{\beta R}{1-\beta}\frac{1}{W_\ell+b_1}=0$$

Upon migration, consider the first-order conditions evaluated at the household previous optimal choice. The only difference is that now W_L is replaced by W_H. Because $W_L < W_H$, the opportunity cost of increasing c_0 and $P_\ell h$, which is lower future consumption, is smaller, and hence the above two equations will be positive, meaning that it is optimal for the households at location H to further increase c_0 and $P_\ell h$. Therefore, the optimal housing consumption $P_H h$ shall be greater than the previous housing consumption, $\frac{b_0+W_L/R}{2}$.

Next, in case $\hat{b}_0^L > \tilde{b}_0$, the expected housing expenditure multiplier is:

$$\mathbf{E}_{b_0}\left[Mult(b_0)\right]=\int_0^{\tilde{b}_0} Mult(b_0;L)dF(b_0)+f(\tilde{b}_0)\left(P_H h(\tilde{b}_0;H)-P_L h(\tilde{b}_0;L)\right)+\int_{\tilde{b}_0}^{\hat{b}_0^H} Mult(b_0;H)dF(b_0)+\int_{\hat{b}_0^H}^{\bar{b}_0}\frac{1}{2}dF(b_0).$$

We compare $\mathbf{E}_{b_0}\left[Mult(b_0;L)\right]$ (no migration) with $\mathbf{E}_{b_0}\left[Mult(b_0)\right]$ (migration allowed), the difference is as follows:

$$\begin{aligned}\mathbf{E}_{b_0}\left[Mult(b_0)\right]-\mathbf{E}_{b_0}\left[Mult(b_0;L)\right]=&f(\tilde{b}_0)\left(P_H h(\tilde{b}_0;H)-P_L h(\tilde{b}_0;L)\right)+\int_{\tilde{b}_0}^{\hat{b}_0^L}\left(Mult(b_0;H)-Mult(b_0;L)\right)dF(b_0)\\&+\int_{\hat{b}_0^L}^{\hat{b}_0^H}\left(Mult(b_0;H)-\frac{1}{2}\right)dF(b_0)\end{aligned}\tag{32}$$

The first term of (32) captures the switchers, who migrate to location H yet remain constrained. Their housing consumption jumps from $P_L h(\tilde{b}_0;L)$ to $P_H h(\tilde{b}_0;H)$. We show this change is positive below.

The second and third term of (32) captures the differential marginal propensity to consume housing services between those facing binding constraint in location H and those with the same wealth in location L. By Proposition 2, both terms are strictly positive.

To show the first term, $P_H h(\tilde{b}_0;H)-P_L h(\tilde{b}_0;L)$, is strictly positive, consider the previous optimization problem of these marginal households. We can replace c_0 and b_1 with the budget equation and the borrowing constraint, and then the first-order condition with respect to the housing consumption, $P_\ell h$, is as follows:

$$\frac{1}{1-\beta}\frac{1}{P_\ell h} - \frac{\beta}{1-\beta}\frac{1-\bar{\omega}}{W_\ell - (1-\bar{\omega})P_\ell h} - \frac{1-\beta+\beta\bar{\omega}}{b_0 - (1-\beta+\beta\bar{\omega})P_\ell h} = 0$$

Upon migration, consider the first-order conditions evaluated at the household previous optimal choice. The only difference is that now W_L is replaced by W_H. Because $W_L < W_H$, the opportunity cost of increasing housing consumption, which is higher debt and lower future consumption, is lower after migration, meaning that it is optimal for the households at location H to further increase $P_\ell h$. Therefore, the optimal housing consumption $P_H h(\tilde{b}_0; H)$ shall be greater than the previous housing consumption, $P_L h(\tilde{b}_0; L)$. $\square$

B.2 Housing Adjustment at Every Date

When households are allowed to adjust housing at every date, the optimization problem becomes

$$\begin{aligned} V_\ell^0(b_0) = & \max_{h_t>0, b_{t+1}, c_t>0} \sum_{t\geq 0} \beta^t \cdot (\log(c_t) + \log(h_t)) \\ & \text{s.t. } b_0 = c_0 + b_1/R + P_\ell h_0, \\ & \quad b_t + w_\ell + P_\ell h_{t-1} = c_t + b_{t+1}/R + P_\ell h_t \quad \text{for any } t \geq 1, \\ & \quad -b_{t+1} \leq (1-\bar{\omega})\, P_\ell\, h_t, \quad \text{for any } t \geq 0. \end{aligned} \tag{33}$$

We solve by backward induction, first characterizing the sub-problem from date 1 onward:

$$\begin{aligned} & \max_{h_t>0, b_{t+1}, c_t>0} \sum_{t\geq 1} \beta^{t-1} \cdot (\log(c_t) + \log(h_t)) \\ & \text{s.t. } b_t + w_\ell + P_\ell h_{t-1} = c_t + P_\ell h_t + b_{t+1}/R, \\ & \quad b_{t+1} \geq -(1-\bar{\omega})\, P_\ell\, h_t. \end{aligned}$$

Let $\beta^{t-1}\lambda_t$ and $\beta^{t-1}\mu_t$ denote the Lagrange multipliers on the budget and collateral constraints at date t, respectively. The Lagrangian is

$$\mathcal{L} = \sum_{t=1}^{\infty} \beta^{t-1} \left[\log c_t + \log h_t + \lambda_t \left(b_t + w_\ell + P_\ell h_{t-1} - c_t - P_\ell h_t - \frac{b_{t+1}}{R} \right) + \mu_t \left(b_{t+1} + (1-\bar{\omega}) P_\ell h_t \right) \right],$$

with complementary slackness: $\mu_t \geq 0$ and $\mu_t \cdot [b_{t+1} + (1-\bar{\omega})P_\ell h_t] = 0$.

The first order condition with respect to c_t yields $\lambda_t = \frac{1}{c_t}$. The first order condition with respect to $b_t + 1$, combined with $\beta R = 1$, gives the Euler equation:

$$\mu_t = \beta\left(\frac{1}{c_t} - \frac{1}{c_{t+1}}\right). \tag{34}$$

The first order condition with respect to h_t is

$$\frac{1}{h_t} = P_\ell \left[\frac{1-\beta}{c_t} + \bar{\omega}\,\mu_t\right]. \tag{35}$$

Define total wealth at date t as $a_t = b_t + P_\ell h_{t-1}$, so that $a_1 = b_1 + P_\ell h_0$ at the beginning of date 1. Let $W_\ell = w_\ell/(1-\beta)$ denote the present value of lifetime labor income.

B.2.1 The Unconstrained Case

Consider a stationary allocation with $c_t = c$, $h_t = h$, $b_t = b$, and $a = b + P_\ell h$ for all $t \geq 1$. Substituting into the first-order conditions yields

$$P_\ell h^*(a) = \frac{a + W_\ell}{2}, \qquad c^*(a) = \frac{(1-\beta)(a+W_\ell)}{2}, \qquad b^*(a) = \frac{a - W_\ell}{2}$$

where $a = a_1 = b_1 + P_\ell h_0$. This solution satisfies the collateral constraint $b \geq -(1-\bar{\omega})P_\ell h$ if and only if

$$a_1 \geq \underline{a} \equiv \frac{\bar{\omega}\, W_\ell}{2 - \bar{\omega}}$$

A stationary allocation satisfying both the optimality conditions and the collateral constraint therefore exists if and only if $a_1 \geq \underline{a}$. For any such a_1, the optimal allocation is uniquely determined and given by $(c^*(a), h^*(a), b^*(a))$ above. The household maintains this allocation for all $t \geq 1$, and the collateral constraint is slack in every period.

The continuation value is

$$V^1_{unc}(a_1) \;=\; \frac{1}{1-\beta}\left(\log c^* + \log h^*\right) \;=\; \frac{2}{1-\beta}\log\left(a_1 + W_\ell\right) \;+\; K_\ell,$$

where $K_\ell = \frac{1}{1-\beta}\log\frac{1-\beta}{4P_\ell}$ is a constant. Note that V^1_{unc} depends on b_1 and h_0 only through their sum $a_1 = b_1 + P_\ell h_0$, since the household can freely re-optimize housing at date 1.

Substituting the continuation value, the date-0 optimization problem (33) reduces to

$$\max_{c_0,\, h_0,\, b_1} \;\; \log c_0 + \log h_0 + \frac{2\beta}{1-\beta}\log\left(b_1 + P_\ell h_0 + W_\ell\right) + \beta K_\ell$$

$$\text{s.t.} \quad b_0 = c_0 + \beta\, b_1 + P_\ell h_0, \qquad -b_1 \le (1-\bar{\omega}) P_\ell h_0.$$

The first-order conditions yield

$$P_\ell h_0 = \frac{b_0 + W_\ell / R}{2}, \qquad c_0 = \frac{(1-\beta)(b_0 + W_\ell/R)}{2}, \qquad b_1 = \frac{b_0 - (2-\beta) W_\ell}{2}.$$

Moreover,

$$P_\ell h^* = \frac{a + W_\ell}{2} = \frac{b_1 + P_\ell h_0 + W_\ell}{2} = \frac{b_0 + \beta W_\ell}{2}$$

Since $\beta R = 1$, we obtain $h_0 = h^*$, and thus no housing adjustment occurs at date 1 onward. This coincides with the solution under the simplified assumption in the main text.

Finally, the collateral constraint binds at date 0 if and only if the unconstrained b_1 violates $b_1 \ge -(1-\bar{\omega}) P_\ell h_0$. This yields exactly the same threshold under the simplified assumption:

$$b_0 \le \hat{b}_0^\ell \equiv \frac{2 - 2\beta + \bar{\omega}\beta}{2 - \bar{\omega}}\, W_\ell.$$

B.2.2 The Constrained Case

When $a_1 < \underline{a}$, the unconstrained choice is not attainable at date 1. We show that the household enters a transitional phase with the following properties: consumption and housing rise monotonically toward their unconstrained levels ($c_1 < c_2 < \cdots \to c^*$ and $h_1 < h_2 < \cdots \to h^*$), while the shadow price of the collateral constraint declines to zero ($\mu_1 > \mu_2 > \cdots \to 0$). Intuitively, constrained households gradually accumulate savings to relax the collateral constraint, incrementally increasing their housing each period as they approach the unconstrained optimum.

To begin, we show that no stationary allocation can be optimal when the collateral constraint binds. This follows directly from the Euler equation (34). When the collateral constraint binds, $\mu_t > 0$, which implies $c_t < c_{t+1}$, contradicting stationarity.

To characterize the transition dynamics, suppose the household enters date t with total wealth $a_t = b_t + P_\ell h_{t-1}$, and the constraint binds, so that $b_{t+1} = -(1-\bar{\omega}) P_\ell h_t$. Substituting into the budget constraint yields

$$a_t + w_\ell = c_t + \phi\, P_\ell h_t, \qquad \text{where } \phi \equiv 1 - \beta(1-\bar{\omega}) \tag{36}$$

The parameter ϕ represents the effective per-unit cost of housing when the household borrows to the maximum. Total wealth entering date $t+1$ is then

$$a_{t+1} = \bar{\omega}\, P_\ell h_t \tag{37}$$

Since $\mu_t > 0$, the Euler equation implies $c_t < c_{t+1}$, confirming that consumption rises along the transition path. Combining the housing first-order condition (35) with $h_t = a_{t+1}/(\bar{\omega}\, P_\ell)$ yields

$$\frac{\bar{\omega}}{a_{t+1}} = \frac{1-\beta}{c_t} + \bar{\omega}\, \mu_t$$

Substituting the Euler equation for μ_t gives

$$\frac{\bar{\omega}}{a_{t+1}} = \frac{1-\beta}{c_t} + \bar{\omega}\, \beta \left(\frac{1}{c_t} - \frac{1}{c_{t+1}} \right) = \frac{1-\beta+\bar{\omega}\, \beta}{c_t} - \frac{\bar{\omega}\, \beta}{c_{t+1}} = \frac{\phi}{c_t} - \frac{\bar{\omega}\, \beta}{c_{t+1}}$$

Together with $c_t = a_t + w_\ell - (\phi/\bar{\omega})\, a_{t+1}$, this defines a second-order nonlinear difference equation in a_t. Given a_1 and a terminal condition (transition to the unconstrained regime), this system determines the entire path.

We next establish that the wealth sequence a_t is strictly increasing throughout the constrained phase. Since $a_{t+1} = \bar{\omega}\, P_\ell h_t$, define a function $g(a) \equiv \bar{\omega}\, P_\ell h_t(a)$, so that $a_{t+1} = g(a_t)$. One can easily verify that $\underline{a}$ is a fixed point of g: at $a = \underline{a}$, the constrained and unconstrained solutions coincide, giving $g(\underline{a}) = \bar{\omega}(\underline{a} + W_\ell)/2 = \underline{a}$. Moreover, $g(0) > 0$ since households can borrow against housing. The function g is continuous and increasing, starts above the 45-degree line at $a = 0$ and meets it at $a = \underline{a}$. If g were to dip below the 45-degree line at some $a' \in (0, \underline{a})$, there would exist an additional fixed point at which the household remains constrained indefinitely — but at any such stationary point $c_t = c_{t+1}$, which contradicts $\mu_t > 0$. Therefore, no interior fixed point exists, $g(a) > a$ for all $a \in [0, \underline{a})$, and wealth is strictly increasing whenever the constraint binds.

Although wealth rises in every period, the household reaches $\underline{a}$ only asymptotically and thus never becomes unconstrained in finite time. To see this, linearize the wealth dynamics near $\underline{a}$. At the threshold, the constrained policy converges to the unconstrained one: $P_\ell h \to (\underline{a} + W_\ell)/2$, and thus the wealth map becomes $a_{t+1} = g(a_t) = \bar{\omega}\, P_\ell h(a_t) \;\approx\; \frac{\bar{\omega}}{2}(a_t + W_\ell)$ near $a_t = \underline{a}$.

Define the gap $\epsilon_t \equiv \underline{a} - a_t > 0$. By definition: $\epsilon_{t+1} = \underline{a} - a_{t+1} = \underline{a} - g(a_t) = \underline{a} - g(\underline{a} - \epsilon_t)$.

Expanding $g(\underline{a} - \epsilon_t)$ around the fixed point $\underline{a}$, and substituting, we have

$$\epsilon_{t+1} \approx \frac{\bar{\omega}}{2}\,\epsilon_t$$

The gap shrinks geometrically at rate $\bar{\omega}/2$, and thus the household never reaches $\underline{a}$ in finite time and the collateral constraint binds for all $t \geq 1$. Collecting these results, on the constrained path consumption rises monotonically, housing rises monotonically, and the shadow price declines geometrically to zero.

In general, the constrained value function does not admit a closed-form solution. It satisfies the Bellman equation

$$V^1_{con}(a) = \max_h \left(\log(a + w_\ell - \phi P_\ell h) + \log h + \beta V^1_{con}(\bar{\omega} P_\ell h)\right).$$

At date 0, when the constraint binds, $c_0 = b_0 - \phi\, P_\ell h_0$, with the only difference from $t \geq 1$ being the absence of wage income. The household chooses h_0 to maximize

$$\log(b_0 - \phi\, P_\ell h_0) + \log h_0 + \beta\, V^1_{con}(\bar{\omega}\, P_\ell h_0)$$

and the first-order condition is

$$\frac{1}{h_0} = P_\ell \left[\frac{\phi}{c_0} - \beta\bar{\omega}\,(V^1_{con})'(a_1)\right] = P_\ell \left[\frac{1-\beta}{c_0} + \bar{\omega}\,\mu_0\right] \tag{38}$$

with the Euler equation $\mu_0 = \beta(1/c_0 - 1/c_1) > 0$.

Finally, one can show that as long as the collateral constraint binds, the household allocates more than one-half of each additional dollar to housing. Housing equity ($\bar{\omega} P_\ell h$) serves as the sole vehicle for wealth accumulation under the binding constraint, so each dollar spent on housing delivers both direct utility and a relaxation of the future collateral constraint. This dual benefit raises the effective marginal value of housing relative to consumption and induces the household to tilt marginal resources toward housing.

C Quantitative Model

C.1 Household Problem

Renter's problem. For a household that chooses to rent in location ℓ, the owned house in location o_t is set aside. The household then makes consumption-savings decisions and chooses the amount of housing services to rent. That is,

$$\begin{aligned}
V_{Rent,\ell}(x_t) = \max_{\{b_{t+1},c,h\}} \; & u(c,h,\widetilde{A}_{\ell,o_t};0,h_t,a_t) + p(a_t)\beta\mathbb{E}_{\epsilon_{t+1}}\left[\max_{d\in\mathcal{L}}\left\{\mathbb{E}_{z_{t+1}}[V_{\ell,d}(x_{t+1})|b_{t+1}] + e(a_{t+1})\epsilon_{d,t+1}\right\}\right] \\
& + (1-p(a_t))\cdot\varphi(b_{t+1}+h_{t+1}P_{o_{t+1},t+1}(1-s_{t+1})) \\
s.t.\; & c + hR_{\ell,t} + \frac{1}{R}b_{t+1} + P_{o_t,t}h_t\delta^h = w_t - F_{b,t} \\
& b_{t+1} \geq -(1-\bar{\omega})P_{o_t,t}h_t(1-s_t),\; h \geq \underline{h}_R \\
& w_{t+1} = b_{t+1} + z_{t+1}G(a_{t+1})W_{d,t+1}, h_{t+1} = h_t,\; o_{t+1} = o_t,\; s_{t+1} = s_t,\; a_{t+1} = a_t + 1.
\end{aligned} \tag{39}$$

In the budget constraint, in addition to consumption and rental housing expenditures, the household must also pay maintenance costs for the owned house in location o_t. We assume that there is a minimum size requirement for renting, denoted by $\underline{h}_R$.

Stayer's problem. If a household chooses to live in their previously owned house, which is feasible only when $\ell = o_t$. He/she only optimizes in consumption-savings decisions after paying the cost of housing maintenance. That is,

$$\begin{aligned}
V_{Stay}(x_t) = \max_{\{b_{t+1},c\}} \; & u(c,\psi^h h_t,\widetilde{A}_{\ell,\ell};1,h_t,a_t) + p(a_t)\beta\mathbb{E}_{\epsilon_{t+1}}\left[\max_{d\in\mathcal{L}}\left\{\mathbb{E}_{z_{t+1}}[V_{\ell,d}(x_{t+1})|b_{t+1}] + e(a_{t+1})\epsilon_{d,t+1}\right\}\right] \\
& + (1-p(a_t))\cdot\varphi(b_{t+1}+h_{t+1}P_{o_{t+1},t+1}(1-s_{t+1})) \\
s.t.\; & c + \frac{1}{R}b_{t+1} + P_{o_t,t}h_t\delta^h = w_t - F_{b,t} \\
& b_{t+1} \geq -(1-\bar{\omega})P_{o_t,t}h_t(1-s_t) \\
& w_{t+1} = b_{t+1} + z_{t+1}G(a_{t+1})W_{d,t+1}, h_{t+1} = h_t,\; o_{t+1} = o_t,\; s_{t+1} = s_t,\; a_{t+1} = a_t + 1.
\end{aligned} \tag{40}$$

C.2 House Production

We assume that in each location, new houses are produced by representative home developers who solve the following optimization problem given land supply $L_{\ell,t}$:

$$\max_{N} P_{\ell,t} \cdot B_\ell L_{\ell,t}^{1-\lambda} N^\lambda - W_{\ell,t} N, \tag{41}$$

where B_ℓ is a time-invariant supply shifter that affects the floor-to-area ratio across different locations, $L_{\ell,t}$ is new residential land supply, and N is effective unit of labor used in home production. The optimization delivers the following housing supply function:

$$Y_{\ell,t} = \underbrace{B_\ell^{1/(1-\lambda)} (\frac{\lambda}{W_{\ell,t}})^{\frac{\lambda}{1-\lambda}}}_{B_{\ell,t}} \cdot P_{\ell,t}^{\frac{\lambda}{1-\lambda}} \cdot L_{\ell,t} - Y_{\ell,t}^d. \tag{42}$$

C.3 Calibration

C.3.1 Cluster of cities

We pool all the cities into five locations based on their house prices in 2015. Location 1 consists of the top three cities – Beijing, Shanghai and Shenzhen, whose house prices far exceed other cities. Location 2 consists of Tianjin and the capital cities of the four most developed coastal provinces (Jiangsu, Zhejiang, Fujian and Guangdong) plus Wenzhou and Xiamen whose house prices are comparable to that of the provincial capitals. Location 3 consists of the other cities in these four provinces. Location 4 and 5 consist of the capital and non-capital cities of other provinces, respectively.[39] Figure A.5 shows that this clustering largely preserves the geographic dispersion in house prices and, more importantly, captures the majority of household migration. Between 2016 and 2020, migration across these five locations accounts for 77% of all intercity migration.

C.3.2 Households

Preferences. We assume the following constant relative risk aversion (CRRA) utility:

$$e(a)u(c,h,\widetilde{A}) = e(a)\Big(\widetilde{A} + \frac{\big((1-\alpha_h)c^\eta + \alpha_h h^\eta\big)^{\frac{1-\sigma}{\eta}}}{1-\sigma}\Big).$$

[39]We exclude four autonomous regions and three most distant provinces (Hainan, Gansu and Qinghai). By 2015, migration to and from these regions and provinces account for only 10% of all intercity migration.

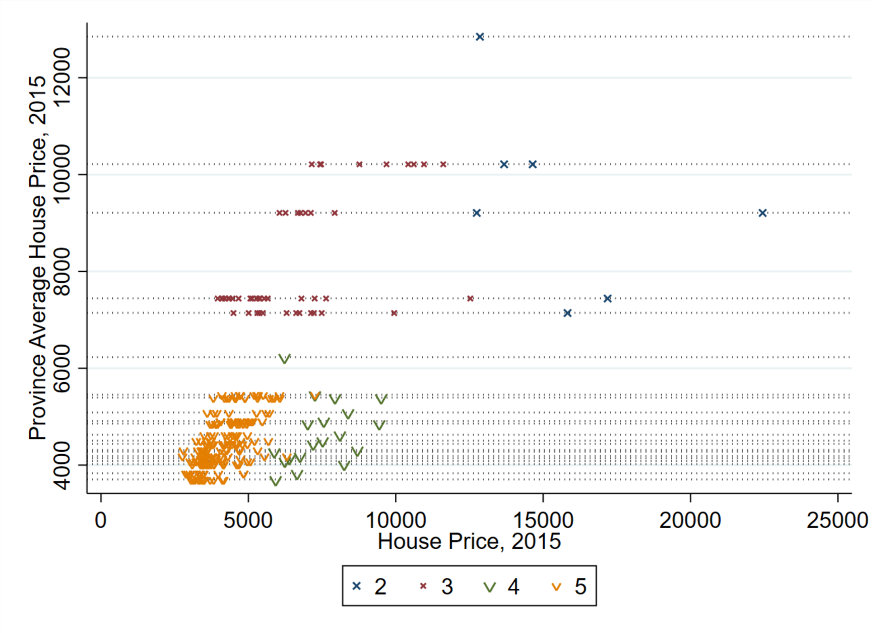


Figure A.5: Cluster of Cities

Note: This figure plots the province average house prices in 2015 against the city's house price scaled by the province average house prices.

$e(a)$ is an equivalence scale to capture deterministic changes in household size and composition over the life cycle. We set it following Giannone et al. (2023). We set the coefficient of relative risk aversion σ to 2. The parameter η governs the intratemporal elasticity of substitution between housing and non-housing consumption. The existing estimates of this elasticity varies a lot – for instance, Favilukis et al. (2023) uses a value of 2/3 while Li et al. (2016) estimates it to be 0.487. We use an intermediate value, which corresponds to an η of -0.7. Solving the renters optimization problem with respect to consumption and housing services subject to the budget constraint, we derive the following expression for the expenditure ratio between housing rent and consumption, $\frac{Rh}{c} = R^{\frac{\eta}{\eta-1}}(\frac{1-\alpha_h}{\alpha_h})^{\frac{1}{\eta-1}}$. We calibrate the preference weight on housing α_h in order to match the average expenditure ratio observed in the CHFS data between 2017 and 2019, yielding the value of 0.05.

We assume the following functional form to evaluate bequests w_b when household dies,

$$\varphi(w_b) = \bar{\varphi}\frac{w_b^{1-\sigma}}{1-\sigma}.$$

Following Kaplan et al. (2020) and Giannone et al. (2023), we calibrate $\bar{\varphi}$ to match the ratio of liquid wealth at age 56-60 to liquid wealth at age 41-45. This results in a value of 10.

Demographics. We model eight working-age groups ($\bar{a} = 8$), covering ages 21 to 60. We calibrate the five-year mortality rate $p(a)$ to match Census 2020 data.

Labor earning. We set the income tax rate τ^W to 10.3%, including pension of 8%, medical insurance of 2%, and unemployment insurance of 0.3%. The age-specific profile $G(a)$ is chosen to match the mean of labor earnings by age. Using household income data from the CHFS, we divide observed pre-tax wages by $\frac{W_{\ell,t}}{1-\tau^W}$ to obtain a measure of $G(a)z_{i,t}$, and then compute the average by age to calibrate G^a.

For idiosyncratic income risk $z_{i,t}$, we first back it out by normalizing observed pre-tax wage by $\frac{W_{\ell,t}}{1-\tau^W} \cdot G^a$. We define four grid points corresponding to the average of the normalized pre-tax wage within the 0-25%, 25%-75%, 75%-87.5% and 87.5%-100% percentiles and assume its follows an i.i.d process.

Discount factor. We calibrate β to match the ratio between the average liquid wealth and earning. This implies an annualized $\beta = 0.985$.

Amenities and migration. In our migration cost specification, the age-dependent component $\kappa_1(a)$ is calibrated to match the average out-migration profile over the life cycle, resulting in an average value of 3.55 across age groups. The bilateral term $\kappa_2(\ell, d)$ is calibrated to match the empirical bilateral migration shares. When a household owns a new house in a destination different from its current housing location, an additional migration cost κ_3 is incurred. We calibrate κ_3 to match the observed share of households that change housing locations, which implies a value of 0.8, close to a quarter of average κ_1.

We calibrate the inverse migration elasticity $\nu = 0.4$, consistent with values found in the literature. Caliendo et al. (2019) estimate an annual cross-state migration elasticity of 0.5 for the U.S. economy. In contrast, Tombe and Zhu (2019) estimate a long-run migration elasticity of 2.54 in a static model of Chinas economy. Based on these estimates, we target a 5-year migration elasticity of 2.5, which implies an inverse elasticity of $\nu = 0.4$.

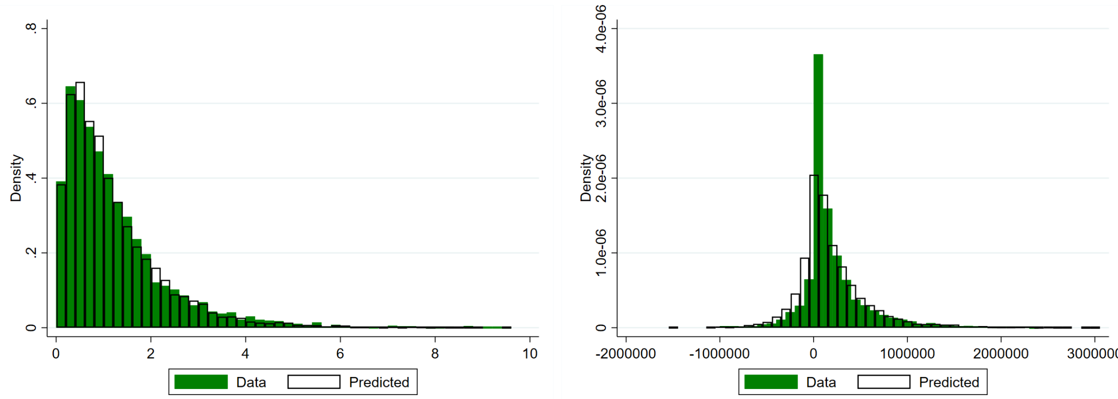
We calibrate the amenity values for each location, $\{A_\ell\}$, to match the observed population distribution between 2016 and 2020. Normalizing the amenity value of location 1 to zero, the calibrated amenity values for the remaining four locations are -0.09, -0.11, -0.16, and -0.22, respectively – indicating that the top three cities, Beijing, Shanghai, and Shenzhen, offer relatively higher amenities. For households who reside in location ℓ but own a house in a different location o, we assume they derive utility from the average amenity value of the two locations. That is, $\widetilde{A}_{\ell,o} = \frac{1}{2}(A_\ell + A_o)$.

Initial distribution of individual household states. The economy starts with a distribution of households who are characterized by the residence location ℓ and individual state variables x_0, which is given by $(\ell, a, z_0, b_0, h_0, o_0, s_0)$. In the representative sample of the National 1% Population Survey Data of 2015, we can directly observe the (ℓ, a, h_0, o_0, s_0) for all urban households that live in their own houses. We define a house to be shanty if the house was constructed before 1990, or there is no formal kitchen and bathroom in the house. For those that are renting, we randomly assign them with s_0 based on the share of shanty and normal houses in their originating cities. Given s_0, we use the average shanty and normal house size for their h_0.

The Population Survey Data has no information regarding the income z and asset b. To take into account the dependence of (z, b) on (ℓ, a, h_0, o_0, s_0), we use the CHFS data of 2015 and 2017 to infer the distribution of (z, b) conditional on (ℓ, a, h_0, o_0, s_0). Specifically, using the CHFS data of 2015 and 2017, we first estimate the conditional mean of $\log(z)$ and b with the following regression:

$$y = \beta^1 \cdot s + \beta_2^s \cdot h + \alpha_{a,s} + \alpha_o + \alpha_\ell + \epsilon.$$

The regression also yields a distribution of the estimated residual term, ϵ^z and ϵ^b. We find no obvious dependence between the conditional mean of $\log(z)$ and ϵ^z. Thereby, we randomly draw ϵ^z from the estimated distribution and add it to the conditional mean, and then take exponential to recover our estimated value of z. For b, there appears to be some dependence between the conditional mean and ϵ^b. Therefore, we first sort households in the CHFS sample into ten groups based on the conditional mean of b, and get the estimated distribution of ϵ^b for each group. Then with the Population Survey sample, we calculate the conditional mean of b and randomly draw ϵ^b from the corresponding group and add it to the conditional mean. Figure A.6 plots the distribution of the actual z and b with the calibrated values based on the CHFS 2015 and 2017 sample. The distribution of the predicted value of z and b based on the procedure above matches the data fairly well.



(a) z (b) b

Figure A.6: Comparing Actual and Calibrated z and b

Note: This figure plots the distribution of the actual z and b with the calibrated values based on the CHFS 2015 and 2017 sample.

C.3.3 Housing

We set collateral haircut $\bar{\omega}$ to 0.3 to match the Loan-to-Value ratio of the first home mortgage. We follow Kaplan et al. (2020) and Giannone et al. (2023) to set annualized $\delta^h = 1.5\%$. We set $\tau^{h,b} = 2.5\%$ to include deed tax and agency fee and set $\tau^{h,s} = 2\%$ to include capital income tax and agency fee. To calibrate the minimum size requirement, from the Population Census data of 2015, we use the 10% percentile of the house size distribution among households that own or rent houses. We set $\underline{h} = 50$ square meters and $\underline{h}_R = 40$ square meters.

Housing grids. Conditional on the dynamic consumption and savings decision, renters solve a static optimization problem to allocate resources between the consumption good (c) and housing services (h), which yields a closed-form solution for optimal consumption and housing expenditure. In contrast, for homeowners, the choice of housing services is dynamic. To proceed with the computation, we generate the following housing grid, starting from the minimum house size: $\{50, 65, 80, 95, 110, 140, 170\}$. The value of 170 square meters corresponds to the 95th percentile in the size distribution in the data.

Homeownership preferences. We govern ψ^h to match the observed average size ratio between owned and rented housing. This results in $\psi^h = 0.15$.[40] We calibrate $\zeta^h(a)$ to match the life-cycle

[40] Our preference specification features complementarity between consumption c and housing services h, with $\eta < 0$. To ensure that homeowners purchase larger houses than renters, it is necessary that $\psi^h < 1$.

profile of tenure choices. The calibrated values are significantly lower for younger individuals (e.g., -0.05 for ages 21 - 25) compared to middle-aged groups (e.g., 0.22 for ages 41 - 45), reflecting the increasing propensity to live in their own houses. The parameter ξ^h is calibrated to match the observed share of shantytown homeowners who purchase new formal housing in their current residence after receiving a cash settlement from the house location, resulting in $\xi^h = 0.35$.

Housing Production Function. The developers' optimization problem implies the following floor-to-area ratio at city i in year t:

$$\log(floor2area_{i,t}) = \frac{\lambda}{1-\lambda}\log(\frac{P_{i,t}}{W_{i,t}}) + \frac{1}{1-\lambda}\log(B_i) + constant$$

To estimate λ, we run the following regression using city panel data during 2010-2022:

$$\log(floor2area_{i,t}) = \beta \cdot \log(\frac{P_{i,t}}{W_{i,t}}) + \alpha_i + \alpha_t + \varepsilon_{i,t} \tag{43}$$

We estimate β to be 0.061 with a standard error of 0.03. We then back out $\lambda = \frac{\hat{\beta}}{1+\hat{\beta}} = 0.0577$.

With λ, we calculate B_ℓ to match $floor2area_{\ell,1}$, the average floor-to-area ratio of all land transactions in location ℓ in 2016-2020 weighted by the land size:

$$B_\ell = (floor2area_{\ell,1})^{1-\lambda} \cdot (\frac{W_{\ell,1}}{P_{\ell,1}\lambda})^{\lambda}.$$

Land Supply and House Requisition. Denote the housing stock in the baseline economy with cash resettlement program by $\{H^\star_{\ell,t}\}$. Under the baseline prices $\{P^\star_{\ell,t}, W^\star_{\ell,t}\}$, land supply from the program can be used to produce housing supply of $B_\ell^{1/(1-\lambda)} \cdot (\frac{P^\star_{\ell,t}\lambda}{W^\star_{\ell,t}})^{\lambda/(1-\lambda)} \cdot LS_{\ell,t}$ for $t \in \{1, 2, 3\}$. The housing stock net of this supply is

$$H'_{\ell,t} = H^\star_{\ell,t} - \sum_{\tau=1}^{\min(3,t)} B_\ell^{1/(1-\lambda)} \cdot (\frac{P^\star_{\ell,\tau}\lambda}{W^\star_{\ell,\tau}})^{\lambda/(1-\lambda)} \cdot LS_{\ell,\tau} \cdot (1-\delta^h)^{t-\tau}$$

We back out the government land supply and house requisition based on the sequence of $\{H'_{\ell,t}\}$. Specifically, if $H'_{\ell,t} - (1-\delta^h)H'_{\ell,t-1} > 0$, we set $Y_{\ell,t} = 0$ and calibrate $L_{\ell,t}$ so that

$$H'_{\ell,t} - (1-\delta^h)H'_{\ell,t-1} = B_\ell^{1/(1-\lambda)} \cdot (\frac{P^\star_{\ell,t}\lambda}{W^\star_{\ell,t}})^{\lambda/(1-\lambda)} \cdot L_{\ell,t}$$

If $H'_{\ell,t} - (1-\delta^h)H'_{\ell,t-1} \leq 0$, we set $L_{\ell,t} = 0$ and

$$Y^d_{\ell,t} = -\left(H'_{\ell,t} - (1-\delta^h)H'_{\ell,t-1}\right)$$

Speculation. Li et al. (2026) regress the expected one-year ahead house price growth by professionals and economists on house price growth during the past year and find a coefficient estimate of 0.538. Assuming the annual house price growth fits an AR(1) process with coefficient of 0.538, we can calculate that on the steady state path, the extrapolation parameter, ρ, will be about 0.2 for house price growth over five-year horizon. Given $\rho = 0.2$, we can calibrate R_s such that the average rent-to-price ratio by Equation (25) equals the average value in the data in 2016-2020, which yields a value of 1.24.

C.3.4 Other Parameters

We set R to be the five-year deposit rate in 2015, which gives $R = 1.145$. We set borrowing spread $\iota = 13.3\%$, which is the average spread between five-year time deposit and mortgage loan rates.

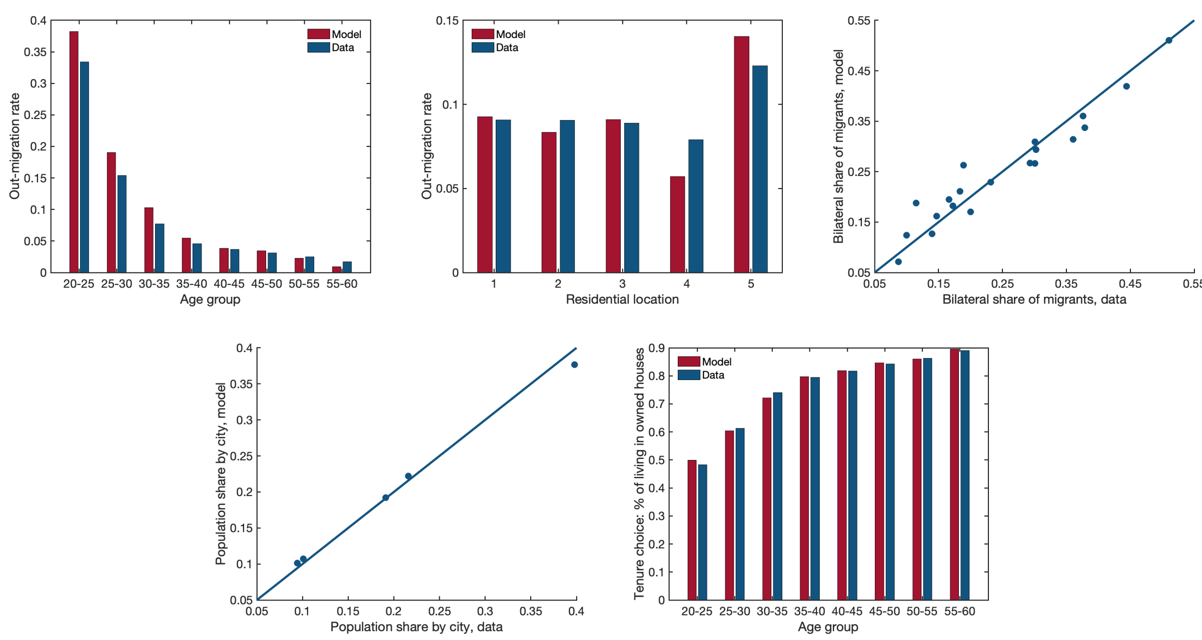


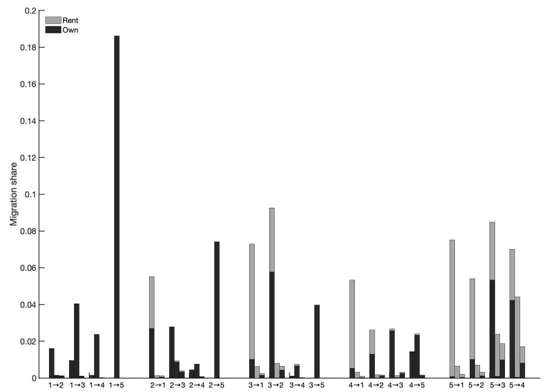
Figure A.7: Key Moments: Model versus Data

Note: This figure shows how the model fits the data in several key moments during 2016-2020.

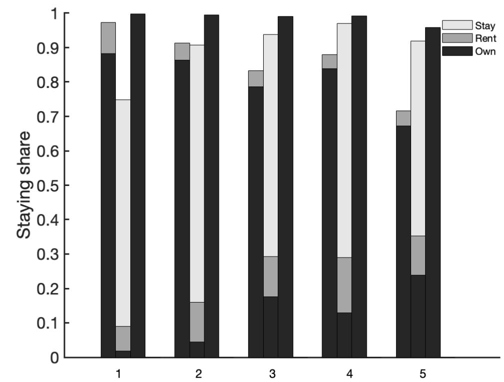
Table A.1: Parameter Values

Parameter	Interpretation	Internal	Value	Moment: model (data)	
Space					
L	No. of locations	N	5		
A_ℓ	Amenity	Y	0, -0.09, -0.11, -0.16, -0.22	Population distribution	Figure A.7
$Z_{\ell,t}$	Productivity	N			
B_ℓ	Housing supply shifter	N			
$L_{\ell,t}, Y^d_{\ell,t}$	Land supply	Y	2016-2020: 0.85, 0.67, 0.42, 0.52, 0.60	Housing market clearing	
Demographics					
$\bar{a}$	No. of age groups	N	8		
$p(a)$	Mortality rate	N			
Preferences					
$e(a)$	Equivalence scale	N			
σ	Relative risk aversion	N	2		
η	Elasticity of substitution	N	-0.7		
α_h	Housing preference weight	N	0.05		
β	Discount factor	Y	0.985	Ave. liquid wealth / ave. income	0.31 (0.29)
$\overline{\varphi}$	Bequest	Y	10	Ave. liquid wealth 56-60 / 41-45	0.85 (0.86)
Earning					
$G(a)$	Age-specific profile	N			
$\{z_{a,j}\}$	Idiosyncratic income state	N			
π_z	Transition matrix of income state	N			
τ^W	Income tax	N	10.3%		
Housing					
$\overline{\omega}$	Collateral haircut	N	0.3		
δ^h	Housing maintenance cost	N	1.5%		
$\tau^{h,b}, \tau^{h,s}$	Deed tax, capital income tax	N	2.5%, 2%		
$\underline{h}, \underline{h}_R$	Minimum housing requirement	N	50, 40		
$\zeta^h(a)$	Age-specific profile	Y	-0.05, 0, 0.07, 0.12 0.22, 0.12, 0.05, 0.035	Tenure choice over life cycle	Figure A.7
ξ^h	Utility loss of not owing a house	Y	0.35	% of the treated migrants purchasing new houses	58% (55%)
ψ^h	Relative house size	Y	0.15	Ave. size of owner- / renter-occupied house	2.05 (1.96)
λ	Labor share of home production cost	N	0.0577		
ρ	speculation	N	0.2		
R_s	Landlord required return rate	Y	1.24	Average rent-to-price ration in 2016-20	
Migration					
$\kappa_1(a)$	Age-specific profile	Y	0.3, 1.4, 2.3, 4.1 7.5, 6.4, 3.5, 2.9	Migration over life cycle	Figure A.7
$\kappa_2(\ell, d)$	Bilateral migration cost	Y		Bilateral migration patterns	Figure A.7
κ_3	Cost of changing house location	Y	0.8	% of households changing house location	3.01% (3.69%)
ν	Migration elasticity	N	0.4		
Financial instrument					
R	5-year deposit rate	N	1.145		
ι	Borrowing spread	N	13.3%		

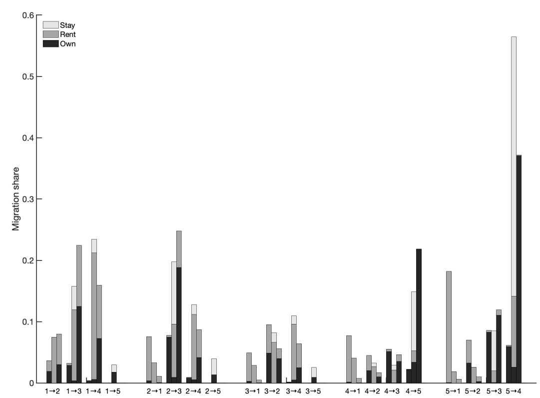
D Additional Quantitative Results



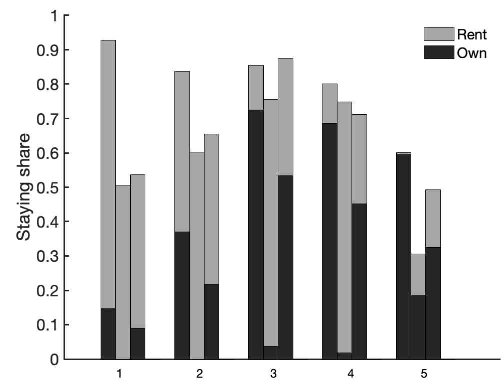
(a) Non-migrants



(b) Non-migrants



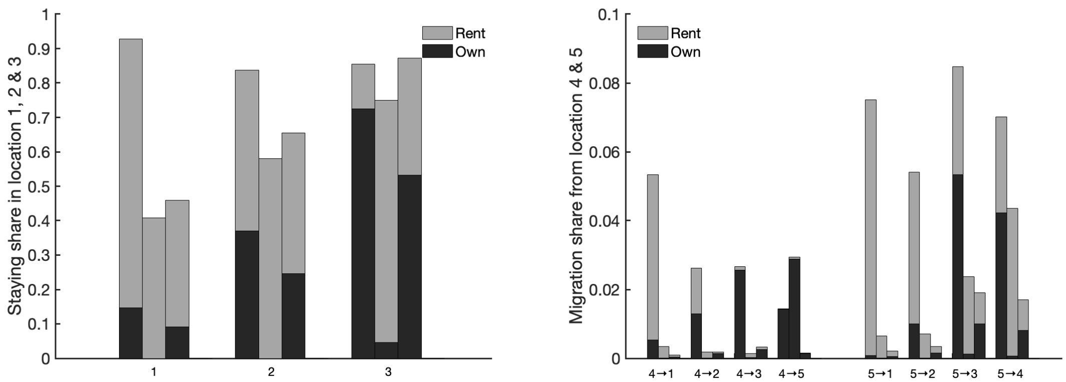
(c) Existing migrants



(d) Existing migrants

Figure A.8: Household Migration and House Tenure: Cash, No and Voucher Resettlement

Note: For treated non-migrants in 2015, Panel (a) plots the share that out-migrates from each residence location to each destination in 2016–2020. Panel (b) plots the share that remains in the 2015 residence location in 2016-2020. Panel (c) and (d) plot the counterparts for treated existing migrants in 2015. For each residence location or location pair, the three bars correspond to cash (left), no (middle) and voucher resettlement (right), with colors indicating tenure choices in the destination.

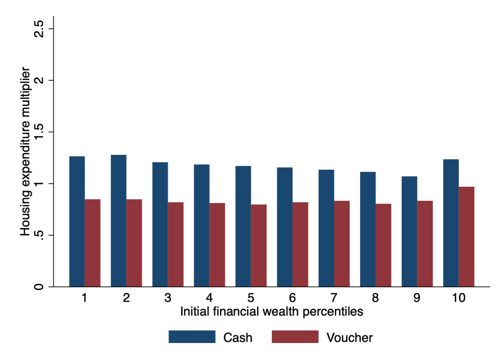


(a) Downgrade Mitigation

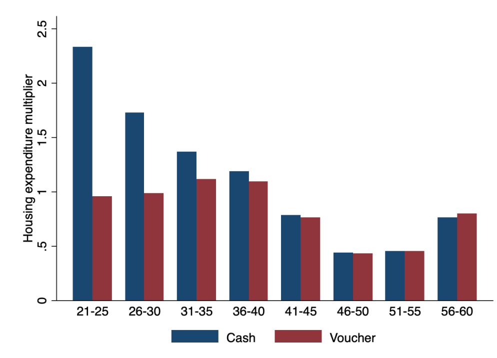
(b) Upgrade Facilitation

Figure A.9: Household Migration and House Tenure Choice: Cash, No and Voucher Resettlement, General Equilibrium

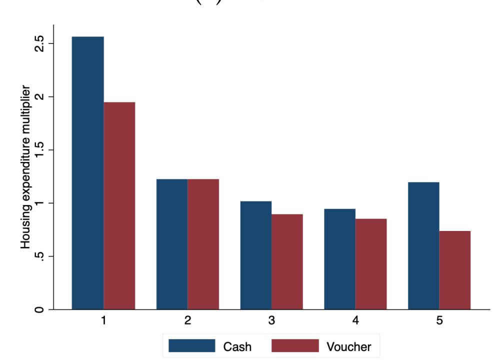
Notes: For treated existing migrants in 2015, Panel (a) plots the share that remains in the 2015 residence location in 2016-2020. For treated non-migrants in 2015, Panel (b) plots the share that out-migrates from each residence location to each destination in 2016–2020. The two bars correspond to cash (left), no (middle) and voucher resettlement (right), with colors indicating housing tenure choices in the new residence location.



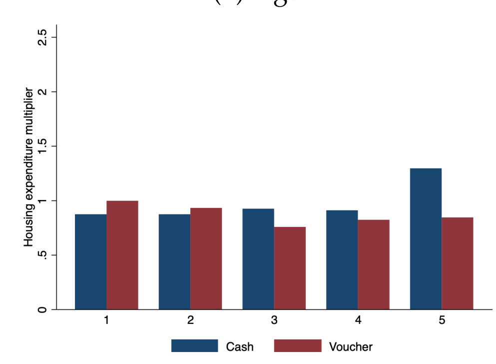
(a) Wealth



(b) Age



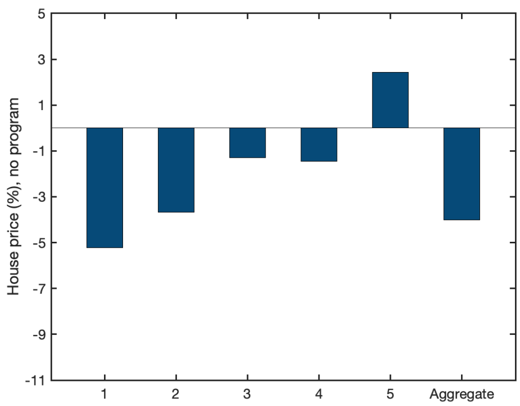
(c) Residence location



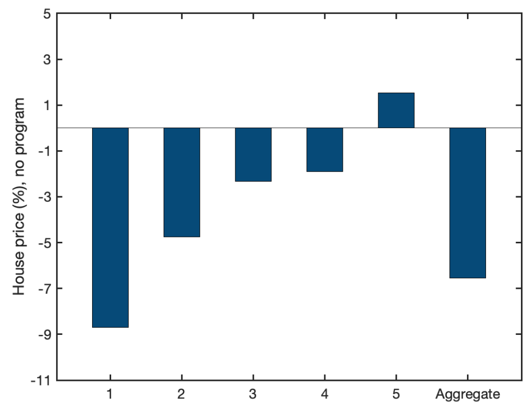
(d) House location

Figure A.10: Lifetime Housing Expenditure Multiplier, Cash vs Voucher Resettlement, General Equilibrium

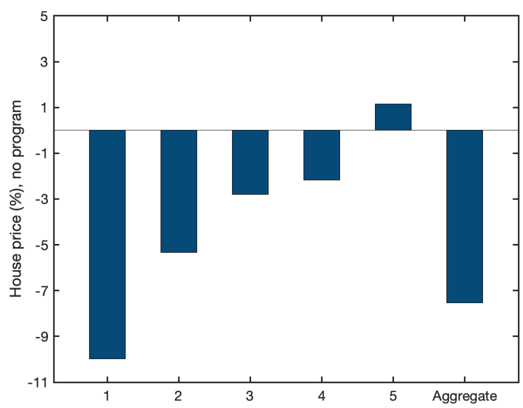
Note: This figure plots the average lifetime housing expenditure multiplier for different household wealth, age, and residence location and house location under cash and voucher resettlement.



(a) No Resettlement, $\rho = 0.2$



(b) No Resettlement, $\rho = 0.23$



(c) No Resettlement, $\rho = 0.25$

Figure A.11: Counterfactual Resettlement and House Price, Role of Speculation, 2016-2020

Note: This figure plots the change in equilibrium house prices across locations under no resettlement relative to the baseline with cash resettlement for different ρs.